JANUARY, 1960

# ELECTRONICS WORLD

Formerly
RADIO & TV NEWS

50 CENTS

SPECIAL FEATURE

## Room Acoustics for Stereo

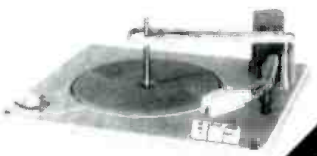
***The first of an important series on the effects of room acoustics on hi-fi reproduction in the home.***

**AIR TRAFFIC CONTROL IN THE JET AGE**
**(See page 37)**

*from the audio research center of the world*

# Norelco® HI-FI COMPONENTS

*developed and guild-crafted by Philips of the Netherlands*



## Norelco

### FULLY AUTOMATIC 4-SPEED STEREO RECORD CHANGER

**MODEL AG 1024—AG1124**

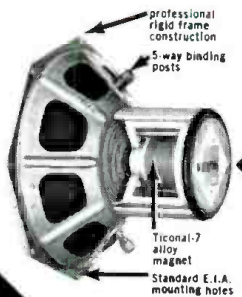
A rugged, versatile, low cost record changer offering years of dependable and trouble-free stereophonic or monophonic reproduction ◆ both manual and automatic operation ◆ 4 speeds ◆ automatic 7", 10" and 12" record intermix ◆

## Norelco

### "CONTINENTAL" TAPE RECORDERS

Music lover, recordist, high fidelity enthusiast . . . there's a professional quality "Continental" tape recorder ideally suited to your specific recording requirements.

- ◆ SIMPLE PIANO KEY CONTROLS
- ◆ THREE SPEEDS: 7½, 3¾ AND 1⅞ I.P.S.
- ◆ FULL FREQUENCY RECORDING . . . BROADCAST FIDELITY PLAYBACK
- ◆ SPECIAL NARROW-GAP HEADS (0.0002 IN.) FOR EXTENDED FREQUENCY RESPONSE
- ◆ SELF-CONTAINED WITH DYNAMIC MICROPHONE AND WIDE RANGE NORELCO LOUDSPEAKER
- ◆ EASILY PORTABLE . . . RUGGED . . . STYLED BY THE CONTINENT'S TOP DESIGNERS
- ◆ CAN ALSO BE PLAYED THROUGH EXTERNAL HI-FI SYSTEM

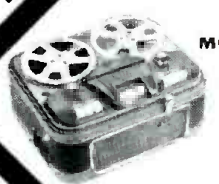



THE T-7 LINE

A NEW LINE OF Norelco 5"-12" LOUDSPEAKERS FEATURING NEW TICONAL VIII MAGNETS (30% more powerful than alnico)

### STEREO-PLAYBACK VERSION

**MODEL EL3516/G53**



Provides every feature of the world-famed original monaural 'Continental' Model EL3516—plus stereophonic playback and mixing facilities for monaural recording.

Add the matching Stereo Companion Piece, Model SCP-1 (to your Norelco EL3516/G53) and you have the all important "second voice for completely self-contained stereophonic playback.

**NEW**

### THE CONTINENTAL "400" 4-TRACK STEREO RECORD/PLAYBACK

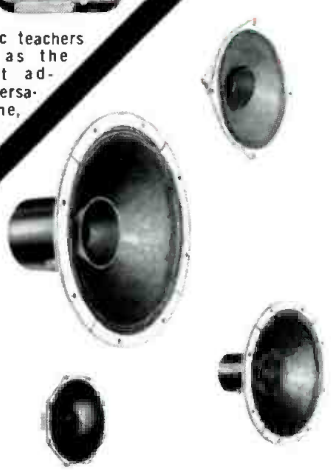
**MODEL EL3536**

◆ four-track stereophonic recording and playback ◆ four-track monophonic recording and playback ◆ self-contained including dual hi-fi preamps, recording and playback amplifiers and Norelco wide-range loudspeaker ◆ compatable with conventional pre-recorded tapes ◆ can also be used as a conventional self-contained phono/P.A. amplifier and speaker system.

### ORIGINAL MONAURAL VERSION

**MODEL EL3516**

Still the greatest buy in a monaural tape recorder . . . the favorite of the nation's schools, and voice and music teachers . . . regarded as the world's most advanced, most versatile, all-in-one, portable tape recorder.



## Norelco

### 'EXHIBITION' SPEAKER ENCLOSURES

Acoustically designed to achieve moderate size without loss of bass response or wideness of dispersion. Characterized by compact size . . . outstanding performance . . . and beautifully styled and handcrafted workmanship. Perfectly matched for the bass response of the new NORELCO T-7 speakers . . . ideal for most other quality 8" to 12" speakers. Available in 3 sizes in beautiful, hand-rubbed Mahogany, Walnut, Blond or Cherry finishes. "Van Gogh" and "Vermeer" models can be used either vertically or horizontally.

The world's greatest buys on the basis of listening quality, the T-7 series incorporates voice coil magnets of Ticonal-7 steel, the most powerful of modern magnet alloys, for maximum efficiency and damping . . . dual cones for wide frequency response . . . constant impedance resulting in an extremely straight response curve . . . longer effective air-gaps and extra high flux density to provide exceptional transient response and to eliminate ringing and overshoot.

The **"HAGUE"**: Completely integrated quality speaker system. Incorporating two high-efficiency T-7 NORELCO loudspeakers in acoustically matched enclosure Designed for optimum dispersion . . . maximum efficiency . . . extremely wide-range, flat response . . . and that unexaggerated "European," clean sound.

**NORTH AMERICAN PHILIPS CO., INC.**
High Fidelity Products Division

**FOR FURTHER DESCRIPTIVE LITERATURE WRITE TO:** 230 Duffy Avenue, Hicksville, L. I., N. Y.

You asked for more!
Since introduction of the Duals, demand has been so great we've extended these famous speakers into 6"x9" and 15" sizes as well as the 8's and 12's!

# MORE POWER PER POUND

in the ALL-NEW

# UTAH*

## dual-diameter speakers

. . . Never before such *concentrated power!* The secret is in Utah's brand new dual-diameter magnetic circuitry and dynamic Uni-coils. By ingeniously combining two magnetic material structures into one, Utah has produced the greatest power per pound in a loud-speaker since the advent of Alnico V. See the all new Utah speakers now—8" full range model **D8LA** and 12" full range model **D12LA**—they're as "hot" as a Jet Airliner!

* These new Utah speakers were inspired by the fabulous new Boeing 707 Jet Airliner, now streaking coast to coast in just 4½ hours! Utah speakers, *too*, pack more power per pound, feature Jet Airliner slim-line design to meet modern demands for more compact Stereo and High Fidelity applications.

utah SPEAKERS

Utah Radio & Electronic Corp., Huntington, Ind.

# ELECTRONICS WORLD

JANUARY, 1960

VOL. 63 ■ NO. 1




*First in radio-television-audio-electronics*

# CONTENTS




**Net Paid Circulation 242,396**

Radio & TV News • Radio News • Television News Trademarks Reg. U. S. Pat. Off.





**SUBSCRIPTION SERVICE:** Forms 3579 and all subscription correspondence should be addressed to Circulation Department, 434 South Wabash Avenue, Chicago 5, Illinois. Please allow at least four weeks for change of address. Include your old address as well as new—enclosing if possible an address label from a recent issue.

**CONTRIBUTIONS:** Contributors are advised to retain a copy of their manuscripts and illustrations. Contributions should be mailed to the New York Editorial Office and must be accompanied by return postage. Contributions will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to whatever adaptations and revisions are necessary to meet the requirements of this publication. Payment covers all author's, contributor's, and contestant's rights, title, and interest in and to the material accepted and will be made at our current rates upon acceptance. All photos and drawings will be considered as part of the material purchased.

ELECTRONICS WORLD is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), at 434 S. Wabash Ave., Chicago 5, Ill. Second class postage at Chicago, Illinois. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. SUBSCRIPTION RATES: one year U. S. and possessions, and Canada $5.00; Pan American Union Countries $5.50; all other foreign countries $6.00.


# "4 STARS" for the CHANNEL MASTER® T-W

**"4 STARS"** — recognized symbol for superb performance.

**"4 STARS"** — going all-out to help you sell more antennas.

Who doesn't recognize these top-rated TV stars? Their audience numbers millions. And hard-hitting commercials are telling these millions ... over and over again ... to replace their old, worn-out antennas with the powerful Channel Master T-W.

On network TV ... in the top farm publications ... in best-selling mass magazines ... Channel Master is using the power of *all-out National Advertising* to help you do a bigger, MORE PROFITABLE, antenna installation business.

That's why it makes good sense for you to promote and install the Channel Master T-W ... the one antenna that has never been equalled for brilliant performance and rugged construction.

**FULL NETWORK TV**

FOUR TOP SHOWS

2 MAJOR TV NETWORKS

210 TV STATIONS

**3 TOP FARM PUBLICATIONS**

The Progressive Farmer

Successful Farming

Farm Journal

**2 BEST-SELLING GENERAL MAGAZINES**

The Saturday Evening Post

Coronet

**NEW DISPLAY POSTERS**


Available from your Channel Master distributor.

Reg. U.S. Pat. Office and Canada

**CHANNEL MASTER works wonders in Sight and Sound**

# CHANNEL MASTER advertising works 'Round the Clock

...to make friends and customers for the full line of Channel Master products.


Get the profit story. Call your Channel Master distributor today.

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

# . . . for the Record

By W. A. STOCKLIN
Editor

## INDUSTRIAL ELECTRONICS

INDUSTRIAL electronics seem to be "magic words" today. No matter where one looks—magazines, newspapers, etc.—one will find articles, promotion pieces, and even ads concerning the part played by service and maintenance personnel in the field of industrial electronics.

It is gratifying, in a sense, to feel that ELECTRONICS WORLD may have played some part in stimulating this interest. Why so many other publications have jumped on the bandwagon so late is rather hard to understand since it is not a field of interest that has developed overnight. Actually, the servicing and maintenance of electronic equipment could be readily foreseen directly after World War II in the increased development of computers and data processing equipment for business applications, along with the startling advances in all forms of telemetering equipment.

We at ELECTRONICS WORLD have been fully aware of the rapid growth in this field, not only as it pertains to dollar volume covering initial equipment sales and salaries but in the total cost of replacement parts. The trend was obvious and, as a result, ELECTRONICS WORLD has published many articles covering the industrial applications of electronics. Just to highlight a few that appeared this past year: "Industrial Tubes & Their Uses," "Ultrasonics —and its Uses." "Infrared– A New Field of Electronics and Optics," "Induction Heating," "Dielectric Heating," etc.

In the case of circuit diagrams, troubleshooting techniques, and test procedures, these are unique with each individual piece of equipment and, since most of this information is made available to service technicians through service manuals or direct special training programs on the part of initial equipment manufacturers, we have not attempted to cover this aspect. Our goal is to provide information on industry-wide techniques and to cover applications and theory of operation in such a way that every technician obtains a much broader picture of the specific industry in which he is employed at present or in the future.

For a service or maintenance technician to be considered qualified in his field, it is our belief that he should know not only basic service techniques but should be an authority in the field in which he operates—an authority not necessarily in the sense that he is an engineer and could design equipment, but a person who can talk intelligently about the various phases of the industry itself.

No one has any specific figures on the number of men who service and maintain industrial equipment. Our guess is that the number is between 35,000 and 50,000. We know, for example, that *RCA* alone has some 3000 technicians at Cape Canaveral for servicing and maintaining equipment. Many other manufacturers have similar groups at the Cape.
of 100 men each month to this force.

*IBM*, as another example, has some 9000 field technicians on the payroll whom they refer to as "repairmen customer engineers." *Remington-Rand* has some 1700 maintenance men and their present plans call for the addition

It is interesting to note that whereas the radio and TV service technician is an independent operator, the industrial service technician is not. The latter is usually employed by the original equipment manufacturer; however, some plants that have a considerable amount of electronic equipment find it more advantageous to have their own service and maintenance departments.

Another extremely important point of interest is that the industrial technician is not concerned directly with cost. His chief function is maintenance of equipment in use and to develop better customer-manufacturer relations. Since most companies refer to these men as field engineers or customer engineers, they initially carry the prestige that goes with such a title. They must, however, earn this prestige, and only by continued professional service can they command the respect due them. It is our goal to continue keeping them abreast of developments in their field so that they can be true professionals.

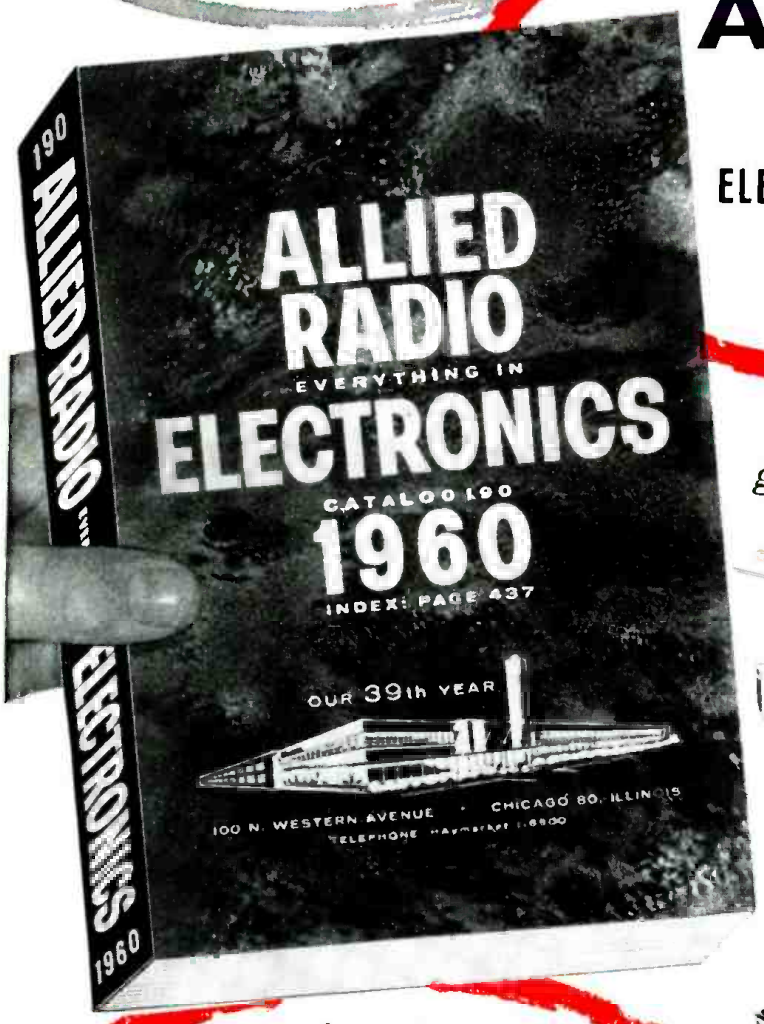
—30—

# FREE

# ALLIED'S 1960

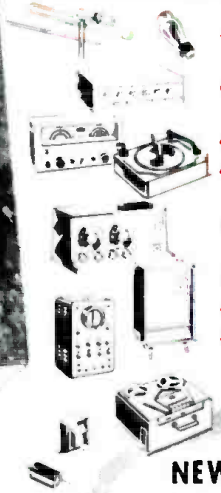
## ELECTRONIC SUPPLY CATALOG

*it's value-packed... send for it!*




*your complete money-saving guide to everything in electronics*

**WORLD'S LARGEST STOCKS**



- Latest Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- Money-Saving, Build-Your-Own KNIGHT-KITS for Every Need
- Values in Recorders and Supplies
- Latest Public Address Systems, Paging and Intercom Equipment
- Amateur Receivers, Transmitters and Station Gear
- Test and Laboratory Instruments
- TV Tubes, Antennas, Accessories
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

**NEW LOW EASY PAY TERMS**

Only $5 down (or less) on orders up to $200. Up to 24 months to pay. Fast handling—no red tape.

*featuring these* **ALLIED** *exclusives:*

**MONEY-SAVING KNIGHT-KITS®**—the very best in build-your-own electronic equipment—designed to save you up to 50%. "Convenience Engineered" for easiest assembly; the only kits covered by Money-Back Guarantee. Complete selection of Stereo hi-fi kits, Hobbyist kits, Test Instrument and Amateur kits. KNIGHT-KITS are an exclusive ALLIED product.

**KNIGHT® STEREO HI-FI**—truly "honored for value"—the best you can buy, yet far lower in cost. Select super-value KNIGHT components or complete systems and save most. Also see the world's largest selection of famous name hi-fi components and money-saving ALLIED-recommended complete systems.

Get every buying advantage at ALLIED: lowest money-saving prices, fastest shipment, expert personal help, guaranteed satisfaction...

*send for the leading electronic supply guide* **FREE**

**ALLIED RADIO CORP., Dept. 1-A**
**100 N. Western Ave., Chicago 80, Ill.**

☐ Send FREE 1960 ALLIED Catalog.

*Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

**ALLIED RADIO**

*our 39th year*

*World's Largest Electronic Supply House*

# HOW TO BUILD A STEREO CONSOLE THAT REPRODUCES MUSIC AS FAITHFULLY AS SEPARATELY MOUNTED COMPONENTS

For many years, serious music lovers have searched for a way to enclose high quality high-fidelity equipment in a cabinet that would match their finest furniture.

Until now, there was no practical solution. You had to compromise. You had to sacrifice the best possible music reproduction if you wanted a good looking cabinet. If you insisted on high quality reproduction, you chose components, some of which may not have been quite so appealing to the eye.

If you dislike compromise, Stromberg-Carlson's new kind of console will interest you. We call them Integrity Series Component Ensembles—and to an uncompromising music lover each word in that name will be significant.

At the start, we faced the same problem that every console manufacturer has tried to overcome: when full-range speakers were rigidly mounted in the same console as high quality components, there was a serious loss of sound quality.

This loss—most often recognized as muddy or boomy noise—is caused by "feedback." It occurs because sensitive components can detect the speaker vibrations which are fed back through the body of the cabinet. These vibrations are amplified with the music and reproduced as noise.

If you own a console now, but do not hear these noises, it is not because your ears are insensitive.

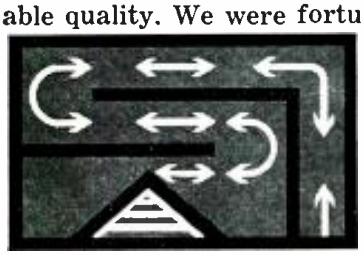
You do not hear them because we and every other console manufacturer had to eliminate them by compromising the musical reproduction of your console. You do not hear them because the sound you hear is not complete.

## HOW TO BUILD A CONSOLE THAT ELIMINATES FEEDBACK NOISES

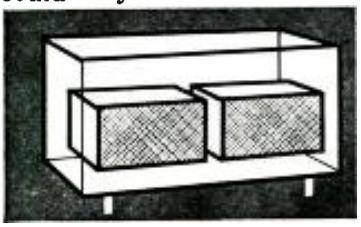
As we analyzed the problem, we realized there were seven projects that we had to accomplish before we could bring you this new kind of console.

*PROJECT #1* **The first consideration was given to our components.** They had to have high quality reproduction. The standards we set for them can be most simply described by the phrase "Integrity in Music Reproduction." If you are familiar with Stromberg-Carlson stereo tuners, amplifiers, turntables and speakers, we believe you will agree they earn this description.

*PROJECT #2* **Speaker systems were the next important project.** For our new kind of stereo console we needed two speaker systems of unquestionable quality. We were fortunate here, because we had already developed a system that met the quality requirements, the well-regarded Acoustical Labyrinth® Speaker System. Its quarter wavelength duct enclosure, properly coupled to a low-frequency radiator, achieved a system resonance lower than the unbaffled free air cone resonance of the radiator itself. This is the kind of quality we knew you wanted.



*PROJECT #3* **To reduce the size of high quality speaker systems so that they would fit into a stereo console of reasonable dimensions.** We were certain that component-quality sound in a console could only be achieved with speaker systems that did not depend on the console cabinet for their enclosure. This meant that we had to reduce the size of the Acoustical Labyrinth enclo-



sure so that we could fit two separate speaker enclosures within a cabinet that had reasonable dimensions. It was not easy, but we did it. After many, many trials and tests we achieved the correct size without sacrificing one iota of the extremely linear and extended response of the system.

## NOW THE MOST DIFFICULT PROBLEM HAD TO BE FACED

*PROJECT #4* **To effectively eliminate feedback by effectively eliminating the mechanical coupling that allows it to occur.** Instead of treating the symptoms, we treated the cause. We developed a method of effectively isolating the speaker systems from the sensitive components. (As a result, Stromberg-Carlson Integrity Series Ensembles are the first successful uncompromised ensembles.)

The key development is what we call ISO-COUSTIC SPEAKER SYSTEM MOUNTING. This mounting, in which the resistance and compliance to vertical and horizontal pressures have been carefully engineered, has solved the problem. It allows Stromberg-Carlson to create a cabinet-within-cabinet suspension system which prevents transmission of speaker vibrations to the sensitive components. If you component owners could put your equipment into a cabinet whose speaker systems have our ISO-COUSTIC Mounting, the quality of the sound you'd hear would be as good as your component system is now. In fact, the components we use are the same ones you would choose for your separately mounted component system. They are interchangeable.

## INTEGRITY SERIES WILL NEVER BECOME OBSOLETE

*PROJECT #5* **To assure the purchaser of an Integrity Ensemble that his choice would never be obsolete,** we designed the units in accordance with a *modular concept.* All of the components are *completely interchangeable.* You can replace any component in the ensemble to keep pace with new developments—without ever replacing your fine cabinetry.

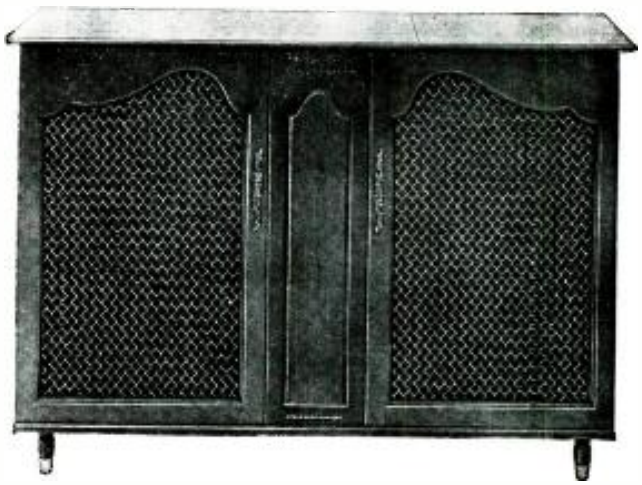
## CABINETRY HAD TO BE EXCEPTIONAL, TOO

*PROJECT #6* **To design cabinets with the permanent beauty of fine furniture.** Federico responded to the challenge by creating cabinetry in Traditional, Contemporary, Early American, Italian Provincial, French Provincial and Oriental styling. You choose from 16 basic models in these styles, in a choice of finishes. These cabinets, like a fine painting, best describe themselves. They must be seen.

*PROJECT #7* **To give you maximum flexibility in your enjoyment of an Integrity Series Ensemble.** Every ensemble provides for your listening tastes and room acoustics by including the Stereo Choice Switch for precise regulation of stereo separation, with or without separate matching speaker systems. All ensembles provide space for adding a tape deck.

You may select your own Stromberg-Carlson stereo components or choose a recommended component complement—in any case Stromberg-Carlson components are always interchangeable.

**If you now own a console or components,** we invite you to exercise your critical judgment by listening to an Integrity Series Ensemble. (You will find that the better component shops—as well as the better department and music stores—have chosen to feature this new kind of stereo console.) Listen carefully. Look closely. Ask questions. Then accept not our judgment, but your own.



**INTEGRITY SERIES COMPONENT ENSEMBLES**

**—three hundred and fifty dollars to about six thousand dollars. You may choose from 16 models in Traditional, Contemporary and Period stylings, each tastefully designed by Federico. You may select your own Stromberg-Carlson components or choose a recommended Stromberg-Carlson component complement—in any case Stromberg-Carlson components are always interchangeable.**

**For a complete color catalog of Integrity Series Component Ensembles and components write STROMBERG-CARLSON, Special Products Division, 1477 N. Goodman St., Rochester 3, New York.**

*"There is nothing finer than a Stromberg-Carlson"*

**STROMBERG-CARLSON**
A DIVISION OF **GENERAL DYNAMICS**

*For integrity in music...*

# A NEW STROMBERG-CARLSON SINGLE-SPEED TURNTABLE

*...in component systems*
*...in Integrity Series Ensembles*

PR-500

**PR-500 SINGLE SPEED** Here is a revolutionary concept in turntable design: a dual-drive system consisting of two hysteresis-synchronous motors operating one belt drive.

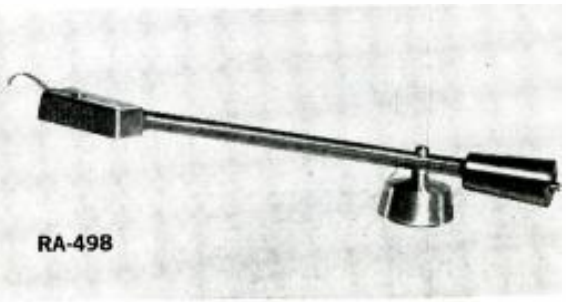
The motors are spaced exactly 180° apart. Any variation of speed is automatically corrected by the interaction of the motors and the impregnated belt. Rumble and noise are virtually eliminated by the belt drive and a unique suspension system in which the tone arm and table, as a unit, are isolated from the mounting board.

Single, 33⅓ speed. Includes tone arm. PR-500, black and brushed chrome ..... $69.95*

**PR-499 "PERFECTEMPO" ALL SPEEDS** The "Perfectempo" incorporates every valid, time-proven design principle: belt drive; continuously variable cone drive (14 to 80 rpm); stroboscopic speed indicator; dynamically balanced, weighted table; precision motor; plus Stromberg-Carlson's original double-acting motor and table suspension system that effectively eliminates unwanted noise. Performance proves it: Wow 0.14% rms; Flutter 0.09% rms; Rumble −55 db re 20 cm/sec at 1 kc. PR-499, morocco red with aluminum trim ..... $99.95*

PR-499

**RA-498 TONE ARM** The Stromberg-Carlson Tone Arm uses the most valid engineering concepts of tone arm design. Single pivot point suspension, true viscous damping and high moment of inertia result in extremely low resonance and consequently yield flat response below the limits of audibility. A calibrated counterweight is adjustable to provide any needle point force. For stereo operation, complete with mounting base, viscous fluid, rest, and cartridge clip. Fits all standard turntables. RA-498 ..... $24.95*



RA-498

**Prices audiophile net, turntables less bases.*

"THERE IS NOTHING FINER THAN A STROMBERG-CARLSON"

*For integrity in music...*

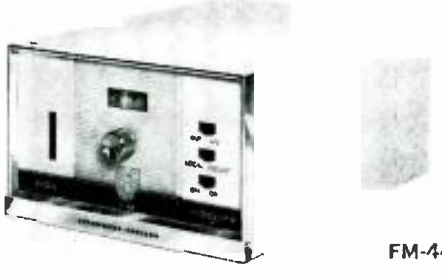
# THREE NEW STROMBERG-CARLSON TUNERS

*...in component systems*
*...in Integrity Series Ensembles*

**SR-445 AM-FM STEREO TUNER** The SR-445 is actually two separate and complete units which have been placed together for convenience of mounting and use. They have individual circuitry in which no duplicate use of tubes or circuits is involved. Operate as an AM tuner, an FM tuner or together as an AM-FM stereo tuner. The SR-445 combines the separate AM and FM tuners described below. The specifications are exactly the same as listed for these two units. SR-445 . . . $129.95*

*All three tuners are available in gold and white or black and brushed chrome. Top cover in white, black, tan or red available at extra cost.*

SR-445



FM-443

**FM-443 FM TUNER** Exceptionally sensitive, low noise reception due to the wide peak-to-peak separation (475 kc) and long, linear slope (350 kc) of the balanced ratio detector, and the grounded grid cascode front end. Sensitivity is 2 uv for 20 db quieting, 4 uv for 30 db quieting (300 ohm). Local-Distant Switch results in 2 uv for 40 db quieting on local stations. Dial station selector and "hair-trigger" tuning eye. Temperature controlled circuits eliminate drift. Includes switched AFC circuit. Tuning Range: 88-108 mc. Bandwidth: 200 kc. Frequency Response: 20-20,000 cps. Self-powered with auxiliary power for AM-441 tuner. Provision for multiplex adapter. FM-443 . . . . . $79.95*

AM-442/AM-441

**AM-442 AM TUNER** For exceptional AM reception, this tuner has a frequency response of 20-7,000 cps, down 7 db at 7,000 cps. It features a tuned RF stage and 3-gang variable tuning condenser. Its tuning range is 540 to 1,600 kc; Bandwidth is 9 kc. Local-Distant Switch adds 20 db quieting on local stations. Adjustable ferrite loop and external antenna. AM-442 . . . . . $59.95*

**AM-441 AM TUNER** Same as above, but without its own power supply . . . . . $49.95*

*Prices audiophile net, zone 1, less cover

**STROMBERG-CARLSON**
A DIVISION OF **GENERAL DYNAMICS**

*For integrity in music...*

# STROMBERG-CARLSON STEREO CONTROL AMPLIFIERS

*...for component systems*
*...for Integrity Series Ensembles*


**ASR-433**

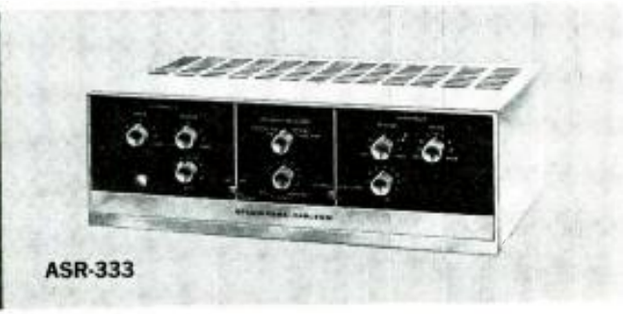
**ASR-433 STEREO "24" CONTROL AMPLIFIER** A dual channel amplifier with excellent performance and control features. Each channel provides 12 watts of exceptionally clean, balanced power. The exclusive "Stereo Tone Balance" signal permits you to adjust the two channels by a single tone.

The deliberately conservative specifications include: frequency response 20-20,000 cps; harmonic distortion less than 1% at full output; IM distortion less than 1% at program level; hum and noise 63 db down. Inputs: magnetic and ceramic phono; tuner; tapehead; auxiliary/tape. Available in gold and white or black and brushed chrome. ASR-433 . . $129.95*

**ASR-444 STEREO "60" CONTROL AMPLIFIER** offers all desirable controls, plus high power. Each channel provides 30 watts of balanced power. It features separate bass, treble and volume controls for each channel, a master gain and loudness control, and the "Stereo Tone Balance" signal. Specifications: frequency response 20-20,000 cps; harmonic distortion less than 0.7% at full output, IM distortion less than 1% at program level. Same inputs as ASR-433. In gold and white or black and brushed chrome.
ASR-444 ..... $169.95*

**ASR-444**

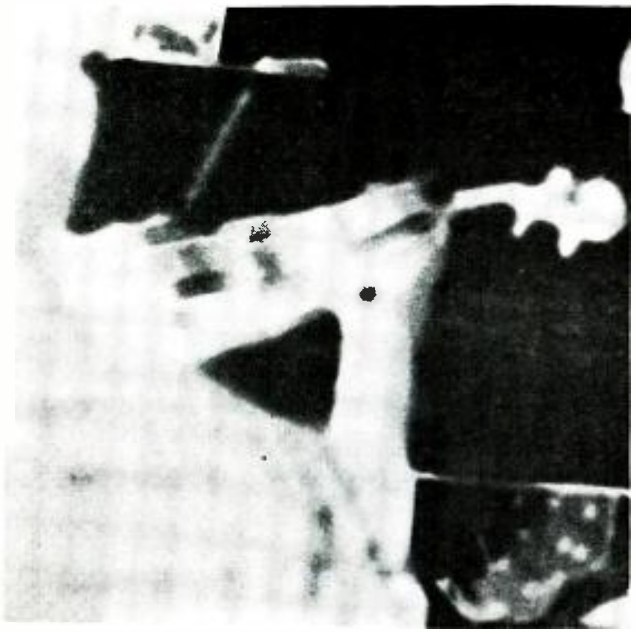
**ASR-333 STEREO CONTROL AMPLIFIER,** and a fine ceramic cartridge, give you quality performance at a low price. This amplifier—with 12 watts per channel—was designed for optimum reproduction with ceramic cartridges. It features tone and volume controls for each channel, plus a loudness control. Frequency response, noise level, distortion, same as ASR-433. Inputs: ceramic phono, tuner, tape/auxiliary. In black and brushed chrome.
ASR-333 ..... $99.95*



**ASR-333**

**Prices Audiophile net, Zone 1, less top covers, which are available in white, black, tan or red.*

"THERE IS NOTHING FINER THAN A STROMBERG-CARLSON"



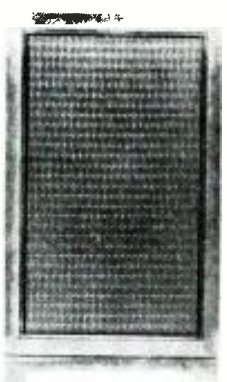
*For integrity in music...*

# STROMBERG-CARLSON SPEAKERS AND SYSTEMS

*...for component systems*

*...for Integrity Series Ensembles*

Stromberg-Carlson manufactures a full line of speakers and the famous Acoustical Labyrinth® Speaker System. This system enclosure achieves a system resonance that is lower than the unbaffled free air cone resonance of the low frequency radiator. It utilizes mass loading and frictional damping as acoustical devices to extend the low frequency range of the system with extreme flatness of response. Five new complete speaker systems with a variety of decorator housings are now available. We suggest that you compare the quality of their performance with similar equipment. You be the judge.



**DECORATOR HOUSING RH-469**

**SPEAKER SYSTEM RS-405**

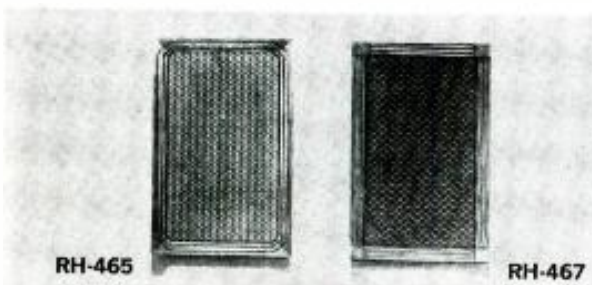
**RW-486**

**RT-477**

**RF-484**

**SPEAKERS** Stromberg-Carlson loudspeakers include tweeters, woofers, coaxials and mid-range transducers. They are available in all popular sizes and price ranges.

The unusual Stromberg-Carlson "Slimline" feature allows maximum versatility in installation, and is made possible by another feature: the new "Barite" ceramic magnet, which is used to insure excellent transient response over the full effective frequency range.



**RH-465**

**RH-467**

**ENCLOSURE KITS** Acoustical Labyrinth enclosures are now available as unassembled kits. All pieces are precision-cut to size, ready to assemble. Nails, glue, complete instructions—everything you need is included. Enclosures are available for 8", 12" and 15" systems. The same decorator housings available for factory assembled systems may be used. Write for full details on speakers and housings available.

For full details on Stromberg-Carlson components, write Stromberg-Carlson, a Division of General Dynamics, 1477 N. Goodman St., Rochester 3, N. Y.

**STROMBERG-CARLSON**

A DIVISION OF **GENERAL DYNAMICS**


### HISTORIC P.A. EQUIPMENT

To the Editors:

I am the honorary librarian of the Association of Public Address Engineers, and am attempting to locate sufficient written matter, photos, etc., of early p.a. work to enable us to have a little historic exhibit at our 1960 Exhibition.

It occurred to me that there may be other old-time p.a. operators among your readers who might care to assist us. We particularly require photos of gear, operating instructions, and circuits.

My father is one of the p.a. pioneers in this country, handling his first job in 1919, with home-made gear!

HAYDON G. WARREN
Warren Public Address Equipment
88 Wellington St.
Luton, England

*Perhaps some of our readers can help Mr. Warren in setting up his exhibit.—Editors.*

* * *

### "SPUTNIK III"

To the Editors:

In your article "Electronics in Outer Space" (August, 1959 issue), there was a table of recent satellites and space probes. I note that under "Sputnik III," the radio lifetime is listed as one month.

I can assure you that I picked up "Sputnik III's" radio while I was reading your August issue after it made its 6500th revolution around the earth. As far as I can determine, the radio was working almost as well for tracking purposes as it did a year ago.

Note also that the Russians are using chemical batteries plus solar cells to keep radio transmitters going over long intervals.

CHARLES H. SMILEY
Brown University
Providence, Rhode Island

*When Reader Smiley's letter was forwarded to Author Jordan McQuay, he replied as follows.—Editors.*

Dear Mr. Smiley:

The tabular data contained in the chart on page 37 of the August issue of ELECTRONICS WORLD was listed primarily in terms of the purpose intended for each satellite or space probe. For purposes of transmitting space data, there was a length of about one month. Naturally, solar-powered transmissions, which have since continued, are useful for tracking purposes and, in that special sense, the solar-powered transmitter has continued to operate (as has our own "Vanguard").

In a subsequent installment of this article (October, 1959 issue), power sources—including solar-powered devices—were further discussed. Of course, there can be no denying that Russia has also used solar cells in tandem with chemical or other batteries. While not overemphasized in the chart, there was certainly no effort made to conceal this fact.

JORDAN MCQUAY
Falls Church, Virginia

* * *

### HI-FI TRIODE AMPLIFIER

To the Editors:

I wish to congratulate you on the hi-fi triode amplifier described in your July issue. I have wired four of these amplifiers for myself and friends, and they have outperformed any that we have had, including more expensive types.

J. N. MANN
Elizabeth, New Jersey

*We are always pleased to hear of our readers' success with some of the projects that we run.—Editors.*

* * *

### METER MOVEMENT PROTECTION

To the Editors:

Mr. Pruitt's article "Protection for Your Meter Movement" in your August issue struck us close to home. We have a large number of *Triplett* 630's and *Simpson* 215's in use, and meter burnout, or pointer bending, is our greatest headache. We have tried *Sarkes Tarzian* diodes M150, M500, and 1442, as well as *International Rectifier* type 5E4 for meter protection. They performed satisfactorily on all ranges except on a.c. volts, where a substantial error in reading resulted.

We are going to keep trying to find a diode or some other means of protection that will not induce this error in measuring a.c.

JOHN H. WENDT, ET1
U. S. Naval Schools Command
U. S. Naval Station
Meter Repair, Teletype
Maintenance School C1
Norfolk 11, Virginia

*Perhaps some of our readers can help solve the problem. If so, we suggest they contact Mr. Wendt directly.—Editors.*

* * *

### THREE-BAND MOBILE CONVERTER

To the Editors:

I have received some correspondence finding fault with the resistance of $R_9$ in my article dealing with the three-band mobile converter (March, 1959 issue).

I had originally designed the con-

# Do you WISH you were EMPLOYED in ELECTRONICS?

### F.C.C. LICENSE—THE KEY TO BETTER JOBS

An F.C.C. *commercial* (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire *licensed* technicians.

### WHICH LICENSE FOR WHICH JOB?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radio telephone license qualifies you to install, maintain and operate every type of radiotelephone equipment (except amateur) including all radio and television stations in the United States, its territories and possessions. This is the highest class of radiotelephone license available.

### GRANTHAM TRAINING PREPARES YOU

The Grantham course covers the required subject matter completely. Even though it is planned primarily to lead directly to a first class FCC license, it does this by TEACHING you electronics. Some of the subjects covered in detail are: Basic Electricity for Beginners, Basic Mathematics, Ohm's and Kirchhoff's Laws, Alternating Current, Frequency and Wavelength, Inductance, Capacitance, Impedance, Resonance, Vacuum Tubes, Transistors, Basic Principles of Amplification, Classes of Amplifiers, Oscillators, Power Supplies, AM Transmitters and Receivers, FM Transmitters and Receivers, Antennas and Transmission Lines, Measuring Instruments, FCC Rules and Regulations, and extensive theory and mathematical calculations associated with all the above subjects explained simply and in detail.

### OUR GUARANTEE

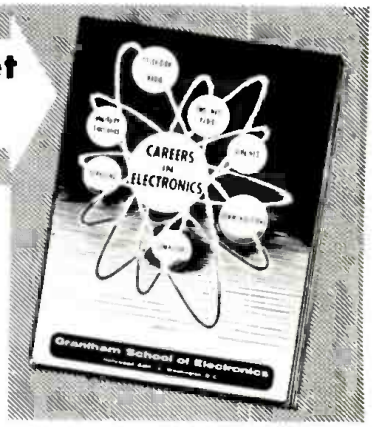
If you should fail the F. C. C. exam after finishing our course, we guarantee to give additional training at NO ADDITIONAL COST. Read details in our free booklet.

## Get
Your First Class Commercial
# F.C.C. LICENSE
## QUICKLY!

### CORRESPONDENCE OR RESIDENCE CLASSES

Grantham School of Electronics *specializes* in F.C.C. license preparation. Correspondence training is conducted from Hollywood, Seattle, Kansas City and Washington; also, resident DAY and EVENING classes are held in all four cities. Either way, by correspondence or in resident classes, we train you quickly and well.

**This booklet FREE!**




This free booklet gives details of our training and explains what an F.C.C. license can do for your future.

### HERE'S PROOF...

that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

| | License | Weeks |
|---|---|---|
| Richard M. Wilhoit, 2104 Santa Paula, Las Vegas, Nev. | 1st | 12 |
| Larry R. Perrine, 7 Normandy Place, Champaign, Ill. | 1st | 15 |
| Emerson F. Lawson, 111 Excelsior Ave., Union, S. C. | 1st | 12 |
| Harold W. Johnson, 5070 Hermosa Ave., Los Angeles, Calif. | 1st | 15 |
| Arthur W. Hardy, 66 Dresser Ave., Great Barrington, Mass. | 1st | 12 |
| Ralph Frederick Beisner, 2126 Grand, Joplin, Mo. | 1st | 12 |
| N. B. Mills, II, 110 So. Race St., Statesville, N. C. | 1st | 12 |
| Dean A. Darling, 403 S. Chase Ave., Columbus 4, Ohio. | 1st | 12 |
| Paul D. Bernard, 408 First Ave., N.E., Watertown, S. D. | 1st | 18 |
| Gerald L. Chopp, 518 Audubon Road, Kohler, Wisc. | 1st | 12 |

# Grantham School of Electronics

| | |
|---|---|
| Hollywood Division | 1505 N. Western Ave. Hollywood 27, Calif. (Phone: HO 7-7727) |
| Seattle Division | 408 Marion Street Seattle 4, Wash. (Phone: MA 2-7227) |
| Kansas City Division | 3123 Gillham Road Kansas City 9, Mo. (Phone: JE 1-6320) |
| Washington Division | 821-19th Street, N. W. Washington 6, D. C. (Phone: ST 3-3614) |

## MAIL COUPON TO SCHOOL NEAREST YOU

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS

1505 N. Western Hollywood • 408 Marion Seattle • 3123 Gillham Rd. Kansas City • 821-19th, NW Washington

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation and no salesman will call.

Name_____ Age_____

Address_____

City_____ State_____

I am interested in: ☐ Home Study, ☐ Resident Classes 08-A

verter using a 6BA6 tube as the r.f. amplifier. This tube has a 300-ma. filament, and the 42-ohm resistor is correct for 12-volt operation. After the converter was completed, I tried using various other tubes in the r.f. section in an attempt to maximize the performance. These other tubes included the 6CB6, 6AU6, 6BC5, and the 6BH6. These tests were made with 6 volts as the filament supply. All of the tubes mentioned have 300-ma. heaters with the single exception of the 6BH6, and that is the one that seemed to perform best. I thought I checked it for filament current, but apparently I did not do so.

Using the converter on 12 volts with the 42-ohm resistor in parallel with the 6BH6 filament would certainly degrade the performance of the unit since there will be only approximately 5 volts on the 6U8 filament. This would probably result in low oscillator output, especially on the 4th overtone for 10 meters. A 21-ohm resistor used in place of the 42-ohm resistor will solve this problem completely.

In addition, pins 3 and 4 were indicated as the heater connections for $V_2$. The proper heater connections are pins 4 and 5.

Many have inquired about how to change the converter to operate on the Citizens Band. The changes are quite simple. However, it would be necessary to sacrifice the 10-meter ham band in order to accomplish this modification.

A 6575-kc. crystal (available on the surplus market for about 75 cents) is used in place of the crystal normally used for ham-band operation. A 100-$\mu$f. capacitor (silvered mica) is installed across the 18-turn secondary winding of $L_1$, the 10-meter r.f. coil. The Citizens Band will then be found between 600 kc. and 1000 kc. on the broadcast receiver dial. The slugs in coils $L_1$ and $L_2$ should be adjusted for maximum response on any signal found near the center of the Citizens Band—approximately 800 kc. on the broadcast receiver.

JOSEPH L. REIFFIN
Biloxi, Mississippi

*A good many of our readers have asked about the conversion of the above unit to Citizens Band operation. The comments given by Author Reiffin should adequately answer these requests.—Editors.*

* * *

**TUBE-TRANSISTOR CARRIER SWITCH**

To the Editors:

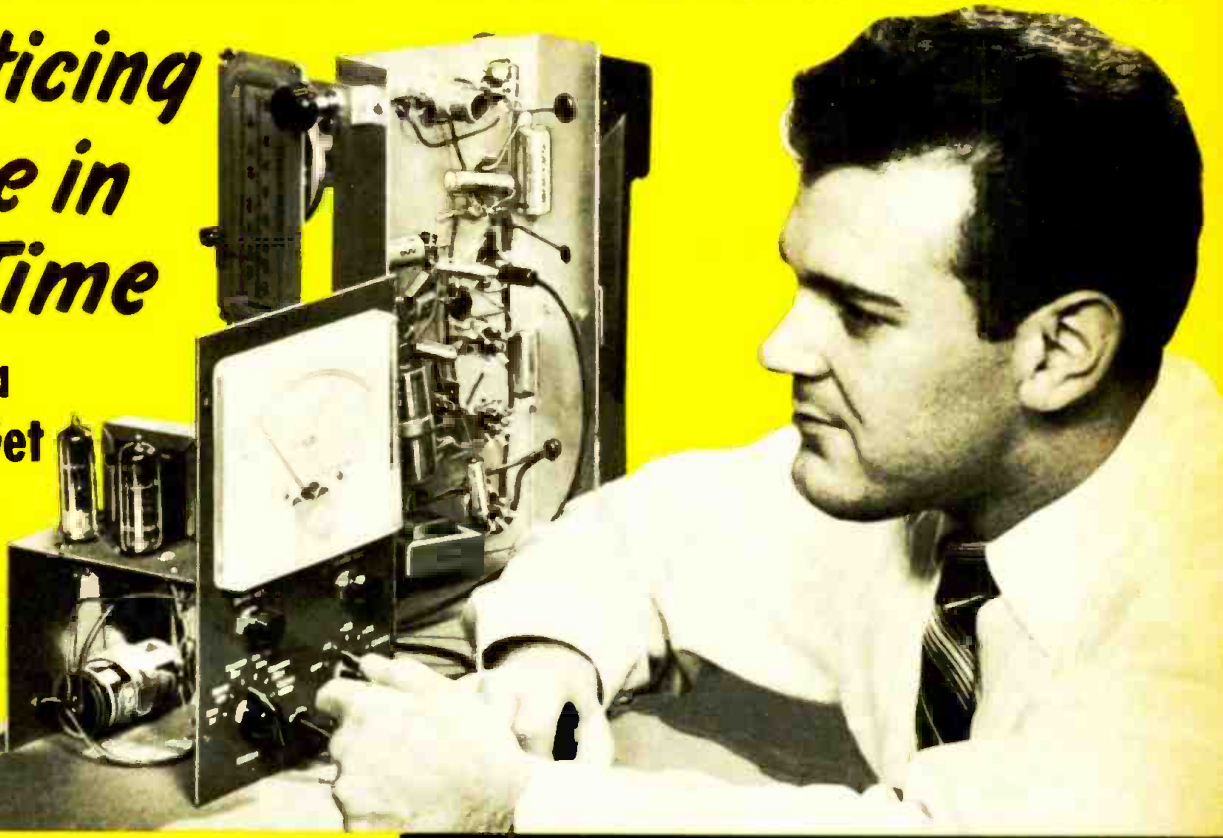
With reference to your article on the "Tube-Transistor 'Carrier Switch'" (October, 1959 issue), I would like to know the specifications for coil $L_3$ used in the receiver.

FAY D. BRUNING
Chuluota, Florida

*Coil $L_3$ in the receiver is exactly the same as coils $L_1$ and $L_2$ used in the transmitter, that is, a* Stancor *type WC-10. Our apologies for omitting this information from the parts list.—Editors.* —30—

# Learn Radio-TV Electronics

## by Practicing at Home in Spare Time



### Without Extra Charge You Get

special NRI kits developed to give actual experience with Radio-TV equipment. You build, test, experiment with receiver or broadcasting circuits. All equipment yours to keep.

### Have High Pay, Prestige, Good Future as a Skilled Radio-TV Electronic Technician

People *look up to* and depend on the Technician, more than ever before. Offices, plants, homes everywhere are obliged to buy his knowledge and services. His opportunities are great and are increasing. Become a Radio-TV Electronic Technician. At home, and in your spare time, *you* can learn to do this interesting, satisfying work—qualify for important pay. To ambitious men everywhere *here* in the fast growing Radio-TV Electronic field is rich promise of fascinating jobs, satisfaction and prestige as well as increasing personal prosperity.

### Increasing Opportunities in Growing Field

A steady stream of new Electronic products is increasing the job and promotion opportunities for Radio-Television Electronic Technicians. Right now, a solid, proven field of opportunity for good pay is servicing the tens of millions of Television and Radio sets now in use. Color TV, Hi-Fi is growing. The hundreds of Radio and TV Stations on the air offer interesting jobs for Operators and Technicians.

### More Money Soon—Make $10 to $15 a Week Extra Fixing Sets in Spare Time

NRI students find it easy and profitable to start fixing sets for friends and neighbors a few months after enrolling. Picking up $10, $15 and more a week gives substantial extra spending money. Many who start in spare time soon build full time Radio-Television sales and service businesses—enjoy security.

### Act Now—See What NRI Can Do for You

NRI has devoted over 40 years to developing simplified practical training methods. You train at home in spare time. Get practical experience, learn-by-doing.

**NATIONAL RADIO INSTITUTE**
**Washington 16, D.C.**

## NRI Has Trained Thousands for Successful Careers in Radio-TV

**Studio Engr., Station KATV**
"I am now Studio Engineer at Television Station KATV. Before enrolling, I was held back by limitation of a sixth grade education." BILLY SANCHEZ, Pine Bluff, Ark.

**Has All the Work He Can Do**
"I have repaired more than 2,000 TV and Radio sets a year. NRI training certainly proved to be a good foundation." H. R. GORDON, Milledgeville, Georgia.

**Has Good Part Time Business**
"Early in my training I started servicing sets. Now have completely equipped shop. NRI is the backbone of my progress." E. A. BREDA, Tacoma, Washington.

SEE OTHER SIDE

Cut Out and Mail This Card—No Stamp Needed

## Sample Lesson and Catalog Both Sent FREE

OLDEST & LARGEST HOME STUDY RADIO-TV SCHOOL

**National Radio Institute**

**Dept. F , Washington 16, D.C.**

Please send me sample lesson of your Radio-Television Training and Catalog FREE. (No salesman will call.)

Name..... Age.....

Address.....

City..... Zone..... State.....

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

## NRI SUPPLIES LEARN-BY-DOING KITS WITHOUT EXTRA CHARGE

### Technical Know-How Pays Off in Interesting, Important Work

### YOU BUILD AC-DC Superhet Receiver

NRI Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.

### YOU BUILD This 17 Inch Television Receiver

As part of your NRI course you can get all components, tubes, including 17" picture tube, to build this latest style Television receiver; get actual practice on TV circuits.

### YOU BUILD Broadcasting Transmitter

As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

### YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

# For Higher Pay, Better Jobs Be a Radio-TV Electronic Technician

### Servicing Needs More Trained Men

Portable TV, Hi-Fi, Transistor Radios, Color TV are making new demands for trained Technicians. Good opportunities for spare time earnings or a business of your own.

### Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Govt. Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

J. E. Smith, Founder

### Train at Home the NRI Way Famous for Over 40 Years

NRI is America's oldest and largest home study Radio-Television school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

### No Experience Necessary—NRI Sends Many Kits for Practical Experience

You don't have to know anything about electricity or Radio to understand and succeed with NRI Course. Clearly written, well-illustrated NRI lessons teach Radio-TV Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available. Address: **NATIONAL RADIO INSTITUTE, Washington 16, D. C.**

### NRI Graduates Do Important Work

**Now Quality Control Chief**
"Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. Now Quality Control Chief." T. R. Favaloro, Norwich, N. Y.

**NRI Course Easy to Understand**
"I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business." D. P. Cressey, Stockton, Cal.

**Works on Color-TV**
"NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WRCA-TV." J. F. Meling, New York, N.Y.

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P. L. & R.)
Washington, D.C.

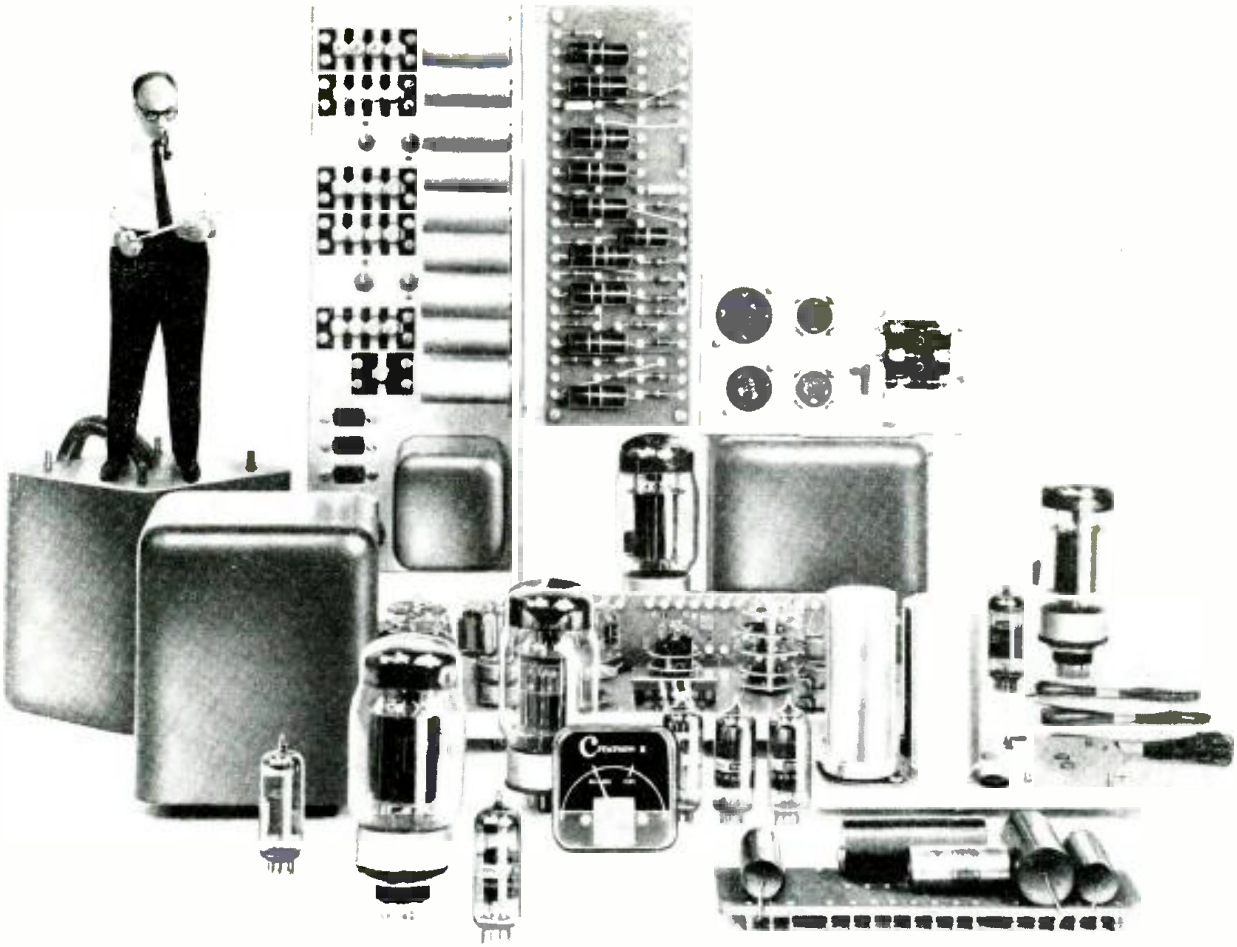
BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE
3939 Wisconsin Avenue
Washington 16, D.C.

**SAMPLE LESSON**
**64-page CATALOG**
**both FREE**

**SEE OTHER SIDE**



# We don't pack an engineer into each new Citation Kit but...

**...the engineering *built into* each kit is so precise that the unit constructed in the home will be the equal of the factory-produced instrument.**

It is far more difficult to design a kit than to produce a completely manufactured product. In the plant the engineer can control his design from the moment of inception until the final packaging. The kit builder has only his tools, his ingenuity and little, if any, test equipment.

Therefore, the complex process of in-plant production and control which guarantees the fine finished product must somehow be *embedded* in the kit design. The Citation engineering group at Harman-Kardon, headed by Stewart Hegeman, has succeeded in doing just this in the design of the new Citation I, Stereophonic Preamplifier Control Center and Citation II, 120 Watt Stereophonic Power Amplifier.

Only heavy duty components, operating at tight tolerances, have been selected for the Citation Kits. As a result, even if every component is operated at its limit – remote as this possibility is – the instruments will perform well within their specifications.

Rigid terminal boards are provided for mounting resistors and condensers. Once mounted, these components are suspended tightly between turret lugs. Lead length is sharply defined. The uniform spacing of components and uniform lead length insure the overall stability of the unit.

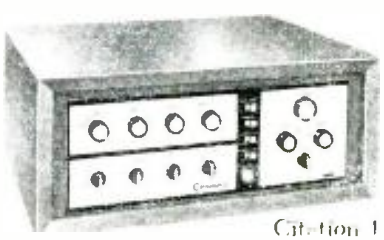
Improper routing of leads, particularly long leads, can result in unstable performance. To prevent this, the Citation II is equipped with a template to construct a Cable Harness. The result: each wire is just the right length and in just the right place to achieve perfect performance.

These truly remarkable achievements in Control Engineering are only a few of the many exciting new developments in kit design from the Citation Division of Harman-Kardon.

**THE CITATION I.** *Stereophonic Preamplifier Control Center,* is a brilliantly designed instrument, reflecting engineering advances found only in the best professional equipment. The control over program material offered by the new Citation I enables the user to perfectly re-create every characteristic of the original performance. (The Citation I – $139.95; Factory-Wired – $239.95; Walnut Enclosure, WW-1 – $29.95.)

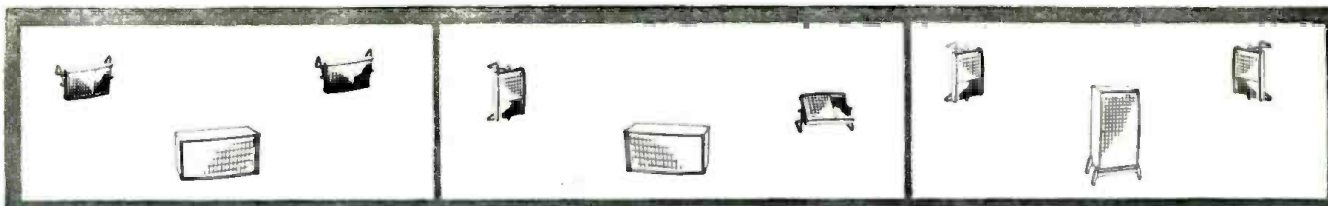
**THE CITATION II.** *120 Watt Stereophonic Power Amplifier,* has a peak power output of 260 Watts! This remarkable instrument will reproduce frequencies as low as 5 cycles virtually without phase shift, and frequencies as high as 100,000 cycles without any evidence of instability or ringing. *At normal listening levels, the only measurable distortion in this unit comes from the laboratory testing equipment.* (The Citation II – $159.95; Factory-Wired – $219.95; Charcoal Brown Enclosure, AC-2 – $7.95.) All prices slightly higher in the West.

Harman-Kardon has prepared a free detailed report on both of these remarkable new instruments which we will be pleased to send to you. Simply write to Dept EW-1, Citation Kit Division, Harman-Kardon, Inc., Westbury, L. I.

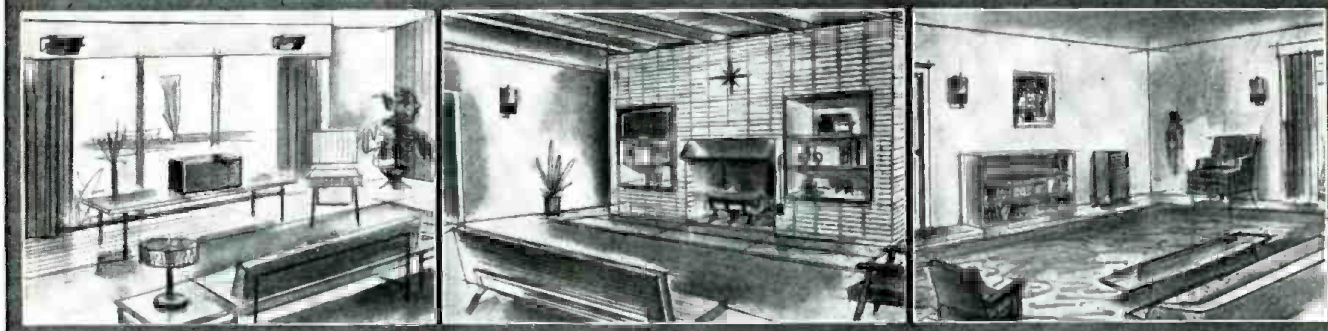


Citation I

*Build the Very Best* CITATION KITS *by* harman kardon



TWO TINY SATELLITES . . . ONE SMALL CABINET . . .

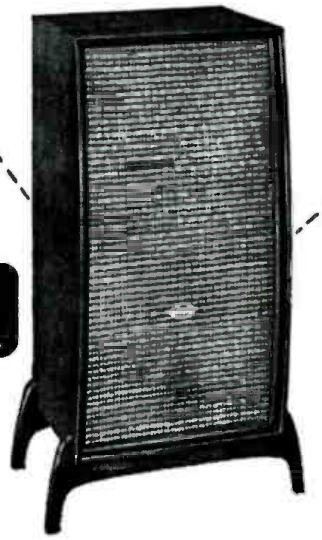


IT'S YOUR DECOR-DESIGNED STEREO SPEAKER SYSTEM!

*the exciting new* GALAXY*II

*by* Jensen

**The stereo speaker system designed with *your* home in mind.**



WITH NEW "FLEXAIR" WOOFER

You've never seen a stereo speaker system like this . . . an inspired merging of function with decor . . . that takes less than a square foot of floor space (or can be off-the-floor entirely) . . . yet gives you big speaker dual 3-way system performance with wide panoramic stereo sound for an entirely new listening thrill! For living room, or any room in your home . . . Jensen Galaxy II is the most livable stereo speaker system ever.

WRITE FOR BROCHURE GY

**$169.50** complete in choice of Walnut, Mahogany or Tawny Ash

Jensen LOUDSPEAKERS

GALAXY II is the equivalent of two complete 3-way speaker systems with the added feature of a "derived third channel" for center-fill. Bookshelf-size Bass-Center Unit in handsome fine hardwood cabinet, contains the new dual channel 8" FLEXAIR* woofer (which handles all bass and center-fill middle frequencies from both stereo channels), dividing networks for both channels and terminal-receptacle panel. Two Satellite Units each with yokes and wall-mounting hardware, plus 20-foot cord, plug into terminal-receptacle panel on Bass-Center Unit. Satellites may be mounted high or low on end, side or adjacent walls or placed on horizontal surfaces up to 20 or more feet apart for wide panoramic stereo sound.

Jensen MANUFACTURING COMPANY

DIVISION OF THE MUTER CO.

6601 South Laramie Avenue • Chicago 38, Illinois

In Canada: Renfrew Electric Co., Ltd., Toronto
In Mexico: Radios Y Television, S.A., Mexico D.F.

*T.M.

# WE'RE MAKING IT EASIER THAN EVER TO BECOME A WELL PAID RADIO-TELEVISION SERVICE TECHNICIAN

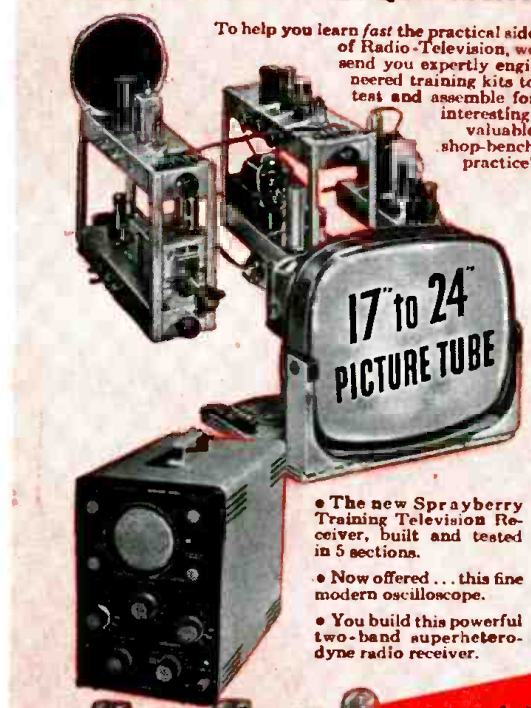
## NOW – Just $6 Starts You Training in

# RADIO-TELEVISION

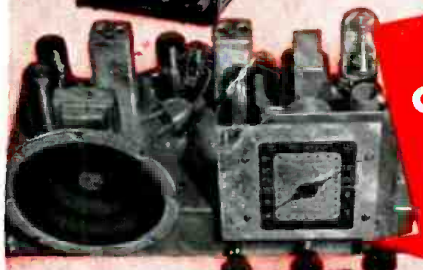
## the SPRAYBERRY "Learn-by-Doing" Way . . .

## 25 BIG, COMPLETE KITS of PARTS & EQUIPMENT

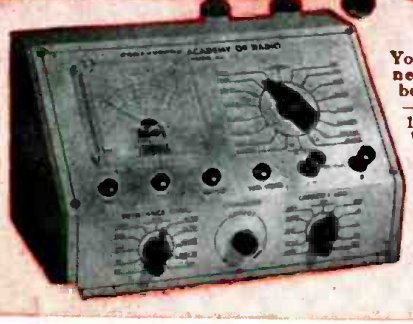
To help you learn *fast* the practical side of Radio-Television, we send you expertly engineered training kits to test and assemble for interesting, valuable shop-bench practice!




- The new Sprayberry Training Television Receiver, built and tested in 5 sections.
- Now offered . . . this fine modern oscilloscope.
- You build this powerful two-band superheterodyne radio receiver.



Big New CATALOG AND Sample Lesson FREE!



You build the new Sprayberry tester—a complete 18-range Volt-Ohm-Milliammeter test meter.

★ ★ ★ ★ This great industry is begging for trained men . . . to step into good paying jobs or a profitable business of their own! Our new plan opens the doors of Radio-Television wide to every ambitious man who is ready to act at once!

Men by the thousands... trained Radio-Television Service Technicians...are needed at once! Perhaps you've thought about entering this interesting, top paying field, but lack of ready money held you back. Now—*just $6 enrolls you* for America's finest, most up to date home study training in Radio-Television! Unbelievable? No, the explanation is simple! We believe Radio-Television *must* have the additional men it needs as quickly as possible. We are willing to do our part by making Sprayberry Training available for less money down and on easier terms than ever before. This is your big opportunity to get the training you need...to step into a fine job or your own Radio-Television Service Business.

### Complete Facts Free—Act Now; Offer Limited

Only a limited number of students may be accepted on this liberal and unusual basis. We urge you to act at once...mail the coupon below and get complete details plus our big new catalog and an actual sample lesson—*all free*. No obligation...no salesman will bother you.

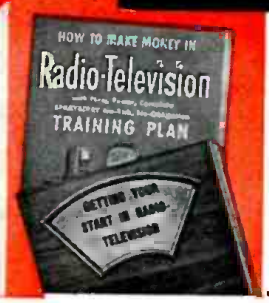
### HOME STUDY TRAINING IN SPARE TIME

Under world-famous 27-year old Sprayberry Plan, you learn entirely at home in spare time. You keep on with your present job and income. You train as fast or as slowly as you wish. You get valuable kits of parts and equipment for priceless shop-bench practice. And everything you receive, lessons and equipment alike, is all yours to keep.

### LET US PROVE HOW EASILY YOU CAN LEARN!

Radio-Television needs YOU! And Sprayberry is ready to train you on better, easier terms, that any ambitious man can afford. *Just $6 starts you!* Mail coupon today... let the facts speak for themselves. You have everything to gain. Let us prove the kind of opportunity that's in store for you!

**SPRAYBERRY Academy of Radio-Television**
**1512 Jarvis Avenue, Dept. 25-F, Chicago 26, Illinois**




**Mail This Coupon Now—No Salesman Will Call**

**Sprayberry Academy of Radio-Television**
**Dept. 25-F, 1512 W. Jarvis Ave., Chicago 26, Ill.**

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME..... Age.....

ADDRESS.....

CITY..... ZONE..... STATE.....

# Within the Industry

**JOHN W. MURPHY** has been appointed manager for *Weston Instruments Division of Daystrom, Inc.*

Mr. Murphy will be directly responsible for engineering, manufacturing, and industrial relations activities for the company in addition to having complete charge of the firm's main plant in Newark, N. J.

Prior to this appointment, Mr. Murphy was associated with the *International Business Machines Corporation* for fourteen years.

* * *

**ELECTRONIC INDUSTRY ASSOCIATION** has approved a complete re-organization of the parts division. A second vice-chairman for the division also was approved, as well as ten subdivision chairmen, division committee chairmen and members, and a new member of the executive committee.

William S. Parsons, president of *Centralab*, a division of *Globe Union Inc.*, is division chairman and Allen K. Shenk, vice-president, marketing, *Erie Resistor Corp.*, has been named second vice-chairman. Messrs. Parsons, Shenk, and vice-chairman W. Myron Owen, president of *Aerovox Inc.*, will administer the activities of the re-organized parts division. The following are the committee chairmen: Russell Cramer, Jr., *Radio Condenser Co.*; E. W. Butler, *Speer Carbon Co.*; and Allen K. Shenk, *Erie Resistor Corp.*

The following subdivision chairmen have also been approved by the executive committee: J. H. Stackpole, *Stackpole Carbon Co.*; Neal Welch, *Sprague Electric Co.*; I. Allen Mitchell, *United Transformer Corp.*; Jack D. Hughes, *Littelfuse, Inc.*; R. G. Zender, *Lenz Electric Mfg. Co.*; John Bentia, *Alliance Mfg. Co.*; Allen W. Dawson, *Corning Glass Works*; Harold C. Buell, *P. R. Mallory & Co., Inc.*; Wilbert H. Steinkamp, *Weston Instruments*; and J. A. Milling, *Howard W. Sams & Co., Inc.*

J. Rodney Reese, component products manager, *Texas Instruments Inc.*, has been elected to the executive committee.

* * *

**MAX F. BALCOM**, director-consultant of *Sylvania Electric Products Inc.*, has been re-appointed chairman of the EIA legislative policy committee. The committee directs the Association's legislative activities as authorized by the board of directors.

Members of the committee are: B. Adler, *Adler Electronics, Inc.*; E. C. Anderson, *RCA*; W. F. Ballhaus, *Nortronics*, Div. of *Northrop Corp.*; R. M. Bixler, *J-B-T Instruments, Inc.*; S. R. Curtis, *Stromberg-Carlson*; L. B. Davis, *General Electric Co.*; P. Dechert, *Philco Corp.*; J. B. Elliott, *Tele-Dynamics Inc.*; R. W. Galvin, *Motorola Inc.*; H. L. Hoffman, *Hoffman Electronics, Corp.*; W. F. Joyce, *Texas Instruments Inc.*; R. C. Sprague, *Sprague Electric Co.*; and D. R. Hull (*ex officio*) president, EIA.

* * *

**DR. WILLIAM L. WHITSON** has been named a vice-president of *Daystrom, Inc.* . . . *Hazeltine Technical Development Center, Inc.*, has announced the election of **W. M. McFARLAND** as president and **D. M. STUART** as vice-president and general manager . . . **CECIL STOWE** has been named manager of the newly created customer relations section of *Orr Industries* . . . **WILLIAM C. COOMBS** has been named chief of the systems analysis section, radio communication and systems division, National Bureau of Standards . . . **MAURICE R. EASTIN** has been appointed manager of *Clevite "Walco"* . . . **GENERAL H. FRANKLIN GREGORY** has been named to the board of directors of *Midwestern Instruments, Inc.* . . . **JOHN H. WATKINS** has been named wood products sales manager of *Packard Bell Electronics* . . . **LESLIE H. WARNER** and **ROBERT E. KENOYER** have been elected a member of the board of directors and controller, respectively, of *Sylvania Electric Products Inc.*

* * *

**DON KIRKENDALL** has been appointed assistant manager of advertising and sales promotion for *Electro-Voice, Inc.* He will assist Everett Leedom, advertising manager, and the firm's product and sales managers in preparing advertising and promotional materials for the company's complete product line.

Prior to joining the Buchanan, Michigan concern, Mr. Kirkendall was advertising manager for *Interstate Electronics Supply Corp.* He also taught English composition, literature survey, and creative writing courses at the Universities of Missouri and Oklahoma from 1948 to 1951.

* * *

**ELECTRONIC PARTS DISTRIBUTORS SHOW** has announced the following committee chairmen for the 1960 show. They are: Carter W. Dunlap, *Dunlap Wholesale Radio Co.*, entertainment; Roy J. Schneider, *Walder Radio and Appliance Co.*, housing; John Brown,

*JB Distributing Co.*, publicity; Helen S. Quam, *Quam-Nichols Co.*, ERA Show Corp., liaison; Jack D. Hughes, *Littelfuse, Inc.*, educational and program; George E. Wedemeyer, *Wedemeyer Electronic Supply Co.*, credentials; Robert E. Svoboda, *Amphenol-Borg Electronics Corp.*, space and arrangements; Edward Rothenstein, *Arco Electronics, Inc.*, finance and show study.

* * *

**HENRY LEHNE** has been elected a senior vice-president of *Sylvania Electric Products Inc.*, a subsidiary of *General Telephone & Electronics Corporation*.

In his new duties, Mr. Lehne will have over-all responsibility for *Sylvania Electronic Systems*, a major division of the company. He has been associated with the company since 1953 and prior to that served with *Republic Aviation Corporation* for fourteen years.

Mr. Lehne is an engineering graduate of Carnegie Institute of Technology and has done graduate work in the advanced management field at the Harvard Graduate School of Business Administration.

* * *

**DAVID A. McGALLIARD** has been appointed distributor sales manager for the *Daystrom-Weston Sales Div., Daystrom, Inc.* . . . **REED WALDRON** is now sales promotion manager of the distributor division of *International Resistance Company* . . . The Cedar Rapids division of the *Collins Radio Company* has named **HERBERT J. PYLE** to the newly created position of director of service . . . **S. GEORGE LAWSON** has been appointed to the newly created post of operations manager for the semiconductor division of *Sylvania Electric Products Inc.* . . . The appointment of **EDWARD J. KEENAN** as director of home study for *RCA Institutes* has been announced . . . *Vocaline Company of America* has named **DONALD G. FERTMAN** sales coordinator . . . **S. I. NEIMAN** has resigned as public relations counsel for the Association of Electronic Parts & Equipment Manufacturers, Inc.

* * *

**ELECTRONIC INDUSTRIES ASSOCIATION** has issued a report on the activities of Panel 1 (System Specifications), under Charles J. Hirsch, *Hazeltine Research Corp.*, of the National Stereophonic Radio Committee (NSRC).

Murray Crosby, *Crosby Labs.*, has agreed to set up tests in collaboration with Harold Parker, *Calbest Electronics*, and William N. Halstead, *Multiplex Services Corp.*, to determine the minimum bandwidth required for good stereophonic broadcasting and the optimum compromise bandwidth for combined stereo and background music broadcast.

Another group reported on the characteristics of FM-AM. It appears that at this time the best signal-to-noise

(*Continued on page* 144)

(Commercial)

# an FCC License

## your Guarantee of Success in Electronics

## in a Minimum of Time

mail coupon NOW!

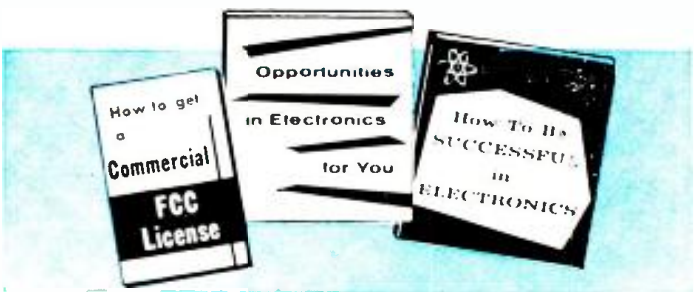
### here's proof of good jobs

**Irving Laing:**

"Your lessons are helping me a lot in my Navy work. You cover topics that were not presented by the Navy at the E.T. School. . . . Your course has helped greatly to get my 2nd class FCC ticket. I am now a radio and T.V. engineer at WTVS and WDTR in Detroit, Michigan."

*Irving L. Laing,*
*15887 Robson,*
*Detroit 27, Michigan*

## Get all 3 FREE





**Receive All These Booklets FREE!**

*Accredited by The National Home Study Council*

**Cleveland Institute of Electronics**

Desk RN-37, 4900 Euclid Ave., Cleveland 3, Ohio

Please send FREE Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other.....

In what kind of work are you now engaged?.....

.....

In what branch of Electronics are you interested?.....

.....

Name..... Age.....

Address.....

City..... Zone..... State.....

Special Tuition Rates to Members of Armed Forces Desk RN-37

# why the most advanced professional cartridge...


# has ceramic elements!

For more than 35 years, Electro-Voice has been a leader in the development and manufacture of dynamic microphones and loudspeakers. Why then, with this extensive experience in designing and producing electro-magnetic devices, is Electro-Voice introducing the new Magneramic 31 Series stereo cartridge using ceramic elements?

The reason is that Electro-Voice is genuinely convinced that a precision ceramic cartridge is the finest type that can be made today . . . definitely superior to the magnetic type. The superiority of the Magneramic 31 is demonstrated in these three areas.

**GREATER FLEXIBILITY** — The 31 Series cartridge will operate perfectly at any stylus pressure from 2 to 20 grams. The same stylus assembly can be used for operation on both turntable and record changers; performance need not be compromised by using a special, stiff stylus assembly for record changers. Record wear is the only criterion in setting stylus pressure — cartridge operation is not affected. Thus, when converting from a changer to a turntable, or vice versa, replacement of the stylus assembly is not necessary when using the Magneramic 31.

**HIGHER OUTPUT** — Along with the trend toward less efficient speaker systems, more amplifier power has become a necessity. While most stereo amplifiers are now designed with input sensitivities to match the typical 5-millivolt output of magnetic stereo cartridges, nearly all monaural amplifiers were designed for at least 8-millivolt input. These cannot be driven to full output with a magnetic stereo cartridge. The Magneramic 31 develops a full 8-millivolt output and couples directly into any "magnetic" preamp unit. This higher output should especially be considered by those planning conversion to stereo utilizing existent monaural amplifiers.

**FREEDOM FROM HUM** — The increased amplifier gain required to satisfactorily drive low-efficiency speakers coupled with decreased cartridge output has significantly increased system hum problems. Also, conventional methods of hum elimination used in monaural magnetic cartridges become difficult or impossible to apply to stereo magnetics. The Magneramic 31 completely eliminates these problems — it is non-inductive and has adequate output.

The Electro-Voice Magneramic 31 MD7 cartridge directly replaces any monophonic or stereophonic magnetic cartridge now on the market. It feeds into the preamp input-jack specified for magnetic cartridges and does not require adaptors or circuit modifications.

**SPECIFICATIONS — MAGNERAMIC 31 MD7**

*Response Range:* 20 to 15,000 cps ± 2 db
*Compliance, Vertical:* 3.5 x $10^{-6}$ cm/dyne
*Compliance, Lateral:* 3.5 x $10^{-6}$ cm/dyne
*Isolation:* 28 db @ 1000 cycles
*Tracking Force:* 2 to 4 grams in transcription arms
4 to 6 grams in changer arms
*Styli:* .7 mil diamond
*Output:* 8 millivolts
*Recommended Load:* 22,000 to 47,000 ohms (Magnetic phono inputs)
*Elements:* 2, Lead Zirconium Titanate (Ceramic)
*Weight:* 8 grams
*Terminals:* 4, standard .050" connectors
*Mounting Centers:* ½" and ⅝" fits both
**Audiophile Net: $24.00**

*Want more information? Write to Dept. 10N for the booklet entitled, "FACTS ABOUT THE ELECTRO-VOICE MAGNERAMIC CARTRIDGE"*

Electro-Voice® INC.

BUCHANAN, MICHIGAN

# Hey... I've got new coil heaters!

**(GOODBYE TO YOUR FRONT-END TROUBLES)**


"All 6BQ7A's used to have folded heaters . . . and gave you plenty of trouble. Now, all of us CBS 6BQ7A tubes have new coil heaters for our new improved cathodes . . . and *you* don't have heater burnouts, shorts or slumping gain."

Yes, the new CBS 6BQ7A offers you *total reliability* . . . proved in performance by leading TV and radio set manufacturers. You, too, can profit from the *total reliability* of CBS tubes. Prove it to yourself. Replace with CBS.

## TOTAL RELIABILITY... proved in performance


Old-style 6BQ7A folded heaters had seven folds . . . each fold a potential source of burnouts and shorts. The new CBS 6BQ7A heaters, because of the telescopic effect of coiling the heater, have only one gradually curved fold. The result is that CBS 6BQ7A's just don't develop those irritating, costly shorts and opens.


*Receiving, industrial and picture tubes • transistors and diodes • audio components • and phonographs*

**CBS ELECTRONICS**
Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

# HIGH-FIDELITY ANAGRAM

By JOHN A. COMSTOCK

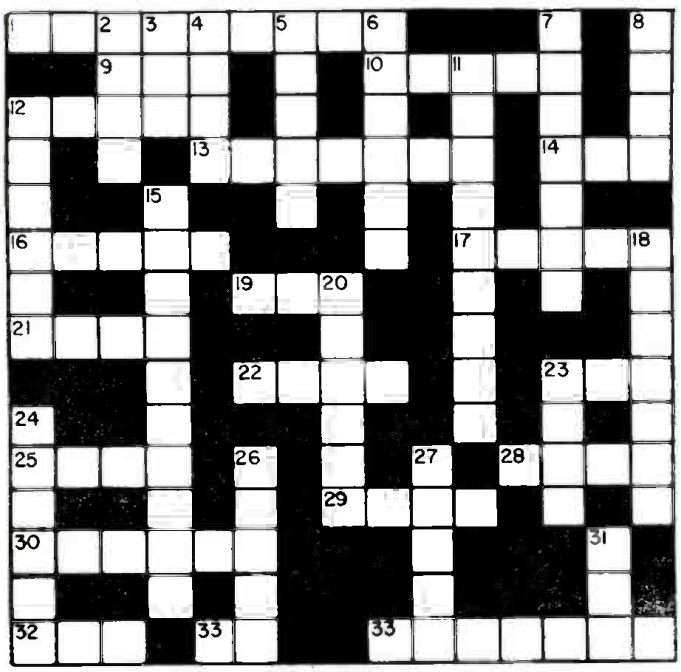
(*Answer on page* 160)

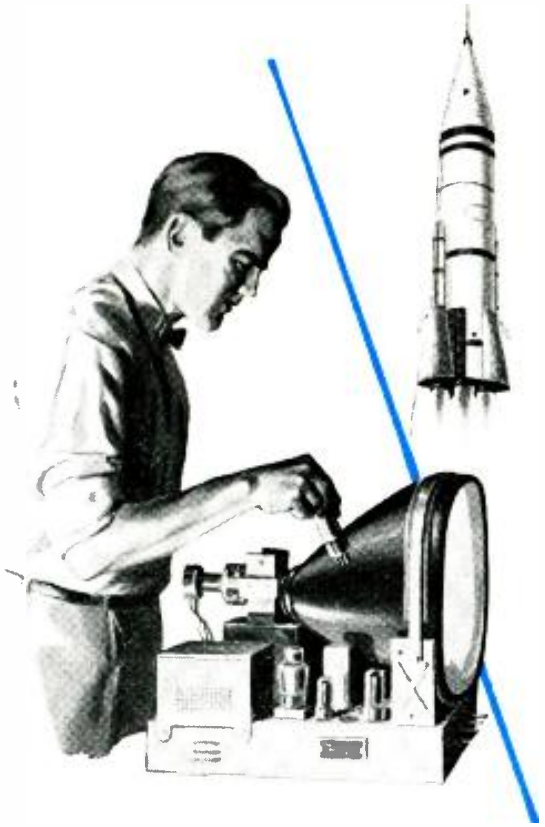
ACROSS

1. Network of component parts in a hi-fi system used to separate the high from the low frequencies, sending them to different speakers for reproduction.
9. A single pulse of recording signal.
10. To remove program material from a recording tape.
12. A device that plays records (Colloq.).
13. A small woodwind that sounds an octave higher than an ordinary flute.
14. Unit used to express magnetic tape recording speed. (abbr.).
16. An ——— amplifier makes sound louder.
17. Music often induces restful ———.
19. A slow fluctuation in turntable speed that causes a fluctuating pitch in program material.
21. A melody for a particular voice or instrument.
22. Accentuation of a bass note by resonance.
23. Abbreviation for a number of interconnected electronic components.
25. An interval of silence between musical notes.
28. Quality or character of sound.
29. Vibration of this small piece of cane or metal gives a woodwind its characteristic sound.
30. Wind instrument of the oboe family.
32. The ——— result to be achieved in any hi-fi system is realism.
33. Type of radio transmission (abbr.).
34. Public musical performance.

DOWN

2. Wind instrument in the form of a slender conical tube in which the tone is produced by a double reed.
3. A music lover may consider it a ——— to criticize the music of the masters.
4. The button depressed on a tape recorder to cut off operation.
5. To regulate the tones of, as the pipes of an organ.
6. To put sound on a magnetic tape or disc.
7. Measurement of sound intensity which corresponds to the characteristics of human hearing.
8. Large drum.
11. Science of sound.
15. Component in reproduced sound not in original program material.
18. Familiar name for disc recording.
20. Hi-fi speaker especially designed to handle the lowest audio frequencies.
23. Bulb-type of record level indicator used in some types of tape recorders.
24. Musical tones corresponding to vibrations greater than 260 cps.
26. Note equal in time value to one-half of a semibreve.
27. "Baritone" of the violin family.
31. Marks the measure between two divisions in a musical manuscript.





ANOTHER WAY RCA SERVES EDUCATION THROUGH ELECTRONICS

# 6 REASONS WHY RCA TRAINING IN ELECTRONICS

## can be the smartest investment you'll make in your *entire lifetime!*

**1. You get the finest training-at-home** under the supervision of the RCA INSTITUTES, experts in technical training for over 50 years. The very name "RCA" means dependability, integrity, and scientific advance.

**2. You get comprehensive training** in your choice of four complete, up-to-date Courses . . . from basic electronics theory to Color TV and Automation.

**3. You get an evaluation of your aptitude** for advanced training. RCA determines, for your benefit, whether you have the requirements for a career in the electronics field.

**4. You get prime quality equipment** as a regular part of your Course . . . equipment that you keep and use on the job. You never have to take apart one piece to build another.

**5. You get each study group on a pay-as-you-go basis.** Should you wish to interrupt your training at any time, you will not owe RCA Institutes a penny more, unless and until you decide to resume the Course.

**6. You get top recognition — worldwide.** Graduates of RCA Institutes now work for leaders in the electronics field; many have their own businesses. This record is true tribute to the high quality of RCA Institutes training.

**Send for this 64-page Home Study Catalog FREE!**


**FOR RESIDENT SCHOOL COURSES SEE AD ON OPPOSITE PAGE**

**RCA INSTITUTES, Inc.** Home Study School EW-10
A Service of Radio Corporation of America
350 West Fourth Street, New York 14, N. Y.

**Without obligation, send me FREE 64-page CATALOG on Home Study Courses. No salesman will call.**

Name ..... Age.....
please print

Address .....

City ..... Zone..... State.....

Korean Vets! Enter discharge date .....

**CANADIANS** — **Take advantage of these same RCA courses at no additional cost. No postage, no customs, no delay. Send coupon to:**
RCA Victor Company, Ltd., 5001 Cote de Liesse Rd., Montreal 9, Quebec
**To save time, paste coupon on postcard.**

# Spot News

*Latest Information on the Electronic Industry*

By ELECTRONICS WORLD'S WASHINGTON EDITOR

ADDITIONAL FREQUENCIES PROPOSED FOR SPACE COMMUNICATION—At the suggestion of the Executive Branch of the government, the FCC has issued a proposal to amend its rules re-allocating the 118-136 mc. band so as to provide additional frequencies, on a protected basis, for earth-space and space communication and for air-traffic control in the interest of air safety. The proposed changes, contemplated to become effective July 1, 1960, would place the 135-136 mc. band in the earth-space category. Three megacycles, 132-135 mc., from the present 132-144 mc. government band would be allocated for aeronautical and aircraft-station use. Two additional megacycles (126.825-128.825) from the existing 126.825-132 mc. band now used primarily by airlines, would be re-allocated for air-traffic control communications.

UNDERWATER TV NOW BEING USED BY NAVY TO STUDY OCEAN BOTTOM—Operational use of a remote-control underwater closed-circuit TV system in deep-water surveys (at depths of more than 600 feet) has been announced by the Navy. This is the first time that a continuous visual survey has been achieved at such depths. Primarily designed for salvage and search, the setup includes an underwater lighting system and a movable camera-housing capable of training 70 degrees in any direction. A propulsion system enables the underwater vehicle to hover at any desired depth in currents and tides of several knots.

MULTI-MILLION-DOLLAR 1000-FT. RADAR ANTENNA SYSTEM UNDER CONSTRUCTION—A vertically directed ionospheric radar probe, equipped with a 1000-foot diameter spherical antenna, to study the mid-course effects of atmosphere on ballistic missiles, is now being built for installation in Puerto Rico. Total cost of the installation, including the land (70 acres) and site development, is estimated at $4.5-million. The device will be capable of using incoherent backscatter radar to obtain radar echoes from Mars and Venus and to map areas of the moon and sun.

TV-TORPEDO RETRIEVING DEVICE TO BE BUILT—A combination mobile deep-water TV system and a retrieving device for spent torpedoes is being designed for use by the U.S. Naval Torpedo Station, Keyport, Washington, at the Torpedo Test Range in Dabob Bay, an arm of Puget Sound. A self-propelled unit, making use of closed-circuit TV, it will feature deep-water lights to illuminate the camera's field of view. An operator in a surface vessel will be able to guide the unit and view the underwater area over a TV screen. When a torpedo is sighted, the operator will guide the unit to it and a pair of claws will clamp the torpedo and bring it to the surface.

HIGH-POWERED SUN BATTERIES ON EXPLORER VII FOR TRANSMITTERS—Sun batteries, 100 times as powerful as those on Vanguard I, capable of generating a minimum of 5 watts continuously, are in the 91.5-pound Explorer VII now in orbit. The batteries have over 2000 solar cells imbedded in ceramic cement, which in turn fills aluminum trays covered with fused silica windows held in place by aluminum frames and sealed by a rubber gasket. To insure constant flow of current, irrespective of spin or tumble, the cells have been grouped in six power units, any one of which can provide the necessary power. Thus, at least one group will be in full sunlight at all times the satellite is not in the earth's shadow.

ARMY SCIENTISTS SHARE $25,000 AWARD FOR MINIATURIZATION ROLES—Five Army scientists from the Diamond Ordnance Fuze Laboratory in Washington, D.C., whose breakthrough in miniaturization has made it possible to pack five times as much electronic gear into missile nose cones, recently shared a $25,000 award. At a Pentagon ceremony, Secretary of the Army Wilbur M. Brucker presented the awards ($5000 each) to Thomas A. Prugh, Mrs. Edith M. Olson, Norman J. Doctor, James R. Nall, and Dr. Jay W. Lathrop.

AVIATION AGENCY SEEKS METHOD TO IMPROVE VOICE OVER RADIO—A $55,000 contract has been awarded to Blonder-Tongue Labs by the Federal Aviation Agency for research on radio transmission of the human voice and the development of an experimental device to improve the intelligibility or ease of understanding of voice communications in aviation. The project will involve study of the human voice and the acoustical environment in which air-traffic control activities are conducted. -30-

# HERE'S A COMPACT DESIGN

## that's preferred among all modern designs!

## IT'S THE SLIM, TRIM NEW 330 MICROPHONE SERIES

Dynamic, Ceramic and Crystal Models

## BY ASTATIC

ACTUAL SIZE

### never before such quality of performance and versatility of application at such low price

Yes, here's a classic design in modern, compact microphones—small, slender, unobtrusive, a beauty in simplicity. But the greatest achievement is in the magnificent performance quality of the Series among a great host of applications.

*The Dynamic Models 335H (high impedance) and 335L (low impedance)* operate with highest quality characteristics in TV and radio broadcast usage, in professional or home recording, public address, almost unlimited other lavalier, hand or stand applications.

*The Ceramic Model 331* is a voice range unit specifically engineered for excellence in communications applications, 27 megacycle citizens' band use, and paging.

*Ceramic Model 333* is a wide-range microphone offering a similarly high new level of perfection for tape recording, P. A. Systems, etc.

*Crystal Model 332*, with satin chrome body and cap, black grille, is already famous through widespread use. Performance throughout the series is of the highest order. THUS, THE GREATEST NEWS OF ALL CONCERNING THESE NEW ASTATIC UNITS IS THEIR AMAZINGLY LOW COST! Check out these new Astatic Microphones at your first opportunity.

| Model | Type | Output | Frequency Range | Impedance | Finish | List Price |
|---|---|---|---|---|---|---|
| 331 | Ceramic | -56 db | 300- 5,000 | High | Black Body and Grille, Chrome Cap | $17.90 |
| 333 | Ceramic | -58 db | 30-12,000 | High | | 17.90 |
| 335H | Dynamic | -56 db | 50-12,000 | High | TV Grey Body, Chrome Cap and Grille | 26.50 |
| 335L | Dynamic | -57 db | 50-12,000 | Low | | 23.50 |

NOTE: Model 331 has momentary-an, spring-return switch, is furnished with hang-up bracket. Cable pravides for audio and relay connections. All other models have slide switch with "lock-on" position, are complete with lavalier and stand adaptor with 5/8"-27 thread.

GO BY BRAND . .
GO BUY ASTATIC

THE Astatic CORPORATION, CONNEAUT, OHIO

KNOWN THE WORLD OVER

In Canada: Canadian Astatic Limited, Toronto, Ontario

Export Sales: Roburn Agencies, Inc., 431 Greenwich St., N. Y. 13, N. Y., U. S. A.

# DIFILM®


# BLACK BEAUTY®
# CAPACITORS
## BEAT HEAT AND HUMIDITY

New DIFILM Black Beauty Capacitors lead the way in tubulars! The operating temperature range of these new capacitors goes up to 105 C (221 F) *without voltage derating.* Capacitance tolerance is held to ±10%.*

● The new dual dielectric used in DIFILM Capacitors combines the proven long life of paper capacitors with the effective moisture resistance of polyester plastic film capacitors . . . to give you performance that can't be beat.

● Here's the kind of performance you can expect from DIFILM: very high insulation resistance, low power factor, moderate capacitance change with temperature, excellent retrace under temperature cycling, and superior long-term stability . . . *all at regular prices!*

● This high performance is fully protected by HCX®, an exclusive Sprague hydrocarbon material which impregnates the windings, filling all voids and pinholes before it polymerizes. The result is a solid rock-hard capacitor section. These capacitors are further protected by an outer molding of humidity-resistant, non-flammable phenolic.

*For complete technical information on DIFILM Black Beauty Capacitors, write for Bulletin M-759 to Sprague Products Company, 51 Marshall St., North Adams, Mass.*

*From .001 μF up

**The major capacitor improvements come from**

**SPRAGUE®**
*world's largest capacitor manufacturer*

**SPRAGUE RESEARCH IS CONSTANTLY PRODUCING NEW AND BETTER CAPACITORS FOR YOU**

# In STEREO and Mono Hi-Fi . . . the experts say your best buy is EICO®

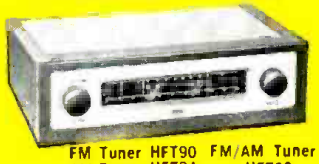
**"The overall design of the HF-81 is conservative, honest and functional. It is a good value considered purely on its own merits, and a better one when its price is considered as well."**
**— Hirsch-Houck Labs (HIGH FIDELITY Magazine)**

- Advanced engineering • Finest quality components
- "Beginner-Tested," easy step-by-step instructions
- LIFETIME service & calibration guarantee at nominal cost
- IN STOCK — compare, then take home any EICO equipment — right "off the shelf"— from 1500 neighborhood EICO dealers.


**Stereo Amplifier-Preamplifier HF81**

Stereo Preamplifier HF85

70W Stereo Power Amplifier HF87
28W Stereo Power Amplifier HF86



FM Tuner HFT90 FM/AM Tuner HFT92
AM Tuner HFT94

Stereo Integrated Amplifier AF4

12W Mono Integrated Amplifier HF12
Other Mono Integrated Amplifiers:
50, 30, & 20W (use 2 for stereo)

2-Way Bookshelf Speaker System HFS1
3-Way Speaker System HFS3
2-Way Speaker System HFS5

Over 1 MILLION EICO instruments in use throughout the world.

Add 5% in the West.

**HF81 Stereo Amplifier-Preamplifier** selects, amplifies, controls any stereo source & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Provides 28W monophonically. Ganged level controls, separate balance control, independent bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers. **"Excellent"** — SATURDAY REVIEW; HI-FI MUSIC AT HOME. **"Outstanding quality . . . extremely versatile."**—ELECTRONICS WORLD LAB-TESTED. **Kit $69.95. Wired $109.95.** Includes cover.

**HF85 Stereo Preamplifier** is a complete, master stereo preamplifier-control unit, self-powered for flexibility & to avoid power-supply problems. Distortion borders on unmeasurable even at high output levels. Level, bass, & treble controls independent for each channel or ganged for both channels. Inputs for phono, tape head, mike, AM, FM, & FM-multiplex. One each auxiliary A & B input in each channel. Switched-in loudness compensator. **"Extreme flexibility . . . a bargain."**— HI-FI REVIEW. **Kit $39.95. Wired $64.95.** Includes cover.

**New HF87 70-Watt Stereo Power Amplifier:** Dual 35W power amplifiers of the highest quality. Uses top-quality output transformers for undistorted response across the entire audio range at full power to provide utmost clarity on full orchestra & organ. IM distortion 1% at 70W, harmonic distortion less than 1% from 20 to 20,000 cps within 1 db of 70W. Ultra-linear connected EL34 output stages & surgistor-protected silicon diode rectifier power supply. Selector switch chooses mono or stereo service; 4, 8, 16, and 32 ohm speaker taps, input level controls; basic sensitivity 0.38 volts. Without exaggeration, one of the very finest stereo amplifiers available regardless of price. Use with self-powered stereo preamplifier-control unit (HF85 recommended). **Kit $74.95. Wired $114.95.**

**HF86 28W Stereo Power Amplifier Kit $43.95. Wired $74.95.**

**FM Tuner HFT90:** Prewired, prealigned, temperature-compensated "front end" is drift-free. Prewired exclusive precision eye-tronic® traveling tuning indicator. Sensitivity: 1.5 uv for 20 db quieting; 2.5 uv for 30 db quieting, full limiting from 25 uv. IF bandwidth 260 kc at 6 db points. Both cathode follower & FM-multiplex stereo outputs, prevent obsolescence. Very low distortion. **"One of the best buys in high fidelity kits."** — AUDIOCRAFT. **Kit $39.95*. Wired $65.95*.** Cover $3.95. *Less cover, F.E.T. Incl.

**New AM Tuner HFT94.** Matches HFT90. Selects "hi-fi" wide (20c — 9kc @ —3 db) or weak-station narrow (20c — 5kc @ —3 db) bandpass. Tuned RF stage for high selectivity & sensitivity; precision eye-tronic® tuning. **Kit $39.95. Wired $65.95** Incl. Cover & F.E.T.

**New FM/AM Tuner HFT92** combines the renowned EICO HFT90 FM Tuner with excellent AM tuning facilities. **K t $59.95. Wired $94.95.** Includes cover & F.E.T.

**New AF-4 Stereo Amplifier** provides clean 4W per channel or 8W total output. Inputs for ceramic/crystal stereo pick-ups, AM-FM stereo, FM-multi stereo. 6-position stereo/mono selector. Clutch-concentric level & tone controls. Use with a pair of HFS-5 Speaker Systems for good quality, low-cost stereo. **Kit $38.95. Wired $64.55.**

**HF12 Mono Integrated Amplifier** provides complete "front-end" facilities and true high fidelity performance. Inputs for phono, tape head, TV, tuner and crystal/ceramic cartridge. Preferred variable crossover, feedback type tone control circuit. Highly stable Williamson-type power amplifier circuit. Power output: 12W continuous, 25W peak. **Kit $34.95. Wired $57.95.** Includes cover.

**New HFS3 3-Way Speaker System Semi-Kit** complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofer (22 cps res.), 8" mid-range speaker with high internal damping cone for smooth response, 3½" cone tweeter. 2¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 32-14,000 cps clean, useful response. 16 ohms impedance. HWD: 26½", 13⅞",14⅜". Unfinished birch **$72.50.** Walnut, mahogany or teak **$87.50.**

**New HFS5 2-Way Speaker System Semi-Kit** complete with factory-built ¾" veneered plywood (4 sides) cabinet. Bellows-suspension, ⅝" excursion, 8" woofer (45 cps res.), & 3½" cone tweeter. 1¼ cu. ft. ducted-port enclosure. System Q of ½ for smoothest frequency & best transient response. 45-14,000 cps clean, useful response. HWD: 24", 12½", 10½". Unfinished birch **$47.50.** Walnut, mahogany or teak **$59.50.**

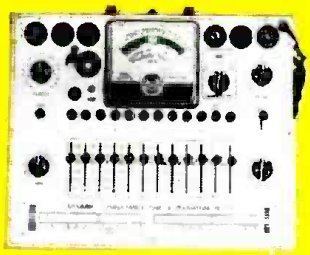
**HFS1 Bookshelf Speaker System** complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. 8 ohms. HWD: 23" x 11" x 9". Price **$39.95.**

**HFS2 Omni-Directional Speaker System** (not illus.) HWD: 36", 15¼", 11½". **"Eminently musical"** — HIGH FIDELITY. **"Fine for stereo"** — MODERN HI-FI. Completely factory-built. Mahogany or walnut **$139.95.** Blond **$144.95.**

**IMPORTANT NOTE:** All EICO kits built according to our instructions, and all EICO factory-assembled equipment, conform to the high standards and specifications as published in EICO literature and advertisements. All EICO factory-assembled equipment is completely and meticulously hand-wired throughout — no printed circuitry; each factory-assembled unit is 100% final-tested throughout for each feature and function — no "spot" or "partial" checking. In EICO's final-test techniques, nothing is left to chance.

**Fill out coupon on next page for FREE CATALOG.**
Ask your dealer about EICO's exclusive STEREO RECORD BONUS

# The specs prove it...your best buy is EICO®



**A**
**DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666**
**KIT $69.95 WIRED $109.95**
Complete with steel cover & handle

**B**
**TV-FM SWEEP GENERATOR AND MARKER #368**
**KIT $69.95 WIRED $119.95**

**C**
**RF SIGNAL GENERATOR #324**
**KIT $26.95 WIRED $39.95**

**D**
**PEAK-TO-PEAK VTVM #232 & UNIPROBE (pat. pend)**
**KIT $29.95**
**WIRED $49.95**

**E**
**COLOR & MONOCHROME DC TO 5 MC LAB & TV 5" OSCILLOSCOPE #460**
**KIT $79.95 WIRED $129.50**
**5" PUSH-PULL Oscilloscope #425:**
**Kit $44.95 Wired $79.95**

**A** Tests all receiving tubes (picture tubes with adapter), n-p-n and p-n-p transistors. Composite indication of Gm, Gp & peak emission. Simultaneous selection of any one of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot.). Sensitive 200 ua meter. 10 six-position lever switches: freepoint connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit. Direct reading of inter-element leakage in ohms. New gear-driven rollchart. **CRA Adapter $4.50.**

**B** Entirely electronic sweep circuit with accurately-biased increductor for excellent linearity. Extremely flat RF output. Exceptional tuning accuracy. Hum and leakage eliminated. 5 fund. sweep ranges: 3-216 mc. Variable marker range: 2-75 mc in 3 fund. bands, 60-225 mc on harmonic band. 4.5 xtal marker osc., xtal supplied. Ext. marker provision. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Narrow range phasing control for accurate alignment.

**C** 150 kc to 435 mc with ONE generator in 6 fund. bands and 1 harmonic band! ±1.5% freq. accuracy. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 v needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine and Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

**D** Uni-Probe — exclusive with EICO — only 1 probe performs all functions: half-turn of probe tip selects DC or AC-Ohms. Calibration without removing from cabinet. Measure directly p-p voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 4½" meter, can't-burn-out circuit. 7 non-skip ranges on every function. Zero center.

**E** Features DC amplifiers! Flat from DC to 4.5 mc, usable to 10 mc. Vert. Sens.: 25 mv/in.; input Z 3 megs; direct-coupled & push-pull throughout. 4-step freq.-compensated attenuator up to 1000:1. Sweep: perfectly linear 10 cps — 100 kc (ext. cap. for range to 1 cps). Pre-set TV V & H positions. Auto sync. lim. & ampl. Direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite screen with dimmer control; plus many more outstanding features.

**FREE CATALOG shows you HOW TO SAVE 50% on 65 models of top quality professional test equipment. MAIL COUPON NOW!**

**New Transistor Portable Radio RA-6**
**Kit $29.95**
**Wired $49.95**
Incl. F.E.T.; less 9V batt. Prealigned RF, IF xfmrs; push-push audio; 6" spkr.

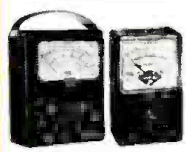
*PAT. PEND.
**NEW Power & Bias Supply for Transistorized Eqpt. #1020**
**Kit $19.95**
**Wired $27.95**

**NEW Tube & CRT Fil. Tester #612**
**Kit $3.95**
**Wired $5.95**
Fast-checks radio/TV tubes, pilot lamps, etc.

Series/Parallel **R-C Combination Box #1140**
**Kit $13.95**
**Wired $19.95**

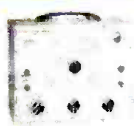
**Tube Tester #625**
**Kit $34.95**
**Wired $49.95**
• tests 600 mil series string type tubes
• illuminated roll-chart
**Pix Tube Test Adapter..... $4.50**

**6V & 12V Battery Eliminator & Charger #1050**
**Kit $29.95**
**Wired $38.95**
Extra-filtered for transistor equipt. **#1060 Kit $38.95**
**Wired $47.95**



**20,000 Ohms/Volt V-O-M #565**
**Kit $24.95**
**Wired $29.95**
**1000 Ohms/Volt V-O-M #536**
**Kit $12.90**
**Wired $14.90**

EICO®
33-00 Northern Blvd. L.I.C. 1, N.Y.
Add 5% in the West. © 1959
TURN PAGE FOR MORE EICO VALUES



**R-C Bridge & R-C-L Comparator #950B**
**Kit $19.95**
**Wired $29.95**
Reads 0.5 ohms-500 megs, 10 mmfd-5000 mfd, power factor

**VTVM Probes**

| | Kit | Wired |
|---|---|---|
| Peak-to-Peak | $4.95 | $6.95 |
| RF | $3.75 | $4.95 |
| High Voltage Probe-1 | | $6.95 |
| High Voltage Probe-2 | | $4.95 |
| **Scope Probes** | | |
| Demodulator | $3.75 | $5.75 |
| Direct | $2.75 | $3.95 |
| Low Capacity | $3.75 | $5.75 |

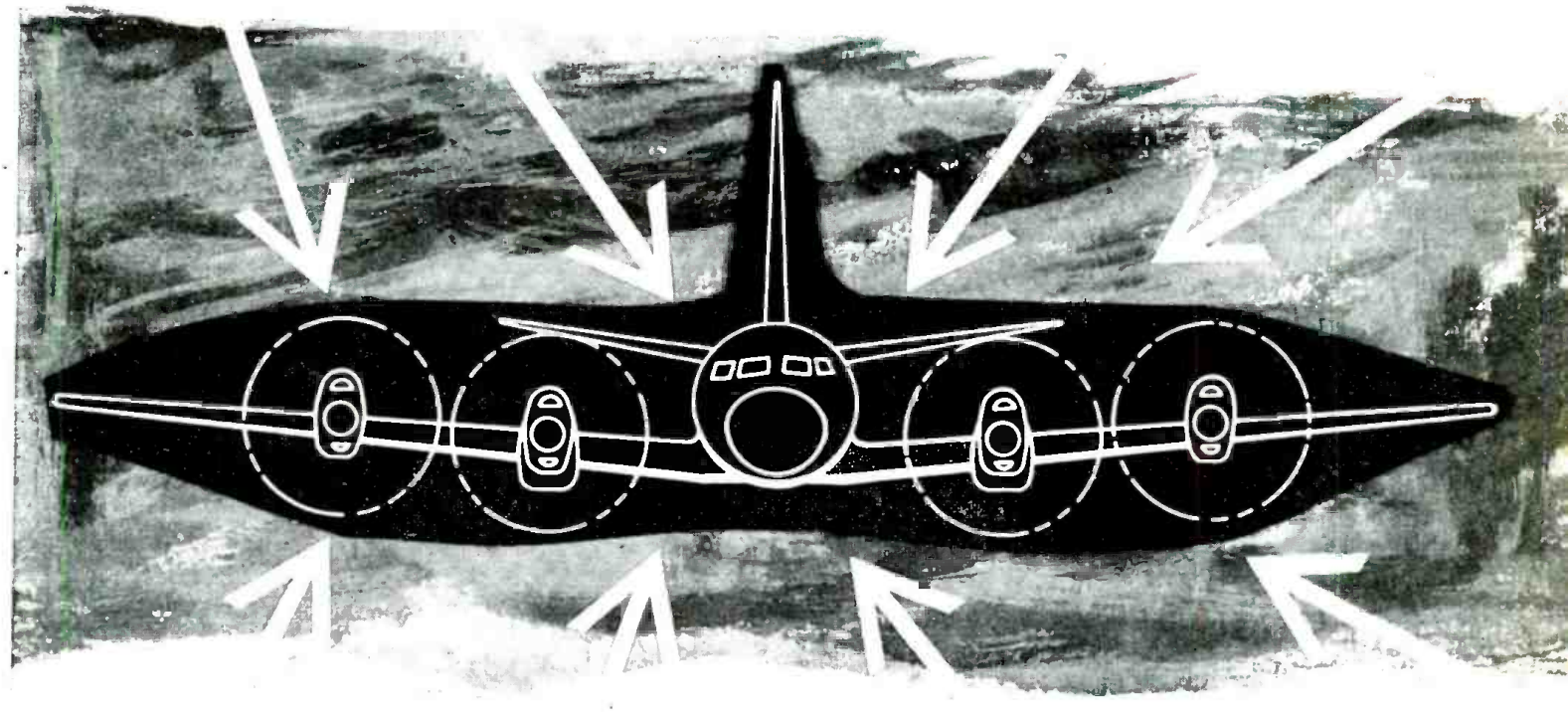
EICO EW-1
33-00 Northern Blvd.
L.I.C. 1, N.Y.

Show me HOW TO SAVE 50% on ☐ Test Instruments ☐ Hi-Fi ☐ Ham Gear. ☐ Send free Stereo Hi-Fi Guide. Send me FREE Catalog, name of neighborhood dealer.

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

SEE OUR OTHER ADVERTISEMENT ON PAGE 106

# Air Traffic Control by ELECTRONICS



By JAMES A. NILAND
Former Assistant to the Administrator, Region 1, Federal Aviation Agency

**With more and faster planes, the control of air traffic must be a precise task with no margin for error. The job is being done by electronics.**

MANY of us have forgotten that less than 20 years ago, air travelers "zipped" through the sky at what was then the fantastic speed of approximately 150 miles-an-hour. Not only the speed, but the altitude of 18,000 to 20,000 feet was sufficient to identify one as a seasoned air traveler.

In the short span of the past two decades, aviation has literally leaped from the two-engine aircraft to the four-engine jets flying five to six miles above the earth's surface at better than 500 miles-an-hour.

And while the speed of aircraft has increased, so has the number of aircraft flying the airways criss-crossing the United States. In 1939 there were approximately 29,000 licensed aircraft; there were upwards of 110,000 licensed to fly in 1959. Approximate figures in the various categories are: military 42,000, air carrier 2000, and general aviation over 65,000. The latter category includes all aircraft either privately or corporately owned. In short, it accounts for all aircraft except military and airline aircraft.

More and faster airplanes have posed a gigantic problem in air traffic control. It's not as simple as red and green lights on railroads or highways. There are no "caution lights" on the airways. It's a precise task with no margin for error, and the job is being accomplished by electronics.

The essential tools of air traffic control are radio and radar. Radio was first, and then radar became the second tool of the air traffic controller after World War II.

## Air Route Traffic Control Centers

Control of aircraft is under two basic sets of rules: IFR (instrument flight rules) and VFR (visual flight rules). Under IFR control, the aircraft is guided by an Air Route Traffic Control Center (ARTC). This guidance assures the pilot that his aircraft is being monitored along its entire course. An aircraft flying VFR is operating on a "see and be seen" basis.

Airways, like highways on the ground, are the core of the air traffic control system. Just as a motorist follows a numbered highway, the pilot follows a numbered airway between terminal points. The numbered airways are just as exact as to turns and direction as are the highways on a road map.

Unlike the driver who selects his numbered route from a gas station road map, the aircraft pilot files a flight plan with an ARTC maintained by the Federal Aviation Agency. There are 31 such control centers (see Fig. 1) in the U. S. linked together by leased telephone lines.

Air Traffic Control Centers differ from airport control towers. Centers direct traffic between terminal areas; control towers guide air traffic in a radius of approxi-

View taken from inside an airport traffic control tower. The tower controls air traffic within about 20 miles of airport.


A New York area traffic controller keeping track of aircraft movements by noting flight location on flight progress strip.

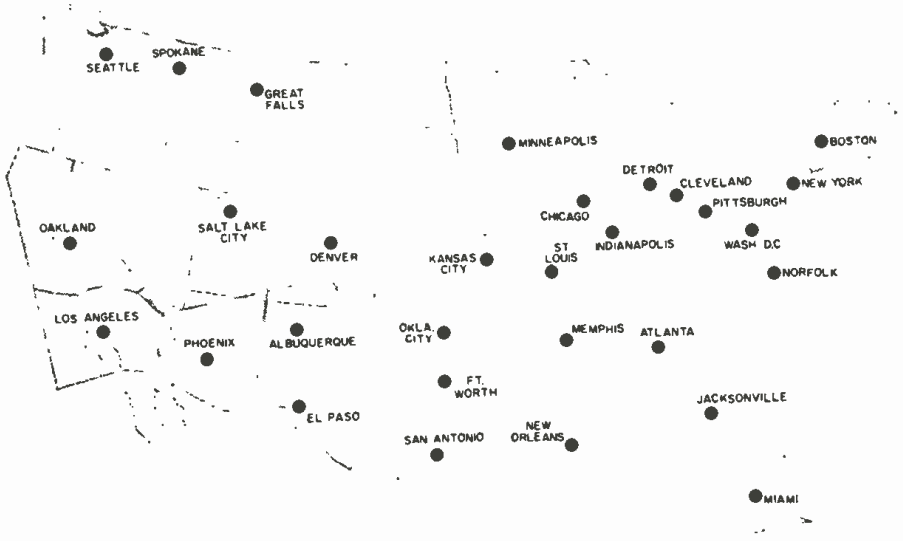



Fig. 1. The FAA air route traffic control center areas are shown above.

mately twenty miles of the airport.

An ARTC is a facet of air travel not known to most plane passengers. Unlike the airport control tower visible to all, the FAA ARTC is usually some distance from the ramps and runways. At New York's International (Idlewild) Airport, it is housed in Hangar 11 about two miles distant from the passenger terminal and control tower. Although designated as a "hangar," it is actually a three-story building with more than half its area given over to air traffic control and electronic equipment.

The New York ARTC guides IFR air traffic between Salisbury, Maryland and Montauk Point on the eastern tip of Long Island. Inland its area of control extends west to Phillipsburg, Pennsylvania and northwest to Elmira, New York. To the east the ocean control section guides traffic over the Atlantic Ocean in an area bounded by Nova Scotia, the Azores, and Bermuda.

All IFR traffic landing or departing from Idlewild, La Guardia, and Newark airports clears through the New York ARTC. To accomplish this seven-day-a-week, around-the-clock job, more than 500 people are employed, working in three eight-hour shifts.

## Communication

Communication is, of course, the heart of air traffic control. New York's air traffic controllers have at their disposal air-to-ground and ground-to-air radiotelephone circuits for communication with aircraft, leased telephone land-lines for communication with other Air Traffic Control Centers, and remote communication stations along the airways. Land-line teletypewriters provide flight-plan information and weather reports.

The direct radiotelephone communication between pilots and air route traffic controllers is accomplished by means of 45 separate channels of individual frequencies, both u.h.f. and v.h.f. For ocean control there are two high-frequency channels. The ocean control transmitter is located at Sayville, Long Island, the receiver at Barnegat, New Jersey, and both are connected to the New York Center by radio relay.

Within the Center there are 260 miles of wiring involved in the interconnection and interlocking of switching controls, microphone connections, earphones, and speakers. Added to this are 1700 miles of land-line circuits linking remote transmitters and receivers. The Center has 115 leased telephone circuits.

## The Flight Plan

In New York, as in all other Air Traffic Control Centers, the pilot files an instrument flight plan at least one hour before departure. The plan indicates his departure time, destination, requested altitude, and airway. This is almost like planning a cross-country trip by motor car. First you decide the time you start, and you have your numbered highway route marked in advance. The big addition, of course, is altitude.

From departure to destination, the aircraft flying an IFR flight plan is under positive control. An aircraft flying from New York to Cleveland is controlled by the New York Center until it passes Phillipsburg, Pennsylvania, where it is turned over to the FAA Air Traffic Control at Cleveland. Before the plane departed from New York, the

Controllers check computer-prepared flight data and weather findings in the computer room of FAA's New York area Traffic Control Center at International Airport.

Cleveland Center was advised of its flight plan and had reserved the requested altitude and airway for the aircraft when it was scheduled to enter the Cleveland control area. This fundamental principle is carried on in nonstop transcontinental flights, or anywhere within the U. S. and its territories.

## VOR and ILS

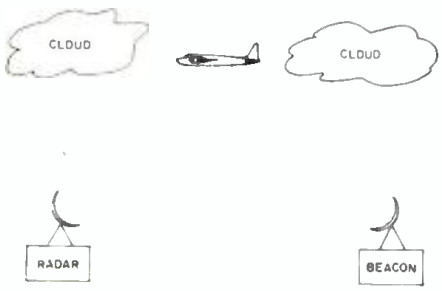
There was a time many years ago when aircraft on cross-country flights were guided in the daylight by arrows painted on roofs of barns, and at night by rotating beacons on mountain tops. Although there are a few beacons still in operation and some air-minded citizens still paint arrows on their rooftops pointing to the nearest airport, navigation of aircraft from the ground both night and day is now being accomplished by electronics.

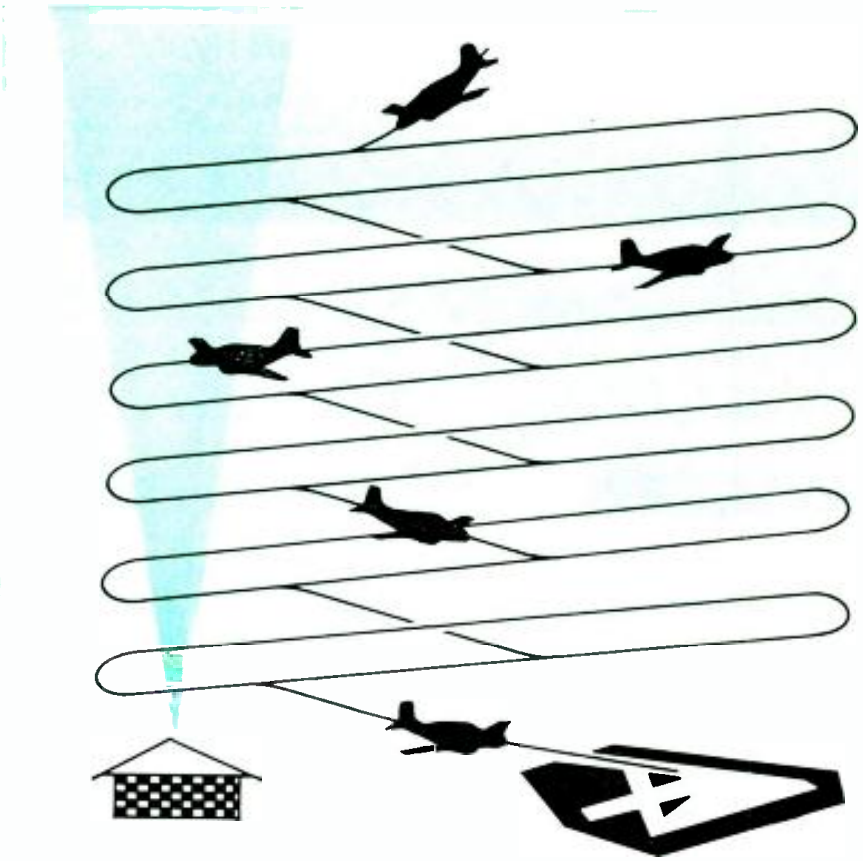
Spaced approximately every hundred miles along the airways are v.h.f. omnirange (VOR) stations. Wherever located, they are an object of curiosity. Their location, dependent on the straight-line airway, might place them in a remote mountain spot, the edge of a town, or near an airport. They are painted in a red and white checkerboard style and have an unusual appearance.

The system is an all-directional range station, giving bearings for the entire 360 degrees around the compass.

Air route surveillance radar (ARSR) antenna.

Fig. 2. Radar signal (left) reflects from clouds, buildings as well as from plane to produce scope clutter. Beacon (right) transmits interrogating signal which triggers plane's transponder into transmitting strong answering signal on different frequency. Beacon receiver does not pick up reflected signals, hence clouds, buildings will not produce any indication on the beacon scope.



This is a stack. Depending on the amount of traffic, an airport may have one or many stacks. Stacks are used in bad weather when planes cannot land as frequently as in good weather. They are also used in good weather when heavy traffic prevents a plane from landing immediately. Stacks, resembling race track patterns, are permanently established near an electronic "fix," which may be a VOR, a low-frequency range station, or a homing beacon. Each leg is designated as either one or two minutes before turn at the standard rate of five degrees per second. In the New York area most holding patterns are one minute per leg because of the heavy traffic.

Stacks are "built" from the bottom up by the Air Route Traffic Control Center. The New York Air Route Traffic Center, in building its various stacks (some twenty-five in all), coordinates its work with the control towers at Idlewild, LaGuardia and Newark airports. In essence, the center builds the stack and the tower unloads it.

Stacks are built at thousand-foot levels starting from 3000 feet and ranging up to 10,000 feet altitude. Jets with their high rate of fuel consumption prefer to be held at higher altitudes, which are most economical for fuel consumption. Jets are usually given expeditious handling when placed in a holding pattern.

Traffic controllers at display scopes of airport surveillance radar (ASR) equipment.

VOR transmitter building located at New York's International Airport (Idlewild).

The VOR sends out static-free radio signals for the guidance of pilots, transmitted on frequencies between 112 and 118 mc.

Each VOR transmits repeated identification signals either in code or recorded voice. These signals enable the pilot to establish his course along an airway. From time to time the identification signals go off the air in order to broadcast weather reports. The weather reports are broadcast 15 and 45 minutes after the hour. Within the last few years this weather data was made public. As a result, farmers, operators of small marine craft, and trucking concerns have been tuning to their nearby VOR for weather reports.

The Instrument Landing System (ILS) now in use at most airports has been an electronic boon to air travelers and airlines. Although not specifically identified as a safety measure, the ILS System has enabled airlines to make scheduled landings under adverse weather conditions.

The system consists of two radio transmitters at an airport sending out radio beams to guide the aircraft on its instrument approach and landing. One beam, called the localizer, tells the pilot whether he is to the right or left of the centerline of the runway. The other beam, the glide slope, shows him the correct angle of descent. This information is displayed in the cockpit of the aircraft by two needles on a single meter face, one vertical, the other horizontal. The vertical needle moving right to left indicates the plane's position in relation to the centerline of the runway. The horizontal needle tilting up or down indicates the position of the aircraft on the glide slope, either low or high. With both needles crossed at right angles, the aircraft is on course and making an accurate landing, even though the pilot may not be able to see the tips of his own plane's wings.

### Computers in Control Centers

The final decisions in air traffic control are made by the air traffic controllers in the control centers and airport towers. Their responsibility is heavy. The present and future tools of the air traffic controller are electronic instruments. The Federal Aviation Agency, which is responsible for the nation's air traffic control system, has pointed out that modernization of the airways involves "increased installations of radar and other electronic equipment."

The FAA has installed in the past six months "Univac" File-Computers in its air traffic control centers in New York, Washington, Boston, Pittsburgh, and Cleveland. The computers will not replace the air traffic controllers but will relieve them of their "bookkeeping chores," and lessen fatigue.

The computer performs the necessary calculations of an aircraft's passage along the airways. Instead of the air traffic controller computing speed of the aircraft and estimating time of arrival over various check points, the electronic computer does it for him. All

(*Continued on page* 152)

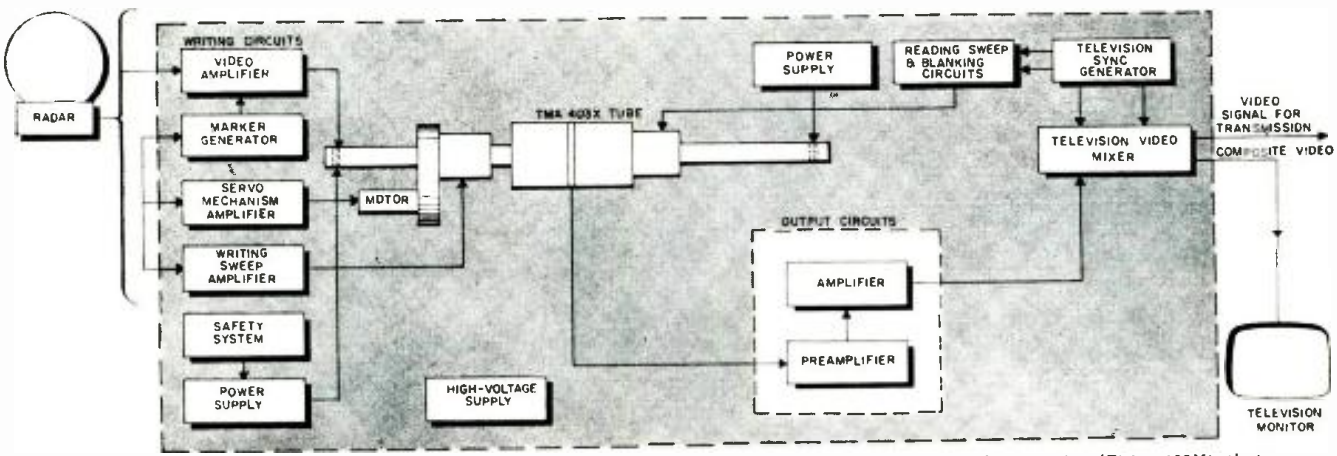



Fig. 3. Functional block diagram of the scan conversion system. Heart of unit is special cathode-ray tube (TMA 403X) that writes radar information on internal target grid with one electron beam and reads TV information with another electron beam.

## COVER STORY

ELECTRONICS WORLD
formerly RADIO & TV NEWS

SYMBOLIC of the Jet Age, our cover shows a portion of one of American Airlines' new 707 Jet Flagships along with the new Newark (N.J.) Airport control tower. The $5-million jet plane is crammed full of electronic gear, not only for communications and radar, but also for air-conditioning control, automatic pilots, fuel-injection control, and many other special uses. It has been estimated that the total cost of all the electronic equipment in the 707 is $500,000.

The nose cone has been raised in order to show the antenna of the weather surveillance radar. This equipment has proved to be so valuable that the FAA has recently proposed a new safety regulation calling for the installation of this type of gear on all airliners. The particular radar installed in the plane on our cover is an RCA AVQ-10, operating in the 5-cm. band. The radar has a maximum range of 150 miles. The antenna rotates through 360 degrees, although the radar beam is cut off toward the rear by the plane's fuselage. The normal coverage angle is therefore from wingtip to wingtip, or about 210 degrees. The antenna can also be tilted downward or upward for better coverage. The nose cone is made of special material that is transparent to the radar beam.

The Newark control tower, recently built by the Port of New York Authority at a cost of $1¾-million, is one of the most modern and well-equipped structures of its type. Although Newark does not handle jet flights, except in an emergency, this tower is symbolic of the importance of electronics in air traffic control. About $1-million of electronic equipment is installed here, including 29 transmitters, 22 receivers, direction finding, and air surveillance radar gear. In addition, the tower controls two instrument-landing systems, one omni-radio range, distance measuring equipment, and a telecommunication network. To maintain and operate this complex network, the FAA has staffed the tower with 16 highly skilled electronic specialists and 58 air traffic controllers. —30—

(Tower photo by Bob Loeb; plane photo courtesy American Airlines.)

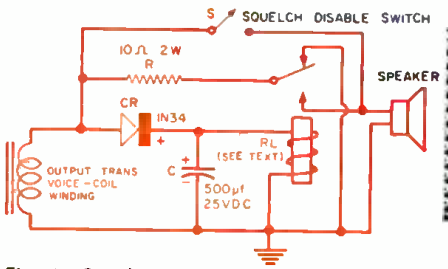



Fig. 1. Simple circuit modification used.


The added squelch-disable switch is a rotary type mounted on the front panel.

# A "Rush Suppressor" for Citizens Radio

By **JAMES D. GREEN**
Chief Engineer, WELO

**A simple modification that will provide a noise squelch for all receivers, including even the superregenerative.**

HAVE you ever listened to a superregenerative receiver for a fairly long time and wished you had a "rush suppressor" or some such gadget? This problem has long since passed with the advent of the more modern superhet receiver, or has it? With the opening of the new Citizens Band service, the superregen is again becoming popular and, for some, a headache. Oh, if we could only quiet that infernal noise!

We recently purchased two of the new *Heathkit* Citizens Band transceivers for communicating with one of our engineers living in a rural area devoid of telephone facilities. This transceiver, like many others on the market, has a superregen receiver and, consequently, no squelch. After the units were assembled, the author began an immediate search for some means of quieting these "rush boxes." We planned to keep them in operation (standby) at least eighteen hours a day and the noise simply could not be tolerated.

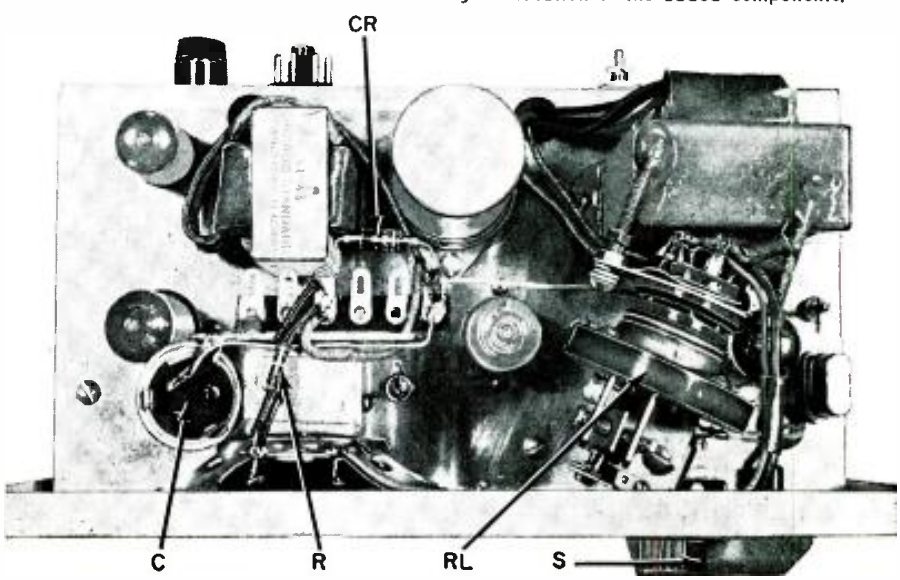
Like most superregens the first audio tube has quite a bit of quench signal on its elements (even with filtering). This eliminated the first audio tube as a point for obtaining control voltage for any type of squelch circuit. Besides, using the noise quieting property of a signal to operate a squelch circuit would involve the use of more tubes. It was decided that any squelch for the superregen should be in keeping with the circuit itself—simple, cheap, and relatively foolproof.

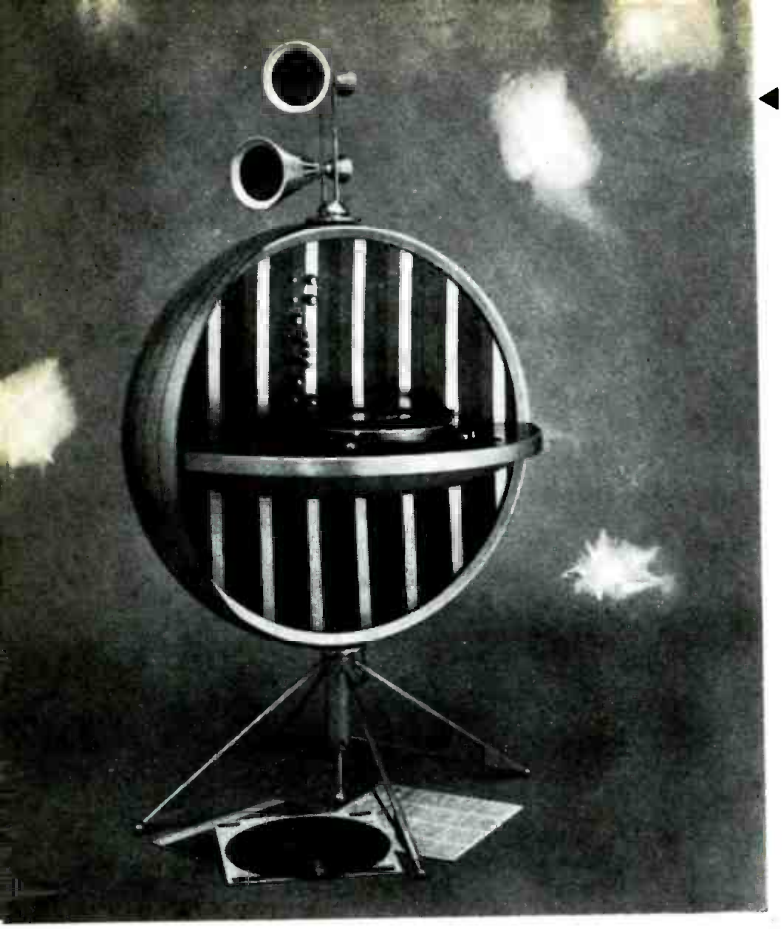
After some deliberation the simple circuit of Fig. 1 was devised. The circuit utilizes the voice-control principle for operation. It was found that any voice signal of comfortable listening level will have stronger audio peaks during modulation than the residual rush-level heard in the receiver. By picking off the audio from the voice-coil winding of the output transformer and rectifying it, we now have a d.c. control voltage that can be used to operate a sensitive relay. The audio present on the voice-coil winding of the output transformer, along with the resultant d.c., is indirectly controlled by the normal volume control on the receiver. By setting the volume control with no signal (normal set rush-level only) just to the point that the relay releases, the speaker is cut off. Ah, dead silence at last!

When a carrier is picked up by the receiver, the d.c. across the relay actually drops and, of course, nothing happens since we have already set the relay to the release point. When the carrier is modulated things change abruptly. The peak audio on the voice winding is greater than the normal

(*Continued on page* 140)

Top-chassis view of the transceiver showing the location of the added components.





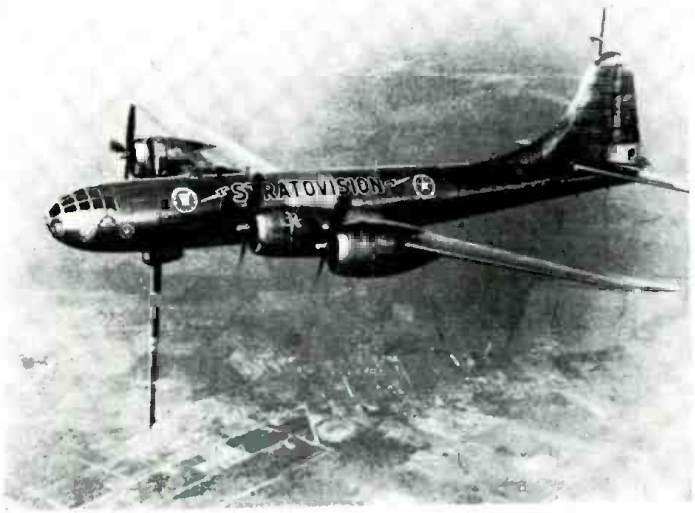
### Aluminum Music Sphere

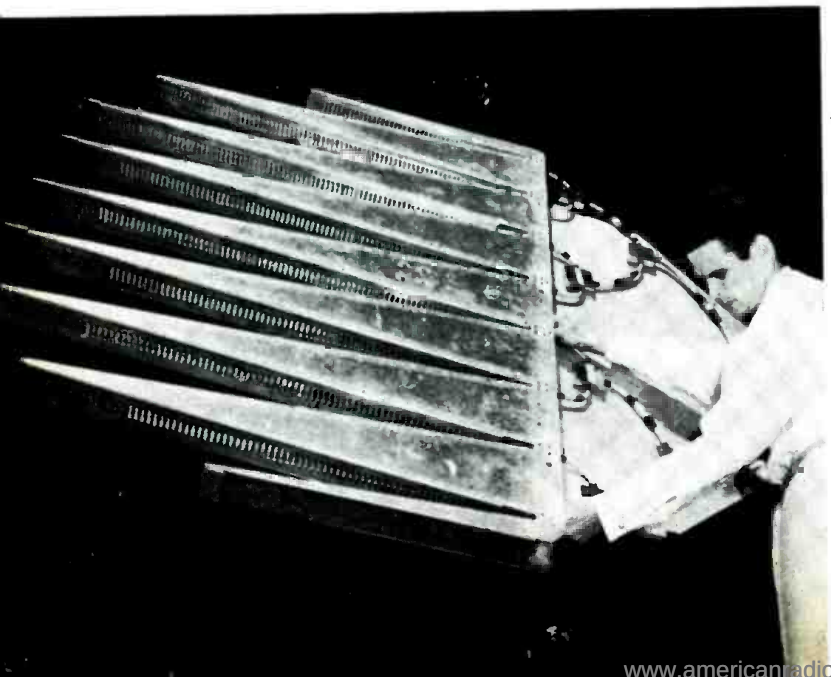
From the world of tomorrow comes this "Forecast Music Sphere," created by Lester Beall for the *Aluminum Co. of America*. The novel enclosure houses a stereo music system with extending satellite speakers which telescope into the aluminum body shell. The front hemisphere is opened to reveal turntable and amplifier controls. The prototype design represents a design concept. It is not on the market, and there are no immediate plans to place it in production.

### Stratovision Goes Educational

Pictured is the experimental *Westinghouse* Stratovision station which first demonstrated the feasibility of airborne telecasting—a technique that will be utilized by the Midwest Council on Airborne Television Instruction to make available instructional television programs over a six-state area. Programs will be transmitted from ground-based facilities at Purdue University in Lafayette, Ind. to the circling four-engine aircraft some distance away. Retelecast will take place from the plane to schools and colleges which choose to participate in the project. Estimated coverage will be a circle 300-400 miles in diameter, reaching from Milwaukee and Detroit to Cincinnati and Louisville.

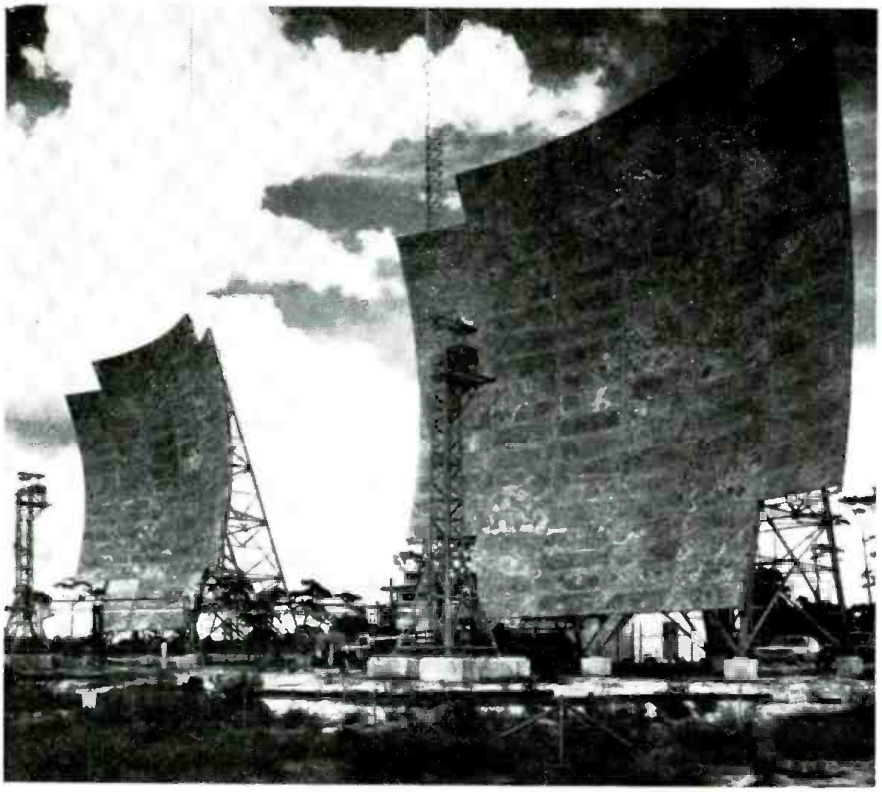
# Recent Developments in Electronics



### Retarded Surface Wave Antenna

A retarded surface wave antenna with high gain and low silhouette has been developed by *Chance Vought Electronics Division* for use in airborne early warning radar as well as ground based and shipboard radar. Initial tests showed such good performance characteristics that the company devoted additional efforts to perfecting the design. Most airborne radar antennas are so large in diameter and thickness that they present aerodynamic and weight problems for the aircraft designer. A 33-foot retarded surface wave antenna would be only 1½ feet in thickness and weigh 2400 pounds, compared to 8 feet and 5030 pounds for a parabola-type antenna. At the same time the new antenna would equal or exceed a conventional antenna in electrical performance. The design is adaptable to various sizes and configurations.



### ◀Twin Tropo Scatter Antennas

A pair of 60-foot tropospheric scatter antennas, specially mounted at opposite ends of a 180-mile long section of the Gulf of Mexico, form a vital link in a new communications network built for the U. S. Air Force's Eglin Gulf Test Range. Built at a cost of $6-million, the entire 565-mile long network is being used for high-speed transmission of timing, telemetering, radar data, and voice signal information along the missile range. The antennas were built by *Blaw-Knox Co.* and erected by *Philco Corp.*

### Boxcar-shaped Radar Antenna

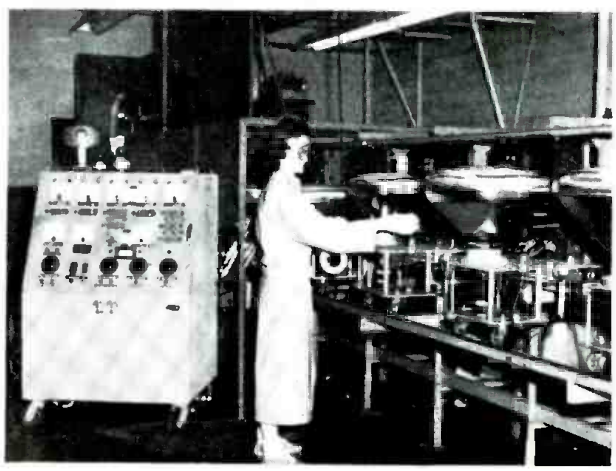
A rotating 50-ton radar antenna, 104 feet long, will warn against enemy air attack when it joins the nation's SAGE defense network in the near future. Developed for the Air Force by *Raytheon Co.* under a $20-million engineering program, the super sentry will detect invaders hundreds of miles away to give early warning.

▼

▲

### Ticker-Tape TV

At the modern new offices of *Goodbody & Co.*, New York City, a network of strategically located closed-circuit TV receivers flashes pictures of stock ticker tapes to customers, partners, and employees in all executive and sales areas. The TV equipment, designed by *General Precision Laboratory Inc.*, enables the firm to provide faster and more efficient service for clients.



### Automatic Testing of TV Picture Tubes ▶

Latest innovation in the manufacture of black-and-white television picture tubes is a new automatic testing machine which has been installed at the *RCA Electron Tube Division's* plant in Marion, Ind. This precision instrument performs 26 different tests on the tubes at a rate of 600 per hour.

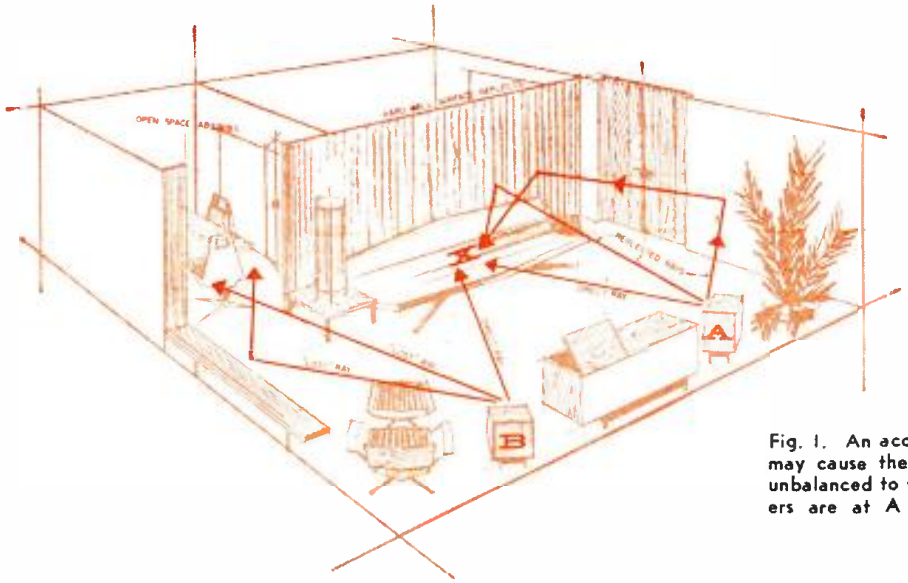



Fig. 1. An acoustically unbalanced room may cause the speaker system to sound unbalanced to the listener. Stereo speakers are at A and B, listener is at X.

# Room Acoustics for Stereo

## PART 1 BASIC PRINCIPLES

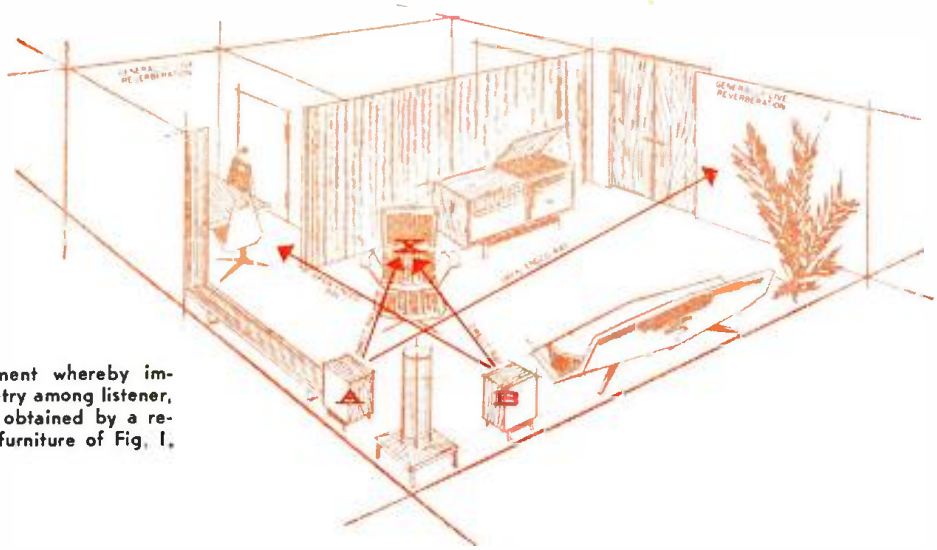



Fig. 2. An arrangement whereby improved acoustic symmetry among listener, speakers, and room is obtained by a rearrangement of room furniture of Fig. 1.

By **ABRAHAM B. COHEN** / Advanced Acoustics Corp.

**There is an intimate relation between the stereo speaker system and the listening room. Here are the general principles to be followed for best results.**

GOOD sound reproduction requires controlled acoustics in the listening room. For stereo listening, the room acoustic problem becomes even more critical because the reverberant room conditions and reflective wall surfaces may either greatly enhance the stereo effect or completely destroy it.

In achieving optimum stereo effect, there is an intimate relationship between the type of stereo speaker system used and the acoustic conditions of the room. Because of the many different types of speaker systems and the innumerable types of listening rooms, a simplified approach to the speaker-room combination will be covered. This approach may then be extended to diverse types of loudspeaker systems.

Proper speaker placement for high-fidelity stereo reproduction is considerably more complex than for high-fidelity monophonic program material. In single-channel reproduction we have but one problem as far as the loudspeaker is concerned, *i.e.*, at which spot in the room will the loudspeaker perform best? With stereo we have a compound problem which involves: (*a*) how far apart shall the speakers be? and (*b*) how shall they be angled toward the listening area? This leads to the next point (*c*) which involves the best place to sit, stand, or recline to get the best stereo effect. Unfortunately, many articles in the stereo literature treat only lightly one additional factor that influences all of these considerations. This factor is the effect of the acoustical condition of the room in which the "stereorama" is displayed.

### Psycho-Acoustic Enlargement

The conditions which characterize a good listening room, whether for monophonic or stereo service, involve two simple factors. The first is that the room be reverberant to the proper degree to give the reproduced sound "liveness." The room should not be too reverberant for then the reproduced sound would appear too cavernous, hollow, and indistinct. Nor should the room be overstuffed for then it would

sound dead and somber. To a considerable degree, stereo systems themselves produce a psycho-acoustical revision of the absolute acoustic properties of the listening room. This, in effect, may make a room seem larger than it really is simply because of the apparent discrete localization of different sections of a large orchestra to separated areas within the room. The very essence of stereo sound reproduction thus "pushes" the walls of the room apart. Our minds automatically tend to convert this "spread out" reproduced orchestra into a "stage" for the orchestra.

Such psycho-acoustic enlargement, when listening to monophonic, or single-channel, program material radiated from one central speaker opening, would be virtually impossible. Some efforts are made to produce artificial enlargement of monochannel recordings at the recording studio by the judicious injection of controlled amounts of reverberation. There have been many "pop" selections recorded with this artificial reverberation added —but in many instances so poorly done that the music and singer are all but lost in the muddled "barrel of sound."

Thus, in monochannel reproduction, size of the room in "undirectional," that is, controlled in a "reverberation direction" but only by the reverberation inserted at the source. This is in contrast to stereo recording where spaciousness is not only injected at the source but is, moreover, under the control of the listener with respect to placement of the speakers and their acoustical environment.

The fact that there has been a fad for injecting reverberation into monophonic recordings, even though overdone, is indicative of the feeling that "spaciousness" does add psychological "depth" to our listening area. There are even electrical reverberation devices, intended for home use, which are designed to "liven up" (psycho-acoustically) the monochannel reproduction. In the case of monophonic reproduction, however, where the original source of the reproduced sound is a single cabinet, it is more difficult to get a wide-stage psycho-acoustic effect without resorting to these highly accentuated effects incorporated in the original selection. It would be considerably better to make the recording under natural reverberation conditions and let the acoustic enlargement be obtained by means of the listening room environment. This, however, is a rather utopian ideal. Pehaps someday the standard living room will come with adjustable sound-conditioning facilities similar to the air-conditioning systems now in widespread use.

In the early days of stereophony, it was frequently noted that, when a switch was made from monophonic to stereophonic playback, to get the same "loudness" effect, the total gain of the amplifiers had to be reduced. Perhaps these were the first straws in the (acoustic) wind that tended to show that with monophonic reproduction the ear needed more re-enforcement from its surroundings to get the same loudness effect as for the stereo reproduction. From this we may possibly conclude that a "live-r" reverberation condition is desirable for monophonic reproduction than for stereo reproduction. This leads us to the thought that it would be desirable not only to be able to correct our listening rooms in general so as to present the proper acoustic environment but to make this acoustic adjustment variable to accommodate changing conditions of playback methods, types of programs, or number of people in the room.

Stereo has the latent power to really put us in the concert hall, spatially, without monophonically overdone artificial effects if the speaker system is properly balanced in performance and is judiciously installed in a manner consistent with *good concert hall practice.* This means that we must look to our living room for the last link in the "realism" chain, with the aim of bringing it as close to good musical acoustic practice as possible.

## Reverberation Adjustment

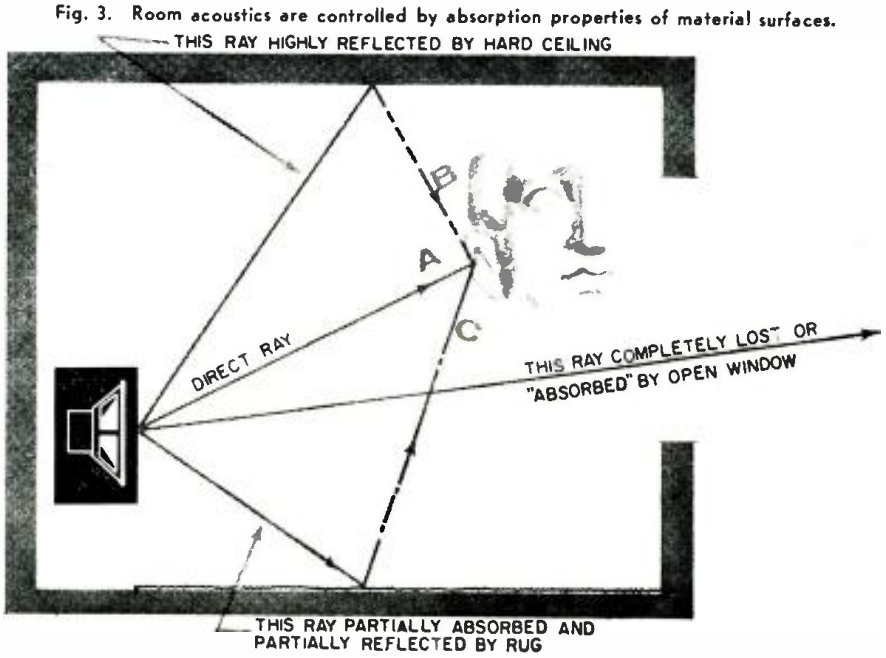
In bringing the concert hall into the stereo room there is nothing we can do about the actual physical dimensions — in terms of feet and inches—of the listening room to approximate the concert hall. However, there is much we can do to change the psycho-acoustic dimensions of the room through adjusting its reverberation characteristics to a satisfactory "concert hall" level. Once this has been done, we can place the speakers so that they function best with the adjusted room conditions to heighten the illusion of expanded acoustic space.

The general principles of room acoustics are easily grasped. We sound very stentorian and robust when we sing in the bathroom because the hard, smooth surfaces bounce the sound around and around with little absorption so that the sound seems to persist loud (but not necessarily clear) as we continue to bellow to our heart's content. On the other hand, if we were enmeshed deep in a well-stocked clothes closet, we could shout until we turned blue with exertion and would still sound weak and feeble. The hard reflective surfaces of the bathroom make the room "live." The soft, absorbent "stuffing" of the clothes closet makes the closet "dead." In between these acoustical extremes lies an acceptable mean for good concert hall— or for that matter—listening room liveness. Our acoustic goal is to achieve a room condition which is live enough to give fullness and body to all the musical resonances yet not so live that recurrent echoes will blur the original rich sound. There have been many determinations as to the optimum degree of liveness for the concert hall, and these same principles may be readily applied to your own stereo listening area. However, before we illustrate the application of "acoustic room conditioning," with emphasis on stereo speaker placement, it would be helpful to examine the reverberation units with which we will be concerned.

## Room Interior Surfaces

If a room is "live," its boundary surfaces are very reflective. If it is "dead," they are highly absorptive. The common factor is, then, absorption. The great body of research that has laid the foundation for dealing with this factor of absorption (and reverberation) was done by Sabine. He proposed that the very logical, and very understandable, unit of absorption be, literally, an open window. Obviously, if sound is generated in a room and some of that sound reaches an open window, that portion of the sound that falls on the open window will leave the room entirely, as shown in Fig. 3. As far as the interior of the room is concerned, the open window completely "ab-

Fig. 3. Room acoustics are controlled by absorption properties of material surfaces.



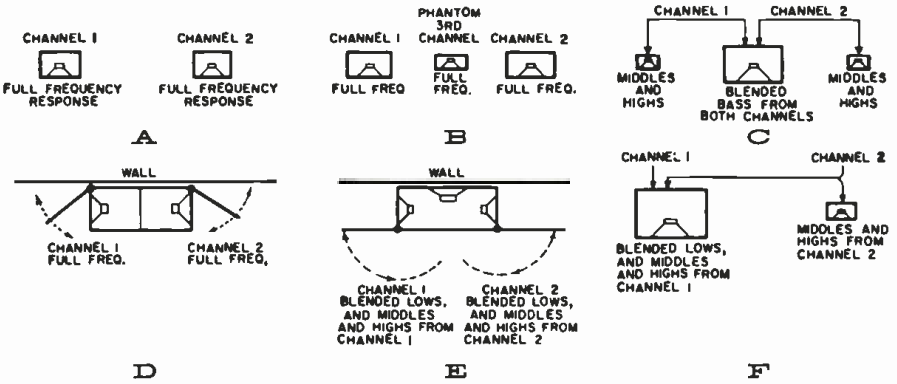



Fig. 4. There are many stereo speaker systems in use today as is shown above.

sorbed" the sound that hit it—for none of that sound found its way back into the room. A square foot of open space in a wall thus becomes an "absorption unit."

Nothing, but nothing, can quite equal the absorption of a hole in a wall looking out into the world. Whatever the material may be, if it is physical, if it can be weighed, calipered, touched—it *will absorb some sound, reflect some sound, and transmit some sound.* Substantive materials thus have individualistic absorption characteristics defined by their "absorption coefficient" in relation to "open space," Whatever the material being considered, its absorption is always less than "open space," a square foot of which is considered to have "unit absorption." Thus, the absorption coefficient of any material is always less than 1.

Referring to Fig. 3, the sound from the speaker system that finds its way out of the window will be completely lost as far as further usefulness to the room is concerned. It has, in effect, all been absorbed by the open window. On the other hand, the sound from the loudspeaker which hits the carpet is partly absorbed and partly reflected back into the room. Likewise, the sound hitting the plastered walls and ceiling is absorbed to a lesser degree and is reflected back into the room with more intensity than is the case with sound striking the carpet. As far as the listener is concerned, the aggregate sound that reaches him is composed of the direct ray *A*, the highly reflected ray *B*, and the somewhat reflected ray *C*. It is obvious, then, that the degree of liveness, or "concert-hall-ism," presented to the listener by his room is controlled by the absorptive properties of his surroundings.

## Special Stereo Needs

This problem of the room condition is important for any type of sound reproduction but for stereo it is doubly important (no pun intended). For the sake of preliminary illustration of the effect of the acoustics of a room on the resultant sound field of a stereo speaker system, we will use as the stereo sound source two speakers, 6 to 8 feet apart, oriented toward the central listening area by approximately 15 degrees each and we will assume that the speakers are as nearly balanced in their performance as is possible.

Now, even though we accept this "paired speaker" condition as being most suitable for our illustration, it should not be inferred that it is the only acceptable stereo speaker configuration. Much definitive work still needs to be done on speaker pairs (or trios), balanced or unbalanced, and we shall have considerable comment to offer concerning this problem after we have explored the preliminary example of the effect of room acoustics on the reproduced sound from the balanced and separated speaker system.

Suppose, now, that we place our perfectly balanced speakers, at the previously specified distance and angular relationships, in a room typical of many new home constructions where the living room and the dining area form a sort of an "L," as shown in Fig. 1. The speakers are neatly balanced on either side of the equipment cabinet. At the opposite wall is a foam rubber settee backed up against a hard plasterboard wall (decoratively papered, of course) with probably an arrangement of picture miniatures hung above the couch (a large, heavy picture would probably rip its supporting hooks right out of the plasterboard). In any event, small pictures or large, the backing wall will be rather "hard" acoustically—it will reflect quite a bit of the sound that hits it.

We turn on our stereo system, lower ourselves onto the comfortable settee and listen. But although our reproducing speakers are balanced, phased, separated, and angled properly, the *listening system* is no longer balanced. Not even the channel-balancing control on the amplifiers or "stereo control center" will correct this acoustically unbalanced room.

Speaker "A" sends a direct sound to the listener *via* ray 1 and considerable wall-reflected sound to the listener *via* rays 2 and 3. On the other hand, Speaker "B," while it may transmit direct sound to the listener, sends very little reflected sound to his ears for there is the "open space" of the dining ell in front of it. Thus the sound from Speaker "A" will be louder *to the listener.* A second effect is that there will be considerable high-frequency loss from Speaker "B" *as heard* by the listener. The high frequencies from Speaker "B" that continue on straight ahead are almost completely lost to the listener while the highs from Speaker "A" come to him directly *and* by reflection. Consequently, although the speakers may have been perfectly balanced acoustically, their reproduction at the ear's location is unbalanced, with the unbalance being preponderantly in the high-frequency range, due to the differential reflective conditions bridging two speakers and the listener. This is unfortunate because much of the stereo effect is contributed by the higher frequencies. If we lose the highs, we lose the directional sense of the system.

We may overcome these deleterious effects of the distortion of the direction of the sound by one of two methods —or preferably—a combination of both. The first obvious method is to re-arrange the furniture; the second method is to alter the reflective properties of the room. Either of these problems may prove difficult to overcome unless one finds some way of convincing the lady of the house that it is actually *her* idea to re-arrange the furniture, or to hang a drape here or there, or to install acoustic tiles hither and yon. Having thus easily (!) surmounted this first "managerial" problem, let us see what might be done with the furniture arrangement shown in the room of Fig. 1 to provide a better acoustic balance among the speakers, room, and the listener.

Fig. 2 shows one alternate arrangement of the speakers where *almost* complete acoustic symmetry among the speakers, room, and listener is available. The listener is in the direct way of each speaker. Each speaker also faces almost equivalent open-ended spaces, that is, Speaker "B" radiates into the dining ell and Speaker "A" radiates into the living room. To the listener, then, there is presented a condition wherein there is a balance between the direct rays from each speaker and the reflected rays.

There is also a second-order effect, but a desirable one. If the rooms are moderately "live" and the program is played at good volume (who ever heard of low volume?)—then an additional acoustic enlargement of the room takes place. The sound components from the speakers that travel into the dining ell area and into the living-room area find themselves bouncing around within these somewhat live end spaces. A "liveness" effect—or reverberance—is thus produced which adds to the direct rays received at the listening area. This partly gives rise to a psycho-acoustical enlargement of the listening room in a way that somewhat simulates the larger chamber music room—provided, of course, that the sound is reproduced loud enough to energize these reflective areas. This arrangement of Fig. 2, though quite severely limiting the effective stereo listening area, does provide a solution (for illustrative purpose) of balanced stereo listening.

## Some Different Approaches

Before we opened the discussion of the above problem of the acoustics of

an unbalanced room upon a balanced speaker system, we deferred our comments about other types of speaker systems and configurations for stereo application. It would now be well to give this matter some consideration before going into the specific problem of room acoustical analysis and adjustment where these different types of speaker systems are used.

There are in use today speaker systems of many types which, as shown in Fig. 4, although greatly different, yield discernible and psycho-acoustically acceptable stereo. In addition to the two separate speaker systems (Fig. 4A), there are systems which consist of two full-range end systems with a "phantom fill" as a third channel in the middle (Fig. 4B). There is a system where the major bass information is all blended in one central system and the higher frequency stereo-determining components are displayed by end-placed outboard speaker components (Fig. 4C). There is also a system which is enclosed in one cabinet where the stereo effect is produced by reflecting into the room—from each of its *back* hinged end doors—the full program content of each channel respectively (Fig. 4D). In addition, there is a system where the lows are blended in one woofer and dispersed by the rear wall, and the high-frequency components of each channel are guided by the *front* hinged end doors to be randomly reflected by the room walls (Fig. 4E). Finally (at this writing, at least), there is the system where the blended lows and highs from one channel radiate from one system and only the highs from the other channel have a separate speaker (Fig. 4F).

Obviously, not all these systems are "best" systems. They each have their individual merits and drawbacks. And obviously, they cannot all produce exact replicas of the original sound coming out of the instruments. But one thing they all do. They give *some* impression of the stereo effect, whether it be a correct or an incorrect one, to which we then add our own personally devised psycho-acoustic image of what we think the stereo reproduction should sound like—and we then have "stereo."

The question then arises how do we treat all these systems when integrating them to the acoustical condition of a particular room. Unfortunately, there is no definite and rigorously circumscribed "best" relation between the speakers of these various systems and any room at random. The number of solutions would obviously approach infinity, depending upon room size, shape, acoustic condition, speaker system, the listening habits of the auditor, and the type of music being played.

To briefly illustrate the complexity of the problem, take the last item just noted—the type of music being reproduced in relation to speaker system and room acoustics. If the stereo program material were that of a string quartet, we would expect, for stereo realism, that the stereo effect encompass a rather small area governed by the usual intimate geometrical relation among the two violins, viola, and cello, as shown in Fig. 5. If the speaker system were an adjustable one in the matter of speaker separation and speaker orientation—as would be possible with the units of Figs. 4A, 4B, 4C, and 4F—then after auditing a few programs the listener might be able to strike an arrangement where the stereo effect produced would be fairly close to the original sound distribution. The arrangement in Fig. 4D could also be acceptably adopted so that the doors, hung from the back edges, and properly angled, would project the quartet image into a centrally confined area with a minimum of deteriorating acoustic splash from the side walls which would otherwise tend to swell the "size" of the quartet. Fig. 4E would probably not be as adaptable to this type of music for, at best, even with the front-hung doors completely closed (onto the front) the stereo-determining middle- and high-frequency components would still be strongly projected towards the side walls of the room and would reach the listener with strong reflected level from these comparatively distant areas with the result that, again, the quartet's geometrical reproduction would be "swelled."

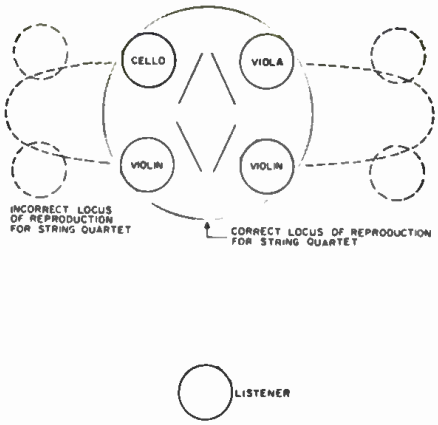


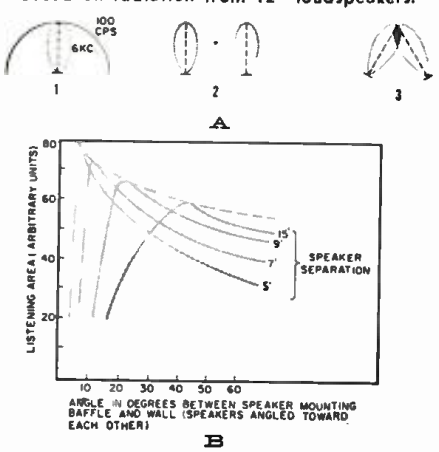

Fig. 5. A stereo reproducing system should be able to "place" the instruments in a manner duplicating their original location.

On the other hand, if the reproduced program were a full-bodied and large symphony orchestra, then this last system with its doors wide open, would direct the sound toward the outer reflecting wall to give a resultant enlarged acoustical image more in keeping with the original effect. The same effect could, of course, be obtained with the other systems through greater separation of the individual speakers, controlled center fill, and system angling. Perhaps this brief dissertation on the correlation of the reflecting properties of the room, the speaker system philosophy, and the program material will bring home the difficulty of achieving one perfect solution—obviously a single solution to suit all conditions is out of the question. But, despite the complexity of the problem, or rather because of its complexity, we must make some simplifying assumptions in an effort to approach analytical results which may then be applied to more complex systems.

## Balanced Speaker System

Even if we limit ourselves to analysis of the stereo effect of two identical systems, we may run into an imponderably large number of physical geometrical relationships between the two loudspeakers that do not necessarily bear any definite relation to the room characteristic. In order to resolve this matter of the placement of two identical systems in order to get the maximum stereo effect, the writer undertook to examine the matter in an analytical fashion in a paper which was presented before the Audio Engineering Society Convention in September 1958. The analysis endeavored to determine how far apart two identical speakers should be placed and how they should be angled toward each other in order to obtain the maximum *area* in which the stereo effect would be perceived when the individual speaker system consisted of a simple 12" speaker. One of the results of this analysis is shown in Fig. 6 from which it is seen that *for such a system* the maximum stereo listening area will exist when the speakers are placed about 7 feet apart and are both toed-in by about 15 degrees from the wall against which they are mounted. Now, obviously, this result cannot be accepted as gospel truth for all of the other types of speaker systems previously illustrated but it does at least give us a toe-hold on a premise that will permit us to discuss the acoustics of a room and its adjustment in terms of a frequency space pattern of which we can be reasonably sure.

Fig. 6. (A) Higher frequency radiation should overlap for best results. The overlap area is determined by speaker separation and angular orientation. (B) Graph of maximum stereo listening area as a function of speaker separation and orientation, based on radiation from 12" loudspeakers.




After we have gone more intensively into the study of the room itself and its acoustics, we may then be able to convert these findings for the balanced system for application to those situations where the composite type of system is to be employed.

*(To be continued)*

# What Set Owners Think

**1** **Time of Last Repair**

| PERIOD | PER-CENT |
|---|---|
| Last year (1958) | 46.7 |
| Since Christmas | 30.7 |
| Before 1958 | 13.2 |
| Never | 9.3 |
| Don't know | .1 |

**2** **Repair Agency Used**

| AGENCY | PER-CENT |
|---|---|
| Local shop | 43.2 |
| Free-lance service | 16.3 |
| Store of purchase | 11.2 |
| Immediate family | 11.2 |
| Factory agency | 10.1 |
| Friend | .8 |
| Others | 7.2 |

**3** **Opinion of Repair Charge**

| RESPONSE | PER-CENT |
|---|---|
| About right | 84.0 |
| Too high | 11.3 |
| Too low | 3.1 |
| Don't know | 1.6 |

**4** **How Agency Is Chosen**

| METHOD | PER-CENT |
|---|---|
| Friend | 33.9 |
| Neighborhood shop | 22.5 |
| Dealer recommendation | 21.9 |
| Yellow pages | 9.4 |
| Mail advertising | 1.5 |
| Other | 10.8 |

SEVERAL months ago a research team at Wayne University, Detroit, Michigan, reported on a study of TV receiver ownership, repair, and related subjects. Directing the survey was Dr. H. Webster Johnson, under whom 15 students canvassed hundreds of homes in Detroit itself and the surrounding metropolitan area. The statistical findings, which have appeared before, are of obvious interest to TV owners, as well as to those who make their livings from the fact that sets do break down now and then. Of greater interest than the cold figures, however, is the significance that may be attributed to them. What do they mean?

As soon as an attempt is made at interpretation, however, problems arise. For example, the wording and intent of some questions become unclear, casting doubt on the validity of the answers. However, it is foolish to criticize a pilot study undertaken with little precedent for guidance. Even as the data stands, we are in debt to the Wayne University investigators for an informative and useful survey.

The thirteen accompanying tables are adaptations of the ones released by Dr. Johnson and, although accurate, are not to be construed as exact duplications. We have ignored some of his tables, re-organized or consolidated others where we felt interpretations would be aided thereby, and changed the sequence.

One may wonder whether the survey, taken over a limited area, would be valid for the entire country. There is reason to believe that it is. The figures on receiver brand preference and hours of use, not shown here, correspond to those turned up in more widespread studies. Multiple ownership of sets and types of sets in use (Tables 12 and 13) also tend to agree with other estimates.

Another question: Are the patterns of set owners and patterns of service in the combined metropolitan-suburban area around Detroit typical? After all, there are many rural and other areas not at all like the one sampled. Nevertheless, the great majority of TV ownership and service is accounted for by just such population centers. In addition, the Wayne University team sampled a wide and varied cross-section of the local population to insure proper distribution.

Probably of least value are the statistics on sets under warranty (Table 10) or covered by TV insurance (Table 11). In the former case, nearly 14 per-cent of the people interviewed did not know whether they were still protected —a fairly large grouping. Consumer confusion on warranty terms and periods is not surprising. It is probable that many respondents who gave definite yes or no answers were in error. As to the ownership of TV insurance, it does not seem likely that nearly 11 per-cent of set owners still carry the type of prepaid, parts-and-labor annual contract that was very common ten years ago but has dwindled to insignificance since. The use of the non-specific term, insurance, may have caused some trouble. It has probably permitted confusion between insurance and warranties, and also with such other practices as separate, extended warranties on picture tubes, limited parts-only contracts, and shorter-term, post-repair guarantees on repair work done.

As to frequency of repair (Table 1), set owners seemed to be much more aware of the nature of things. Only .1 per-cent couldn't recollect when they had last had to call for service! With the survey actually conducted before the mid-point of 1959 (the Christmas referred to in Table 1 being that of 1958), slightly over 77 per-cent of the set owners had needed service of some kind over the preceding period of nearly a year and a half. More than 22 per-cent had required no service at all over that period, or had never required service.

Table 1 provides a clue to one contradiction that often shows up in studies of the service industry. We are generally told that the number of sets in use has increased, over the last decade, at a much greater rate than the number of people in the business of repairing these sets. For this reason, it is frequently assumed that average income per shop or per man from service has multiplied considerably. Yet all too many service technicians insist that this is simply not so. Evidently a sharp decrease in the frequency of repair has helped balance out the number of sets to a considerable degree. Ten years ago, a set covered by a service contract would be involved in several service calls per year. Today a large percentage of sets can go a year and a half or more without a single call.

As to repair agencies (Table 2) and the manner in which they were selected (Table 4), all the data turned up was interesting, but rather mixed with respect to the happiness it will generate in the independent service industry. Only a little over 54 per-cent of set owners turn to a local service shop or the store of purchase when they have trouble.

The picture is probably somewhat better than the figures show, however. Not every operator who falls into the "free-lance service" category, handling more than 16 per-cent of all calls, is also necessarily in the questionable "night crawler" class. While factory agencies account for a sizeable portion of the service business, the meaning of this category is not clear, especially in the Detroit area. At least one set manufacturer (*Philco*) is using a special plan, worked out in cooperation with many local independents, in which calls made to the manufacturer's agency are referred to participating independent shops.

Nevertheless, a discouragingly large number of defective sets, sidetracked by one means or another, are never seen

# Of Service

**5** Nature of Service

| TYPE | YES | NO | DON'T KNOW |
|---|---|---|---|
| Removed set from home | 32.2 | 65.2 | 2.6 |
| Completed work promptly | 91.3 | 6.3 | 2.4 |
| Replaced tubes | 84.8 | 7.7 | 7.5 |
| Replaced other parts | 32.1 | 55.3 | 12.6 |

**6** Set Owners' Reactions

| RESPONSE | YES | NO | DON'T KNOW |
|---|---|---|---|
| Dealt honestly | 88.1 | 7.4 | 4.5 |
| Acted courteously | 94.3 | 3.0 | 2.7 |
| Satisfied | 83.5 | 16.5 | |

**Do you agree with these conclusions drawn from the raw data turned up in a survey of consumer behavior and reactions concerning service techs, charges, and quality of repair work?**

**7** Opinion on Fair Price

| PRICE | PER-CENT |
|---|---|
| $2.00 | 1.6 |
| 2.50 | .5 |
| 3.00 | 22.9 |
| 3.50 | 1.6 |
| 4.00 | 26.6 |
| 5.00 | 24.3 |
| 6.00 | .5 |
| Other | 4.8 |
| Don't know | 17.1 |

**8** Use of "Drug-Store" Checkers

| RESPONSE | PER-CENT |
|---|---|
| Have not used | 63.5 |
| Have used | 35.8 |
| No answer | .7 |

**9** Satisfaction with "Drug-Store" Checkers

| RESPONSE | PER-CENT |
|---|---|
| Satisfied | 60.7 |
| Not satisfied | 35.7 |
| Other | 3.6 |

by the independent service industry. Do-it-yourself service (combining the "immediate family" and "friend" categories) accounts for 12 per-cent of all service work. This trend, not likely to reverse itself, lends force to those who argue that service shops should set up to accommodate the do-it-yourself group rather than to ignore it.

If Table 4 is any indication, the service shop that wishes to prosper will generally fare better by clinging to such established practices as operating a local, limited-area business, maintaining good relations with his customers, establishing a good reputation, and working cooperatively with TV dealers who do not maintain their own service departments. More than 78 per-cent of the people interviewed go to the neighborhood shop or ask a friend or dealer for a recommendation when their sets act up. Advertising in the yellow pages or by mail accounts for a relatively small per-cent of direct business. However, a 10 per-cent difference in volume can spell the difference between success and failure, and very few shops will conclude that all advertising is a waste of time.

With respect to mail advertising, Table 4 may be somewhat misleading. As commonly employed by the majority of independent shops, this medium is quite ineffective. Studies of individual dealers who have instituted modest but sustained, carefully planned, direct-mail campaigns after years of fumbling with the method, generally report notable and gratifying increases in volume as a result of such efforts. Table 4, then, may simply confirm the fact that few service shops know how to get the most out of their mailings or just don't bother with the method at all.

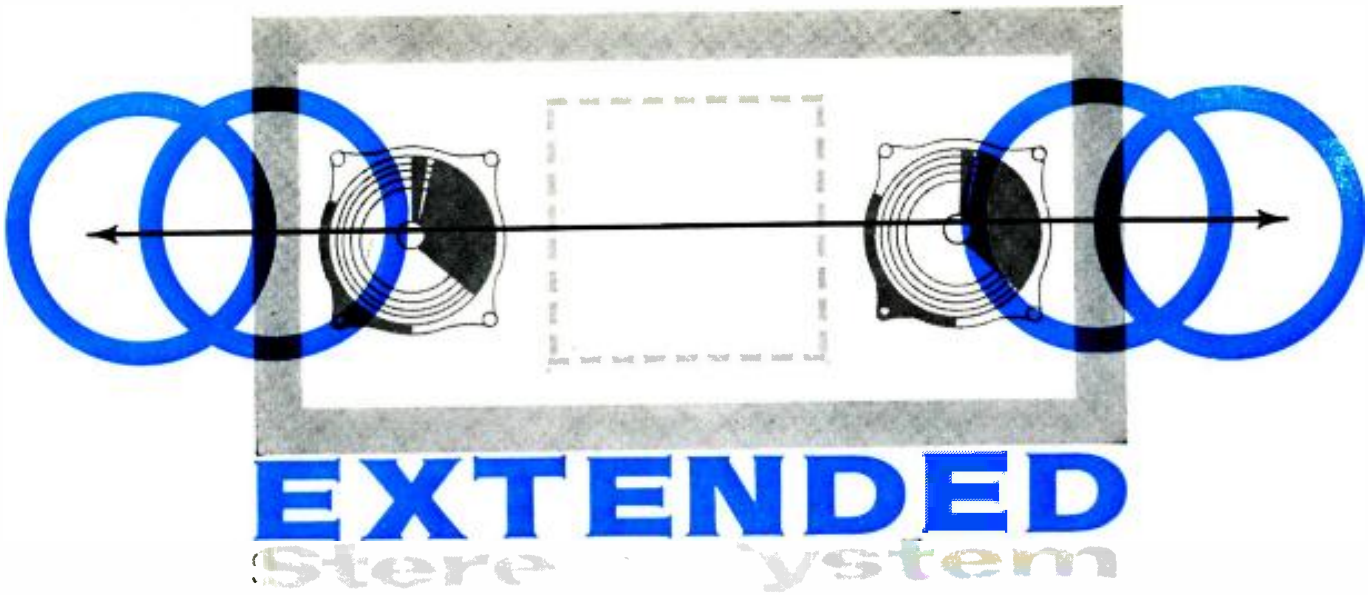
Some fairly well-known facts are confirmed by Table 5—but a fallacy inherent in one of the most widely accepted of these facts is clarified. Nearly 85 per-cent of all instances where service was required involved the replacement of tubes. The promoters of drug-store testers and other schemes for diverting service business away from the service professional have made much of this point, but the statistics are often given a misleading and sinister twist: it does *not* follow, as usually stated, that 85 per-cent of all TV troubles can be cured by tube replacement. Nearly one-third of the service calls involved replacement of other parts, whether new tubes were needed or not. Also a like percentage of calls involved removal of the set to the shop, scarcely necessary where tube-only defects exist.

Primary reliance on tube replacement by non-professionals to keep a set going obviously leaves much to be desired. The practice can have unfortunate effects not only on the service professional, but on the set owner and the set itself. It is difficult to guess at the number of defects that should be corrected which are concealed by tube replacement, especially by repeated tube replacement, and the poor economy this practice represents as compared to a check by a qualified technician. Here is a point worth publicizing.

Also of interest in Table 5 is the fact that over 91 per-cent of respondents felt they had received prompt completion of work. We can relate this to Table 6, which shows that only 7.4 per-cent of the owners felt that they had not been dealt with honestly, only 3 per-cent sensed any discourtesy, and 16.5 per-cent were not satisfied. In a sense, all of the reactions separately listed in these tables relate to customer satisfaction, which is generally high, on the order of 90 per-cent. Evidently the industry can afford to be far less on the defensive and far less self-conscious about consumer acceptance than it usually is. This has a great deal of bearing on the next point.

What does the set owner consider a fair price for a service call? The average price developed from Table 7 is about $4. A *reasonable* price would be higher, but the consumer

(*Continued on page* 138)




## Method employed in Zenith's 1960 models to control and extend the apparent separation in stereo reproduction.

EDITOR'S NOTE: *Some of our readers may argue that the technique to be described below is an artificial method of producing an exaggerated stereo effect. Others will claim that since stereo itself is an illusion, then any method employed to enhance the illusion is justified. In any case, the system is claimed to be particularly effective when left and right speaker systems are contained in the same enclosure. We feel sure that our readers will be interested in the circuit and method used.*

THE following circuit is used in *Zenith's* new stereo models in order to enhance the stereo effect. According to the manufacturer, the system eliminates the need for the usual small area center listening position and permits the user to control the degree of apparent separation produced. The method is said to be particularly useful in cases where all the speakers are contained in a single enclosure. As will be seen below, a sum and difference technique is used. By controlling the amount of the difference channel various degrees of the stereo effect can be produced.

The block diagram in Fig. 1 shows the basic principle of operation. The stereo cartridge supplies separate left (L) and right (R) channel signals. These signals are then applied through an automatic balance control circuit to a mixer preamplifier. Out of the mixer two types of information are obtained. These are the sum signal (L + R), which is applied to the sum amplifier, and the difference signal (L−R), which is applied to the difference amplifier. A stereo control in the difference channel determines the degree of stereo effect produced. Outputs from both amplifiers are applied to a transformer matrixing circuit. Here the information is separated and applied to the two sets of speakers used.

### Mixer Preamp Circuit

The controlling circuit governing the degree of stereo is the mixer preamp shown in Fig. 2. For the sake of convenience assume that the signals coming from the stereo cartridge are −L and −R. These signals are applied to the wiper arms of two 3-meg. potentiometers that are ganged together. These pots are in the grid circuits of the 12AZ7 twin-triode. The controls are so wired that when the signal is increased at one grid, it is decreased at the other grid, and *vice versa*. In this manner, satisfactory balance can be obtained. The twin-triode acts as a preamp as well as a mixer so that we can obtain the sum and difference information.

With a −L signal supplied by the cartridge, there will be +L at the plate of the left preamp because of phase reversal of the tube. If we assume that the left preamp has a gain of 2, then there will be +2L at the plate. This 2L signal is applied through the 68,000-ohm resistor and the .1-μf. capacitor to the output. Also at the plate of the left preamp is a voltage divider consisting of a 15,000-ohm resistor and a 6800-ohm resistor. At the junction of these two resistors there will be some +L signal.

(*Continued on page* 156)

Fig. 1. Block diagram of arrangement used for "extended stereo."

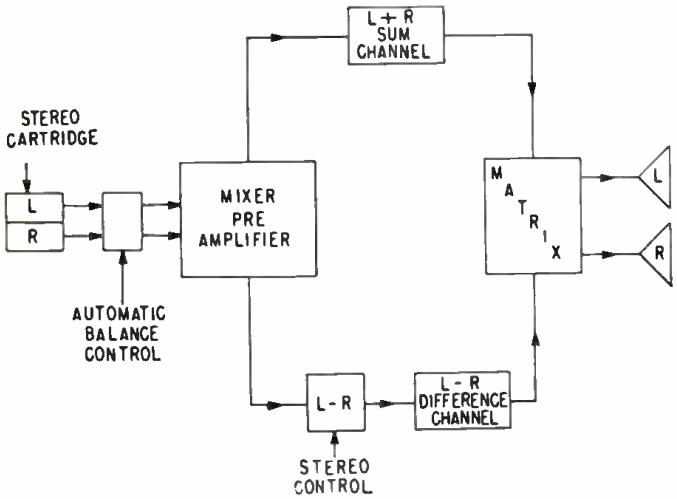
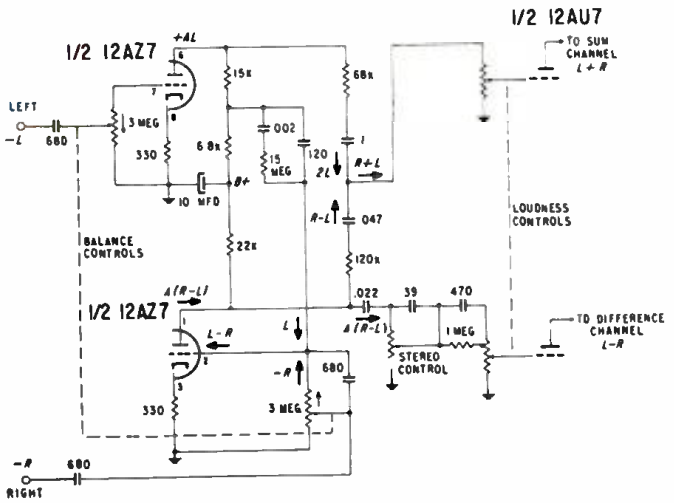
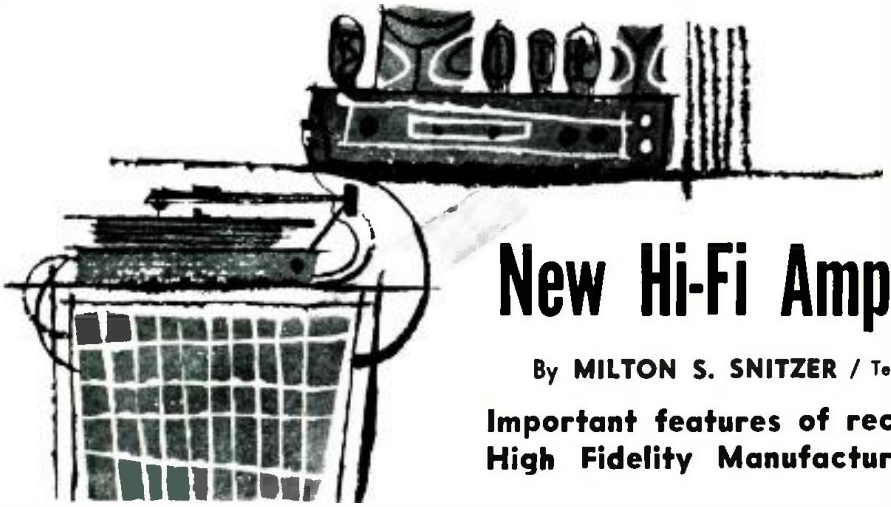



Fig. 2. The mixer-preamplifier circuit employed in Zenith sets.





# New Hi-Fi Amplifier Standards

By **MILTON S. SNITZER** / Technical Editor, ELECTRONICS WORLD

## Important features of recently released Institute of High Fidelity Manufacturers standard IHFM-A-200.

*EDITOR'S NOTE. After reading the following description of some of the measurement techniques to be used for rating hi-fi amplifiers, our readers are sure to wonder just how the measurements we take on the equipment we review compare with the new standards. In some cases our methods follow the new standards quite closely. In other cases, our measurements are somewhat more comprehensive than is required by the standard. It is a bit too early for us to determine whether we will continue with our fairly elaborate tests in the future or whether we will test just those items outlined in the new standard.*

*Another big question is how the industry as a whole will go along with the new standards in quoting their own products' specifications. Some manufacturers of top-quality components that we have talked to think that the new standards will probably have little effect.*

RECENTLY, the Institute of High Fidelity Manufacturers issued its "Standard Methods of Measurement for Amplifiers (IHFM-A-200)," the second in a series of standards designed to establish comprehensive measurement techniques for high-fidelity components. The first standard, released last year, was devoted to high-fidelity tuners. (Refer to article "New FM-AM Tuner Standard" by D. R. von Recklinghausen in our October, 1959 issue.) The new standard defines terms and test conditions and lists tests and ratings for amplifier output, sensitivity, frequency response, distortion, hum and noise, and damping factor.

Those who are looking for limits of distortion, acceptable hum and noise figures, and other performance criteria for hi-fi amplifiers will *not* find them in the new publication, nor does the standard tell what performance an amplifier must have in order to be classed as a "high-fidelity" unit. Instead the standard gives specified methods of making a number of important measurements which, if all manufacturers follow the procedures given, will permit an accurate comparison to be made among the performances of various amplifiers.

The chief engineers of nearly every company manufacturing hi-fi amplifiers contributed to the standard. Mr. Richard Shottenfield of *Pilot Radio Corp.* served as chairman of the Institute's Sub-Committee on Amplifiers, which actually drafted the publication. It is to be submitted to the Electronic Industries Association, Institute of Radio Engineers, and the Audio Engineering Society for their information and investigation toward acceptance by them as a common standard.

### Test Conditions

All the amplifier tests are to be performed under certain "standard test conditions" that are defined exactly. Line voltage is to be 117 volts and the amplifier is to be preconditioned by operating at one-third rated power output for at least one hour before any test is made. Power amplifiers are terminated by a resistance load that is essentially non-reactive and within 1 per-cent of proper resistance. Voltage amplifiers designed to be connected to a subsequent amplifier are terminated by a .1-megohm, 5 per-cent resistor shunted by a 1000-$\mu\mu$f., 5 per-cent capacitor to simulate the input circuit of the following amplifier. Any gain or level controls are set for maximum gain, while any control affecting frequency response (such as tone or loudness controls) are set for flattest electrical frequency response. Note that this is not necessarily at the mechanical mid-positions of the tone controls.

### Output Ratings

Power amplifiers are rated in terms of *continuous power* output and/or *music power* output at 1000 cps at a certain rated total harmonic distortion. Continuous power output is the conventional steady-state sine-wave power measurement obtained by squaring the output voltage and dividing this value by the resistance of the dummy load. Music power output is measured the same way except that the input signal is applied suddenly and the measurement is taken immediately, before the supply voltages have changed from their no-signal values. Because of the difficulty in taking this measurement quickly enough, especially with amplifiers having poor voltage regulation, it is necessary to maintain the voltages at their high no-signal values artificially.

One way of doing this is to substitute for the amplifier's own power supply, another supply with excellent voltage regulation that will maintain the voltages steady under full-load conditions. Another way is to insert a variable autotransformer at the input and raise the line voltage sufficiently to bring the amplifier's power supply voltages back to their no-load values. Usually, amplifiers with well-regulated supplies and with fixed bias (such as from a separate rectifier system) will show little difference between continuous power and music power ratings. On the other hand, amplifiers with poor power-supply regulation and self-bias may show a substantial difference. In any case, the music power rating will be higher than the continuous power rating.

Another output measurement specified for power amplifiers is that of *power bandwidth*. This is simply the continuous power-handling ability at rated distortion between the half-power (−3 db) points measured on the frequency scale.

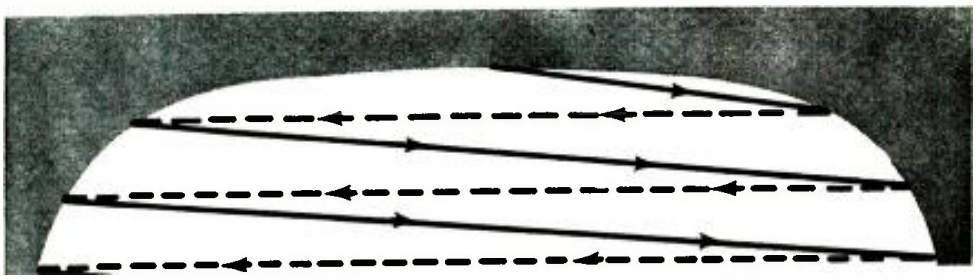
With voltage amplifiers, the output is rated in terms of a certain output voltage across the .1-megohm load mentioned previously.

### Sensitivity & Frequency Response

The sensitivity characteristic is the amount of input voltage, at 1000 cps, required to produce rated power output with a power amplifier or rated voltage output with a voltage amplifier.

The performance of the amplifier with respect to frequency is measured at an output level no higher than 10 db below rated output and no lower than 20 db above the residual noise. For example, when checking the frequency response of a 10-watt amplifier, the measurement should be taken at a level no higher than 1 watt. In the case of a voltage amplifier rated at 1-volt output, the measurement should be taken at a level no higher than .32 volt. The response, expressed in db, is to be plotted on semilog paper with a 20 db change in level corresponding to the length of one frequency decade. By using this standardized presentation, it is impossible for some curves to look better than others simply because of the manner of drawing them. In rating the frequency response the maximum positive and negative deviations are to be given with respect to the response

(*Continued on page* 127)



# Horizontal Deflection Circuits

**By KENNETH BRAMHAM / Haziness about some fine points in this circuit's operation is the real cause of many "dog" jobs.**

ALTHOUGH the purpose and over-all operation of the TV receiver's scanning circuits are well known, some of the inner details, particularly in the horizontal scanning circuits, have eluded many technicians. This is particularly unfortunate since some of the fine points have bearing on the interpretation of faults and the logic of troubleshooting.

The purpose of a TV scanning circuit is not difficult to understand: the normal path of the CRT's undeflected beam is to the center of the viewing screen. The beam must be made to scan the entire screen area in a given pattern 30 times each second. Modern receivers use wide deflection angles (70 to 110 degrees), which are more readily obtained with magnetic rather than electrostatic deflection. The electron beam passes through a varying electromagnetic field set up by a varying current in coils of copper wire (the deflection yoke) mounted on the neck of the CRT.

If we mount a pair of deflection coils vertically on a CRT (one coil above the neck and one below) and allow current to flow through them, the dot of light produced on the viewing screen by the electron beam will move from its normal position and take up a new position to one side of the screen. Increase the current in the coils and the dot moves over still farther until, with enough coil current, it moves off one side of the screen.

Suppose we rotate the coils through 90 degrees, so that they are disposed horizontally, with one on either side of the CRT neck. Changes in coil current will now cause the dot to move up or down vertically. Thus the TV deflection yoke has its two pairs of coils to produce both types of motion. To scan a single, horizontal raster line on a TV screen, the electron beam must go through the following sequence: it must move from the center of the screen, the electron beam must go right-hand side; retrace, at a much higher speed, back to the center and past it to the left-hand side; and then, resuming its initial, constant speed, move back to the center of the screen.

To produce this sequence of movement or deflection of the beam, the controlling magnetic field must go through a corresponding cycle of change, which means that the current flowing through the coils must also go through a similar pattern of change, represented by a saw-tooth current waveform. This requirement for the current cycle would appear to be a fairly simple one. However, at the frequencies involved with TV scanning, matters become rather more involved.

It is interesting to note that, while a complete horizontal scanning cycle takes 1/15750 sec., no more than ⅛ of this time (1/78750 sec.) is ordinarily used for the retrace portion of the cycle. The minimum raster width of a 21-inch picture tube is at least 1.5 feet. To cover this distance in the allotted time, the retracing spot must travel at a speed of about 1000 miles per minute, or about 60,000 mph!

A practical indication of the effect of scanning frequency on required scanning power is provided by a comparison of vertical and horizontal deflection circuits. There is not much difference between these two in the distance to be scanned, the vertical distance being three quarters of the horizontal. Nevertheless, a TV receiver that uses a miniature triode to handle a watt or two for vertical deflection may have a heavy-duty pentode handling 50 watts or more for horizontal scanning. The difference in power is like that between the output stage of a table radio and the amplifier of an expensive hi-fi system!

Vertical-circuit damping is generally performed by a pair of half-watt resistors across the yoke windings. The resistors dissipate unused energy remaining in the yoke field at the end of each vertical scan. If a similar damping arrangement were used in the horizontal circuit, large power resistors would have to be used, and a water cooling system might be a good idea, in addition! Instead of resistors, a damping tube is used. This is a better way for more than one reason: instead of wasting the considerable energy in the field at the end of the scanning cycle, this energy is returned to the circuit by the damper to be used for a good part of the next scanning cycle.

The typical horizontal-output circuit shown in Fig. 1 is reduced to a simplified form in Fig. 2. In the latter, the horizontal-output transformer ($T$) is shown without added windings for high-voltage supply, a.g.c., phase comparison, or other purposes, while a capacitor ($C_s$) is added to represent the shunt capacitance due to the windings of the transformer. In conformity with modern design practice, the yoke is shown connected across a part of the transformer winding, rather than being in series with the transformer (direct drive) or being connected to a separate secondary winding, as in many older designs. The 6AU4 damper tube is seen to be in series with the transformer and boost capacitor ($C_1$); while the 6CD6 output tube, the output transformer, the boost capacitor, and "B+" supply form an additional series circuit.

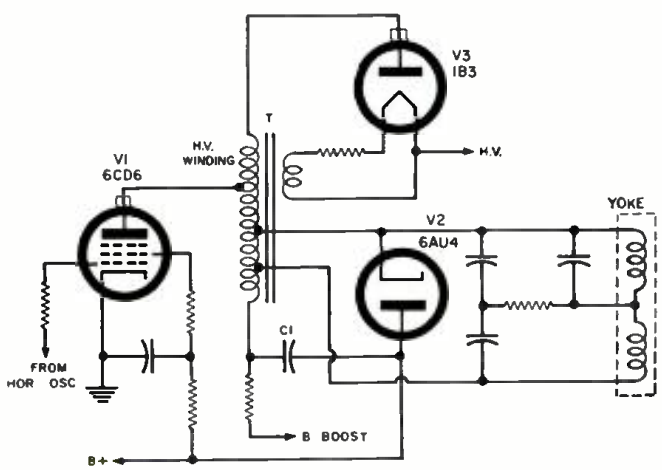



Fig. 1. Wide-angle TV sets of modern design typically use horizontal - output circuits, like the one shown here, with an autotransformer.

A feature of this arrangement is that the output tube conducts for less than half of each cycle, reducing the ratings needed for this tube.

A horizontal-output system bears more resemblance to a pulse circuit, in which the tubes are only required either to conduct fully or to cut off, than it does to the many familiar circuits where the output current follows slight variations of input (grid) voltage. For this reason, it is convenient to regard both output and damper tubes as high-speed switches. This is shown in the equivalent circuits of Fig. 3. Switch $S_1$, representing the 6CD6 of Figs. 1 and 2, is shown closed when the drive voltage to the grid is positive, and open when the tube is cut off by a negative grid voltage. $S_2$, representing the 6AU4 damper tube, is closed when its cathode voltage is negative with respect to its plate. When this tube is cut off by a cathode voltage that is positive with respect to the plate, $S_2$ is shown open.

Circuit conditions in the first part of the scanning cycle are shown in Fig. 3A. The output tube grid voltage, charted below the circuit diagram, has become positive, closing the equivalent switch, $S_1$. The supply potential, consisting of the "B+" voltage plus the charge on $C_1$, causes a current ($I_b$) to flow through the transformer ($T$), and $S_1$, inducing a much higher current ($I_y$) at a lower voltage in the yoke.

Also in Fig. 3A, a back e.m.f. producing a current opposing that of the supply current will be noticed. This is produced in the transformer by the sudden surge of supply current at the start of the cycle and it gradually decreases, allowing a steady increase of $I_b$ and $I_y$. As $I_y$ increases from zero, the magnetic field around the yoke increases and moves the scanning beam to the right, as shown by the solid line in the scanning diagram of Fig. 3A. During this part of the cycle, the damper tube cathode is held positive with respect to its plate by the charge on $C_1$, and the position of the damper-tube tap on the transformer. The equivalent switch ($S_2$) is therefore open.

The relation between grid voltage, yoke current, and scanning dot position for the second part of the cycle is shown in Fig. 3B. $S_1$ is now opened by the grid voltage, which has become negative. As $I_b$ is cut off by the now open $S_1$, the magnetic fields built up around the transformer and yoke decay rapidly and induce a rapidly decreasing current, $I_c$, in the transformer and $I_y$ in the yoke. The latter current is in the same direction as the original $I_b$ in the first part of the cycle. $I_c$ charges the winding capacitance ($C_w$) of the transformer while the scanning beam retraces to its original position in center screen. Thus, at the end of this part of the cycle, both switches are open, no magnetic field exists, and all the energy in the circuit is stored in $C_w$.

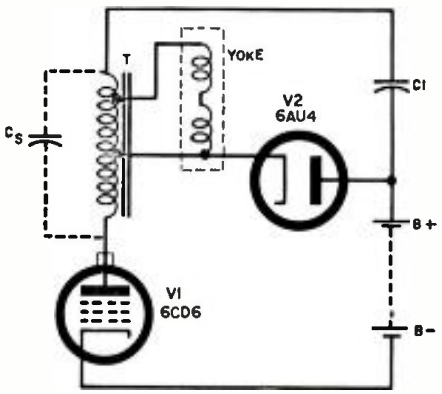


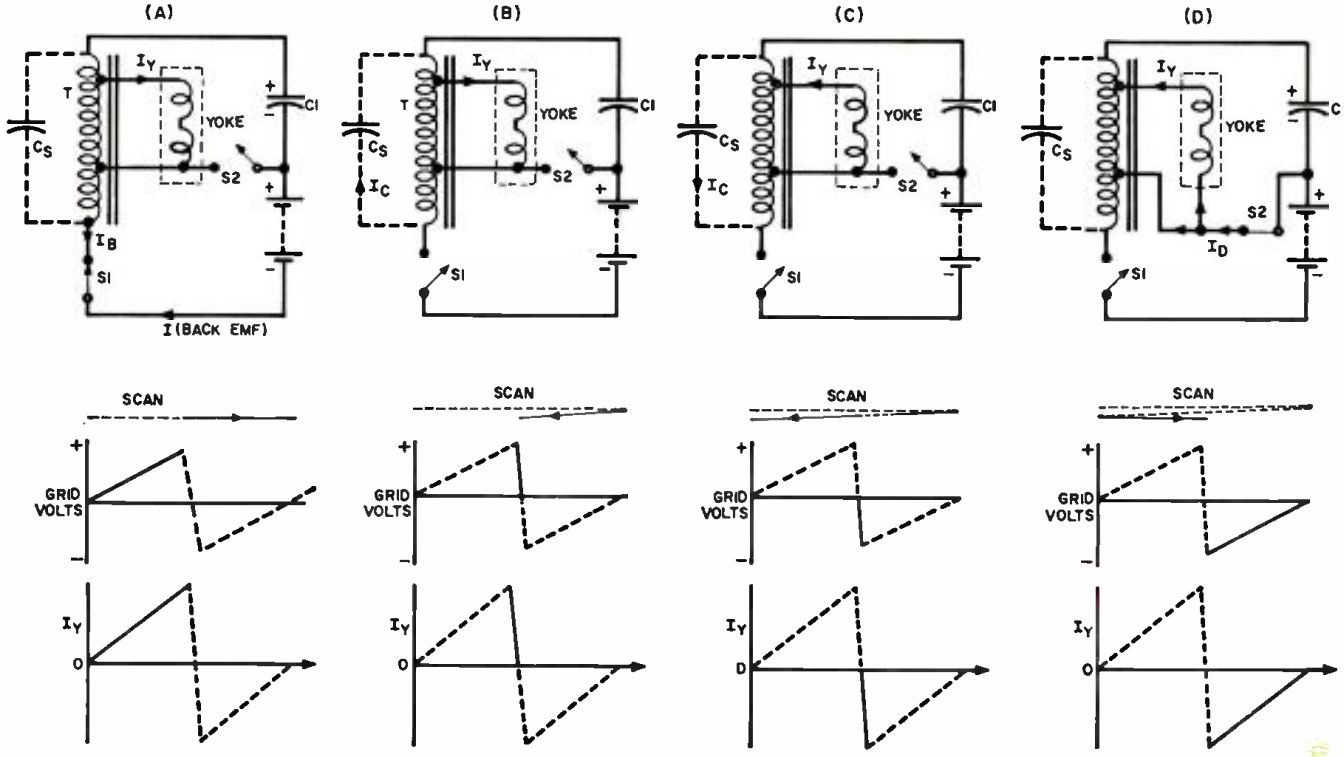
Fig. 2. Simplification of Fig. 1 circuit.

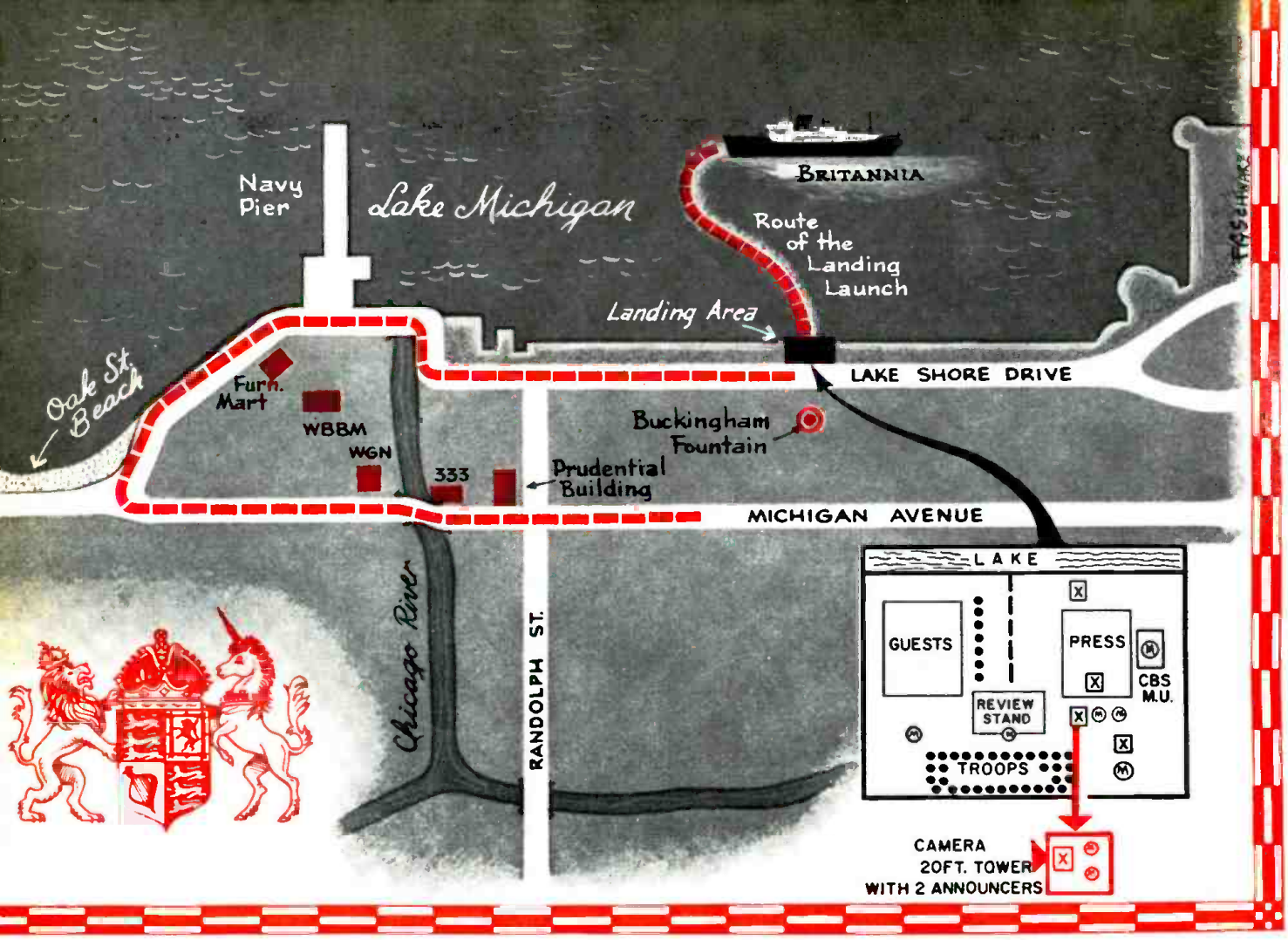
Refer now to Fig. 3C. The winding capacitance ($C_w$) now discharges and allows current ($I_c$) to flow in the transformer winding, which induces a current in the yoke ($I_y$) in the opposite direction to the current of the previous part of the cycle. The magnetic field thus created around the yoke moves the scanning beam to the left of the screen. Furthermore, the speed at which this action occurs, like the speed of the first part of the retrace cycle depicted in Fig. 3B, is much greater than the speed of the normal scanning action described in Fig. 3A. This higher retrace speed is determined by the resonant frequency of the tank circuit made up of transformer $T$, shunted primarily by its own winding capacitance ($C_w$) and also by the values of other components in the circuit. The self-resonant frequency of this tank is several times the 15,750-cps rate of normal scan generally being in the order of 70,000 cps.

If there were nothing to stop it, the transformer tank would continue to oscillate until the energy in it, moving back and forth between the transformer's inductance and its capacitance ($C_w$), was dissipated in heat. However, another element in the circuit prevents $C_w$ from being recharged in the final part of the scanning cycle (Fig. 3D). The potential developed across the transformer in the preceding portion of the cycle has made the cathode of the damper tube negative with respect to its plate, and the tube is able to conduct. This is shown by the closed

(*Continued on page* 110)

Fig. 3. Circuit conditions, beam movement, and waveforms for the four phases of one scanning cycle. Switches replace tubes to depict conditions of conduction as "on-off" positions. Arrows indicate conventional current flow rather than electron flow.






Outline map, showing route of Queen's entry and the locations of TV cameras. The inset shows the technical setup at landing area with its cameras (X) and mikes (M).

# How A Pool Telecast Works

By **RICHARD H. MOSS**
NBC Television

**Technical details on how Chicago TV stations combined their facilities to cover the visit of Queen Elizabeth.**

QUEEN ELIZABETH'S thirteen-hour visit to Chicago last July was perhaps the most gala occasion in that city's recent memory. An estimated half-million Chicagoans turned out to greet the Queen and Prince Phillip at lake-front welcoming ceremonies and during a colorful motorcade along Lake Shore Drive and famed Michigan Boulevard to the Loop, Chicago's downtown area. Three and a half million more viewed on TV screens their entry into the city as the Windy City's four TV stations joined to provide full coverage of the pageantry with the second "pool" telecast in the city's history.

## Early Arrangements

The TV pool had its beginnings at a meeting in the office of Chicago's mayor, Richard J. Daley, about a month before the royal visit. Arrangements for the occasion had been known for some time and at least two of the TV stations, WBBM (*CBS*) and WBKB (*ABC*), were planning full-scale coverage of the events on an independent basis. Their plans were changed by the Mayor's announcement. At the site of the Queen's arrival, space was limited and security would be tight. Every news agency in the country wanted to be there. Daley visualized a news gathering stampede that might leave the Queen trampled. For these reasons, only one station would be permitted to set up at the welcoming ceremonies. The others could take a feed from that station. A coin toss by the Mayor's representative gave the privilege to WBBM.

With natural competitive instincts channeled into a cooperative effort, telecasting plans took on more concrete form in a series of meetings during the next few weeks. Although a planned-to-the-minute day was in store for the royal party, practical considerations and other programming commitments limited the pool TV coverage to the events surrounding the Queen's arrival. The royal yacht, *Britannia*, was to drop anchor east of Buckingham Fountain, the Queen coming ashore in a 40-foot launch to land at a specially built dock at Buckingham Plaza. There would be greetings from Governor Stratton of Illinois and the Mayor, remarks by the Queen, and a parade into the city.

The events to be televised were to occur within a two-and-a-half square mile area along the lake shore, with the parade following a hairpin-shaped route roughly four miles long. With the *CBS* mobile unit slated to do the key pickup at the landing point, WBBM was a natural as the pool control station, and its staff, with "Sis" Atlass as producer, assumed the burdens of organization. Accessibility of camera sites along the parade route and availability of special equipment were the deciding factors in assigning other pickups. WGN's locations at Tribune Tower and the Prudential Building afforded unbeatable prospects. WBBM's permanent remote point at the Furniture Mart provided a good view of about a mile of the parade route. *NBC's* WNBQ could deliver on-the-move coverage of any part of the ceremony with the network's radio-linked parade car. Ironically, the sta-

tion with the most aggressive early plans, WBKB, was not physically located to provide suitable camera positions.

## Final Plans

Final plans called for ten cameras at five remote locations. Two remotes were to feed the WBBM control center direct. WGN's two pickups would be routed through a sub-control studio at Tribune Tower, thence to the pool control. The fifth "location," *NBC's* parade-following *Cadillac*, was to beam its signal to a microwave receiver on top of a Michigan Avenue building for relay by wire to the central control room.

Each remote location would be staffed by a director and announcers from the participating stations, switching cues coming from the *CBS* director at the pool control studio. All positions were to be linked into a single communications circuit. The output of the program control studio would be fed to the TV master control rooms of all four Chicago telecasters. Some planned to mix the pool feed with audio and/or video originations from their own studios. WNBQ (*NBC*), for example, was going to video-tape portions of the pool feed for delayed network broadcast, and elected to originate a separate audio feed from Buckingham Plaza instead of using pool audio from that point.

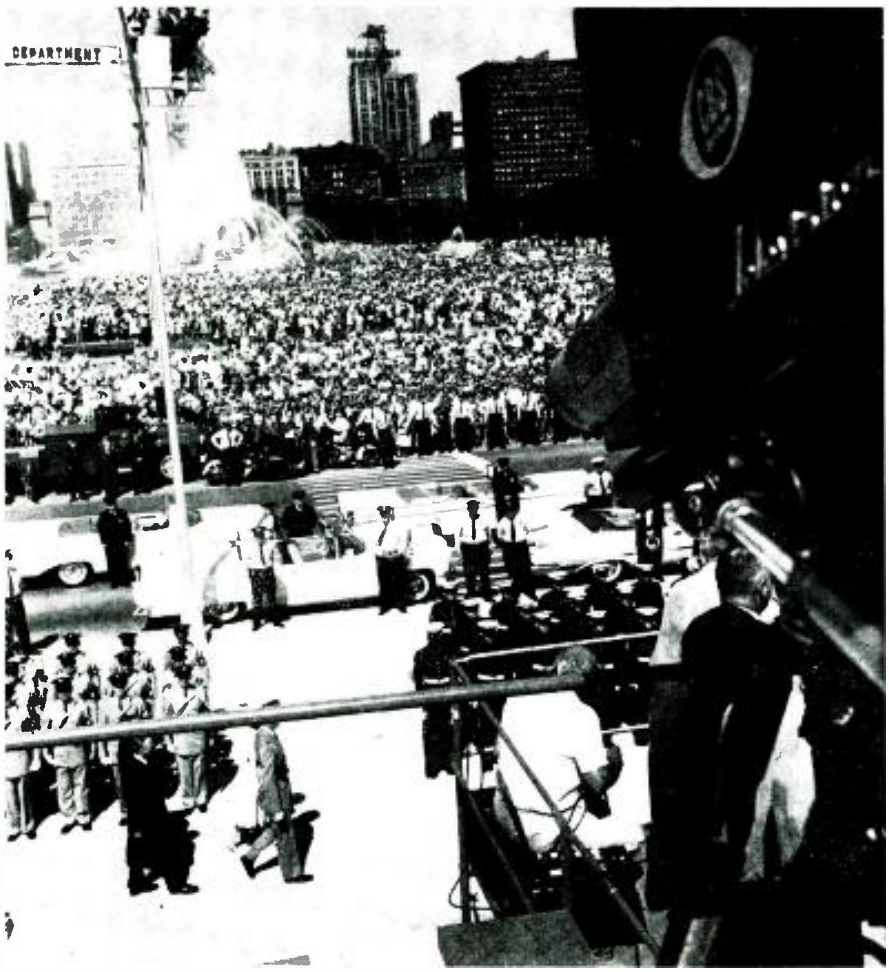
As the participating stations laid their own plans and set about collecting all the long lenses they could put their hands on, *Illinois Bell Telephone Company* got to work on the man-sized job of linking stations and camera locations with a maze of special lines. For the television coverage, nine coax lines and about forty audio pairs, a third of them equalized, were required. At the same time, *Telco* was busily supplying the interconnections for twelve radio pickup points and four additional radio stations, as well as setting up radio feeds to *Bell of Canada* and to Great Britain. The *Canadian Broadcasting Company* was to get a video feed *via* Buffalo.

Some of the equipment to be used on the telecast had to be shipped to Chicago from other locations. The largest single "import" was *NBC's Cadillac* mobile unit which was driven in from New York, arriving three days before the Queen. Upon its arrival, the WNBQ crew assigned to it spent two days in setting up and in practice runs along the parade route. Special attention had been paid to selection of the best location for its microwave receiver. The roof of the 333 N. Michigan Building, adjacent to the Chicago River, was found to afford optimum line-of-sight location for the welcoming events. Signals from the mobile unit were usable over most of the motorcade path except the extreme north end, where buildings intervened, and along a portion of Lake Shore Drive, where microwave fade was caused by trees. Engineers handling the parabolic reflectors of the roof-top receiver and the mobile transmitter were, of course, required to "pan" the equipment to maintain usable signals. Some difficulty

WGN's Prudential Building location provided cover shots for the telecast. This early morning view shows cameramen checking shots.

was encountered at the receiver location in distinguishing the distant *Cadillac*, a problem which was resolved by supplying the operator with a hand-held monocular. The *Cadillac* crew was slated to do double duty, incidentally, originating a special pickup for Garroway's "Today" as well as taking part in the pool.

Columbia Broadcasting System television cameras were employed to cover the actual landing of the Queen. Note Buckingham Fountain in background.




## The Big Event

The day of the big event began early for the engineering crews involved. Earliest birds, the *CBS* lake-front crew, checked in at the closely guarded Buckingham Plaza with their mobile unit at 3:15 a.m. Four cameras were located here, at positions in and around bleachers set up for an expected 500-man press corps. An eighteen-foot scaffold accommodated one camera and two announcers. This site afforded an excellent all-round view of the proceedings and a good shot toward the *Britannia* moored about ¾ of a mile to the east. Use of a *Bach* 6:1 Zoomar with adapter provided the required flexibility and a maximum focal length equivalent to a forty-inch lens. The announcers were supplied with video monitoring facilities and double headsets—pool audio on one earpiece, cue circuit on the other.

Other cameras were placed at different levels and situated (see map) to

This WGN camera got a 40-foot boost from Bureau of Electricity truck. Camera was provided with 6:1 Zoomar with 40" adapter.

give close-up coverage of specific parts of the ceremonies with standard lens complements supplemented by long lenses as necessary. Two additional Zoomar lenses, and 40- and 60-inch lens adapters were also available.

Audio-wise, the main problem to be solved was distribution from the Queen's microphone located on the reviewing stand. To obviate the forest of microphones so often seen before prominent speakers, WBBM manufactured a distribution box which provided twenty-eight 50-ohm mike-level feeds for use by all parties concerned—radio, TV, and newsreel. These feeds were available, by pre-arrangement, on *Hubbell* twist plugs installed at the mobile unit.

The remaining audio setup was comparatively simple, with two hand mikes provided for announcers, two stand mikes for pickup of band music, and a parabolic mike set up atop the mobile unit to re-inforce the band coverage and to cover other areas of interest.

A 60-ampere, 120/240-volt power source was provided by the Chicago Park District and a standby mobile generator was put on the scene by WGN.

The setup at the Prudential Building (the first TV pickup from this location, incidentally) was simplified to some extent by the fact that it is WGN's transmitter location and afforded a ready source of power as well as existing audio and video lines to the WGN sub-control studio. However, it was necessary to "strip" a mobile unit, moving and setting up audio and video control and switching equipment at a temporary control room adjacent to the camera locations on the 39th floor roof, 450 feet "up" and .8 mile from the landing location. Two cameras and two hand mikes for announcers were located here, with, of course, video monitoring facilities for the announcers.

The WGN crew at this location was to provide the pool with "cover" shots of the beautiful lake front and harbor areas surrounding the ceremonies as well as views of the motorcade as it passed along Lake Shore Drive, ⅜ mile to the east of the building. The "cover" camera used a 35-mm. lens which produced, for the viewer, a field of vision akin to "being there in monochrome." The same turret accommodated a WGN-built "folded" 25-inch lens for closer views. The second camera utilized a 6:1 Zoomar with adapter for shots of the *Britannia* in the harbor, the Queen's launch approaching the landing, and the passing parade.

During the latter stages of the procession, the Prudential Building cameras were moved to the north side of the roof to get further cover shots of the motorcade coming southward on Michigan Avenue.

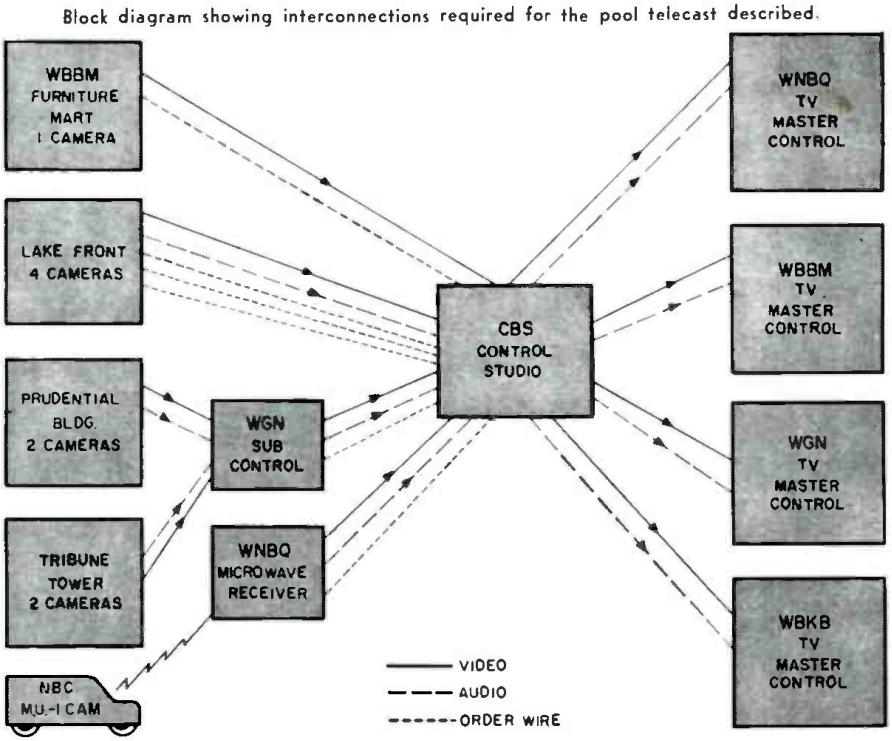
At the southeast corner of the Furniture Mart roof, thirty-two floors directly above Lake Shore Drive, WBBM placed a single camera to cover the portion of the parade route which was inaccessible video-wise to other units. WBBM maintains a permanent remote studio at this building, so that setup involved only extension of existing cables. Audio for shots from this location was provided by an announcer in the WBBM studios.

WGN's second position, on the street in front of Tribune Tower, was covered by two cameras and an announcer. Once again, the engineering problem was minimized by the fact that terminal facilities existed for a regular "man-on-the-street" pickup. One camera was located at sidewalk level with a standard lens complement. The second was boosted forty feet above street center on the elevator platform of a

(*Continued on page* 154)

NBC Cadillac used microwave relay atop the car for good on-the-move coverage.

Block diagram showing interconnections required for the pool telecast described.



# DIRECT MAIL


# Promotion for Service

By **WILLIAM LEONARD** / **For a business that operates only in a specific area, selective promotion gives the best result.**

THE CONSTANTLY shifting tides of business make it necessary for every service dealer to systematically reappraise the relative merits of the advertising he is using to keep his name and the work he can perform in front of the general public. He cannot afford to let his business slip into a rut. He must stay alert for ideas that will continue to regenerate the interest in his business that will inspire set owners to call him when they need service on their electronic products.

One dealer, who almost lost his business because he failed to maintain adequate communication between his shop and potential customers, recounted how circumstances forced him into a promotion plan that put his business back on a stable basis.

"I had no serious trouble," he said, "in getting adequate charges for my work. My problem was that I just was not getting enough work to fill the hours I had available to do it. If you can't keep your hours filled with profitable work in a service business, you cannot pay your bills and make a decent living at it."

"How did you solve your problem of insufficient volume?" he was asked. "As I look back on it now," he replied, "the solution was relatively simple. I merely put something to work for me that had been available to me for a long time. I rebuilt my business volume through the studied and consistent use of direct mail."

"What prompted you to turn to direct mail?" "It started out as an emergency measure," he explained. "My income dropped to the point where I had to have more business—or else. One day, as I was mulling over my problem, I found an interesting promotion piece in my mail. As I studied it, it occurred to me that I could adapt the idea to my own business. I went to see a printer whose set I had taken care of and discussed the idea with him. He developed a very striking flyer in the form of what is known as a 'self-mailer.' I ordered two thousand of them. When they came in, my wife and I addressed these mailers to every customer who had ever called us for service. We staggered the addressing and mailing over a thirty-day period.

"The results were really astonishing," he continued. "Our calls for service soon climbed back to a normal level. We found that mailing about four hundred pieces per week brought in the maximum volume I could handle without adding another man.

"Since then, it has been our regular program to mail a promotion flyer to approximately four hundred householders every week. We have added to our mailing list, of course. We used the first flyer for about three months. After going through our own customer mailing list, we used a cross-indexed directory to make a house-to-house mailing to all residents in our normal working area. This brought us a lot of new customers.

"We have gotten a big bang out of looking for new ideas to use in these promotion pieces. We are carefully avoiding the rut of mailing something just to be making a mailing.

"On the basis of my experience," he concluded, "I feel that carefully planned direct mail material, consistently used, is the only type of advertising that will really pay off for a small, independent, electronic service dealer. In my case, I was fortunate to find a promotion-minded printer who is able to take ideas and crystalize them into effective mailing pieces specifically designed for my business in my own community. It has really paid off for us."

The service dealer should constantly keep in mind that, unlike the self-service laundry, he does not see the same people again and again on a regular weekly basis. A particular customer may need service only once every six months or a year. Therefore, the customer does not get a chance to form the habit of going to one shop.

A dealer can no longer depend on the sign on his store front and the ads he carries in the directory pages of the phone book to keep him supplied with the new business he needs to keep his shop going. He must keep every radio and TV set owner in his immediate trade area continually aware of the fact that he is ready to take care of the service anytime the owner's set goes haywire. A single mailing is usually practically worthless, although an ingenious one will sometimes pay off. A postal card, a small mailing piece, or a letter once a month or every other month, is the type of promotion that will do the most good.

The mailing program should not be confined just to contacting people to solicit new business. The dealer who does not use a mail follow-up on the customers for whom he has performed service is missing a good bet. A letter or card with a return post card should be sent to a customer a few days or, at most, a week after a job is completed. This card should carry two or three questions which the set owner is to answer and send back to the dealer.

In this type of customer-checking follow-up, ask the questions that are important to you and your business. Don't be afraid to ask frank questions. Effective questions would be something like these: "Was your set serviced to your satisfaction?" "Was the work turned out in a reasonable time?" and "Do you feel our charges were fair and equitable?" Always leave a space for "comments and criticisms," and make it optional with the customer to sign it. Of course, cards can be simply coded so you will know the name of a customer who sends in a criticism without signing the complaint.

The most important part about this type of customer follow-up is the impression it leaves with the set owner. It will inspire him to think "He really cares about the kind of job he does!" The few cents spent on this small bit of customer relations creates good will whether or not the card is returned.

A dealer should not go into any kind of direct-mail promotion without having a definite plan and purpose in mind. The reason will determine what type of mailing you should use in your program. Unless you have an unusual "gimmick," do not look for spectacular results from the first mailing to your selected list. Here are a few "motives" you could use as the basis for pieces prepared for a long-range mailing program:

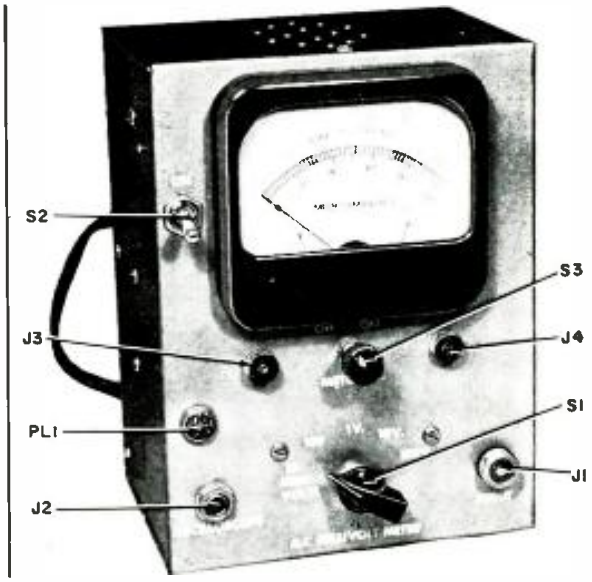
1. Let people know you are around.

(*Continued on page* 149)

# Wide-Band A.C. Millivoltmeter

By **LYLE E. SHARPE**

**Reading only 10 millivolts full-scale on its low range, this meter is handy for audio and other low-level measurements.**



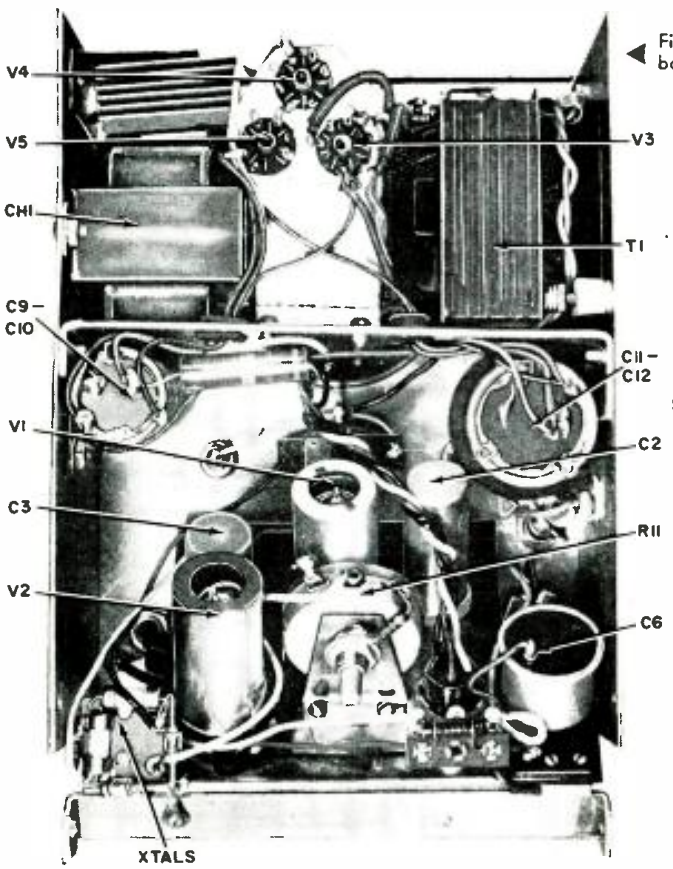

The meter need not be larger than a conventional v.t.v.m.

THE NEED to check out audio circuits is a good enough reason in itself for wanting a wide-band a.c. millivoltmeter, and there are other applications in addition. The absence of such instruments on the benches of service technicians and experimenters is due to the relatively high cost of laboratory units rather than to a feeling that the instrument is not necessary. Thus the cost and effort of putting together the unit described here is well worth while.

The meter is flat within 1 db from 10 cycles to 400 kc. on all scales. For comparative measurements, it is useful to better than 2 megacycles with a 10-millivolt input. Voltage may be read directly on the existing scale of the 0-100 microammeter used, the five ranges being 0 to 10 millivolts (.01 volt), to 100 millivolts (.1 volt), to 1 volt, to 10 volts, and to 100 volts. These are provided by the range switch ($S_1$ in Fig. 3) and the voltage divider comprising resistors $R_1$ to $R_5$ inclusive. $S_1$ is a single-pole, 5-position, shorting type switch so that the input grid of the circuit will not be open when going from one range to another.

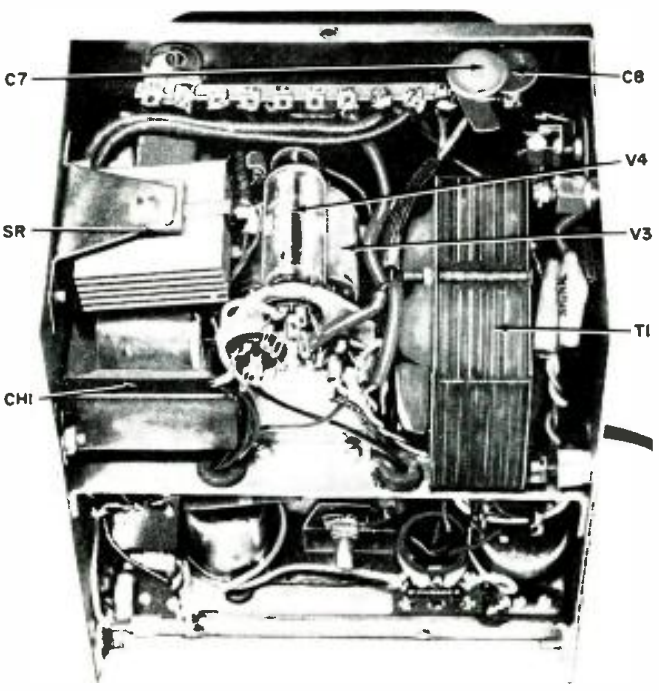
The circuit consists essentially of an audio amplifier with a suitable rectifying system for the 0-100 microammeter. Ten millivolts on the grid of $V_{1A}$ will provide the 1.7 volts required at the input of the meter bridge rectifier to produce full-scale deflection of the movement.

Due to high inverse feedback and degeneration from the unbypassed cathode resistors, the circuit achieves excellent stability and linearity. The entire instrument was housed in a box 4½ inches deep, 6 inches wide, and 8 inches tall, with several holes drilled in each end for air circulation. This type of cabinet lends itself to use particularly well, as the back and ends




◀ Fig. 1. Rear view with amplifier section dropped down at the bottom to expose layout. Power supply shelf is at the top.

Fig. 2. This view from the top down highlights the arrangement of components in the power-supply section.



are removed in one piece giving access to both the amplifier and power supply. Of course, the instrument may be constructed in any available, shielded cabinet, but be careful to isolate the amplifier from the transformer field.

## Power Supply

The power supply uses 3 miniature tubes to obtain 255 volts of regulated voltage, the 6X4 filament being operated from the 5-volt filament winding of the power transformer. When operated in this manner, it takes longer for the rectifier's heater to reach its operating temperature, giving a gradual rise to the operating voltages on the amplifier tube plates. For this reason, smaller units may be used as filter capacitors. The 6.3-volt winding of the power transformer is wired "back to back" with a 6.3-volt, 3 amp. filament transformer ($T_2$) to produce 110 volts of a.c. that is isolated from the power line. This voltage is rectified and dropped through $R_{20}$ to give 24 volts of d.c. for the amplifier filaments operated in series ($V_1$ and $V_2$).

Figs. 1 and 2 show the manner in which the power supply is mounted on a shelf in back of the meter, 3½" from the top of the cabinet. The filter capacitors ($C_9$ to $C_{12}$) are mounted underneath the shelf as shown after taping the cans to insulate them from the chassis. The high-voltage supply is grounded to the chassis at $J_1$. A bus bar is run from this point to the amplifier tubes for ground connections. The filament supply (point $Y$) is grounded to the chassis at pin 4 of $V_1$.

## Amplifier

The amplifier proper utilizes two dual triodes, a 12AX7 and a 12AU7. The input stage ($V_{1A}$) is a cathode follower and is cathode-coupled to the second section ($V_{1B}$), which operates with a grounded grid. The signal is then coupled through $C_4$ to the 12AU7, which is a cascaded voltage amplifier. $R_{15}$ feeds back some of the voltage from the plate of $V_{2B}$ to the cathode of $V_{2A}$. The signal then passes from the output tube ($V_{2B}$) through $C_6$, the closed-circuit jack $J_2$, and $R_{21}$ to four 1N34 diodes connected in a full-wave bridge circuit. The bridge is returned to ground through the cathode resistors of $V_{2A}$ ($R_{11}$ and $R_{12}$), providing approximately 15 db of feedback. Meter sensitivity is controlled by the amount of feedback through potentiometer $R_{11}$.

The amplifier was mounted on a small copper chassis ⅞" x 4" x 4". The front lip of the chassis was bent past the 90-degree angle to approximately 110 degrees and the center of the lip was trimmed out to provide clearance for the range switch. The amplifier was then fastened to the back of the front panel with the grid of $V_{1A}$ as close as possible to its connection on $S_1$. When mounted in this manner, the chassis slopes toward the rear, giving easy access to the amplifier deck. $C_2$ and $C_3$ are miniature can type electrolytics mounted on the amplifier deck. Potentiometer $R_{11}$ mounts on a bracket on top and at the rear of the chassis, where it is accessible for adjustment. The amplifier chassis was secured by two screws in the front panel and a bracket on the rear which fastens to each side. This is shown in Fig. 1 where the four screws are removed and the amplifier dropped out of the case somewhat. The copper chassis, power-supply shelf, and rear bracket may all be formed in a small bench vise.

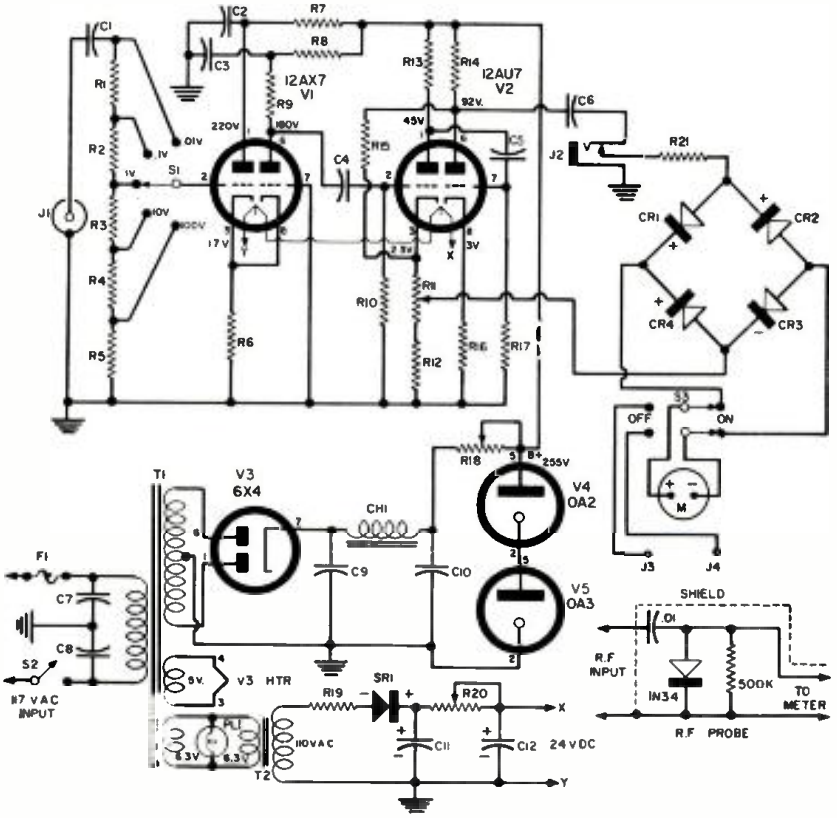
All rules applying to high-gain amplifier construction should be observed. Make all amplifier ground returns to the bus bar, which is grounded to the chassis at $J_1$. No shielded wiring is used, as this would result in a loss of high frequencies. Instead, tube sockets are oriented in such a way that straightforward point-to-point wiring is used with all signal leads kept as short as possible. Precision resistors (1 percent) were used for all units in the voltage divider except one and elsewhere as specified. Because of their low inductive reactance, the author used "Nobleoy" metal-film resistors made by *Continental Carbon Co.* While the lowest-value resistor in the divider ($R_2$, 111 ohms) should also be a precision unit, this is not a readily available value. However, it can be made up from standard-value units in conjunction with an accurate device for measuring resistance. The author filed a notch in a 100-ohm, 1-watt, carbon resistor to raise its value, checking the increase with a bridge. (Precision resistors at 110 ohms are available.)

## Adjustment

Before the millivoltmeter is set up for operation, wiring is completed with two exceptions: the "B+" lead at pin

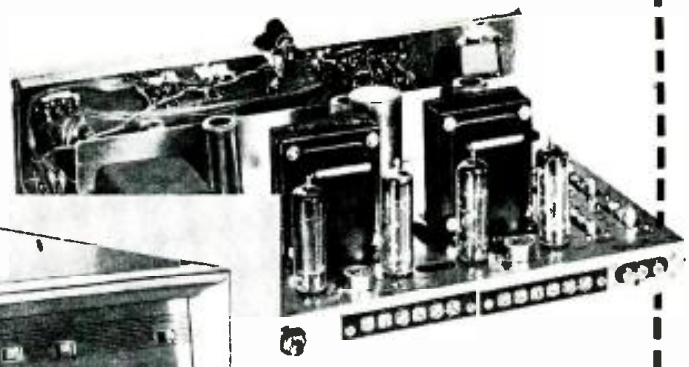
(*Continued on page* 130)

Fig. 3. In addition to main schematic, r.f. probe circuit is at lower right.




*$R_1$—1 megohm, ½ w. res. ± 1% (see text)*
*$R_2$, $R_3$—100,000 ohm, ½ w. res. ± 1% (see text)*
*$R_4$—10,000 ohm, ½ w. res. ± 1% (see text)*
*$R_5$—1000 ohm, ½ w. res. ± 1% (see text)*
*$R_6$—111 ohm, 1 w. carbon res. (see text)*
*$R_7$—1500 ohm, ½ w. res.*
*$R_8$—25,000 ohm, ½ w. res.*
*$R_9$—22,000 ohm, ½ w. res.*
*$R_{10}$—500,000 ohm, ½ w. res.*
*$R_{11}$—1000 ohm, linear pot, wire-wound*
*$R_{12}$—500 ohm, ½ w. res.*
*$R_{13}$—270,000 ohm, ½ w. res.*
*$R_{14}$—33,000 ohm, 1 w. res.*
*$R_{15}$—150,000 ohm, ½ w. res.*
*$R_{16}$—1000 ohm, ½ w. res.*
*$R_{17}$—1 megohm, ½ w. res.*
*$R_{18}$—2000 ohm, 10 w. adjustable res.*
*$R_{19}$—25 ohm, 1 w. res.*
*$R_{20}$—400 ohm, 20 w. adjustable res.*
*$R_{21}$—10,000 ohm, ½ w. res.*
*$C_1$, $C_4$, $C_6$—.1 μf. paper capacitor*
*$C_2$, $C_3$—10 μf., 400 v. min. elec. capacitor (Sprague EL-10)*
*$C_5$—2 μf. paper capacitor.*
*$C_7$, $C_8$—.01 μf. paper capacitor*
*$C_9$, $C_{10}$—20/20 μf., 450 v. elec. capacitor*
*$C_{11}$, $C_{12}$—200/80 μf., 150 v. elec. capacitor*
*$CH_1$—12 hy., 50 ma. filter choke*
*$CR_1$-$CR_4$—1N34 crystal diode*
*$M$—0-100 μa. meter*
*$SR_1$—150 ma., 150 v. selenium rectifier*
*$T_1$—Power trans. 300-0-300 v. @ 60 ma.; 5.0 v. @ 2 amps.; 6.3 v. @ 3 amps.*
*$T_2$—Fil. trans. 6.3 v. @ 3 amps.*
*$F_1$—2 amp. fuse*
*$J_1$—Coax. mic. chassis connector (Amphenol type)*
*$J_2$—Closed-circuit jack*
*$J_3$, $J_4$—Pin jack*
*$S_1$—S.p. 5-pos. switch (shorting type)*
*$S_2$—S.p.s.t. switch $S_3$—D.p.d.t. switch*
*$PL_1$—6.3 v. pilot light*
*$V_1$—12AX7 tube*
*$V_2$—12AU7 tube*
*$V_3$—6X4 tube*
*$V_4$—0A2 tube*
*$V_5$—0A3 tube*

**A new hi-fi integrated amplifier system for quality reproduction.**



Front and rear views of the PACO Model SA-40 integrated stereo amplifier.

ELECTRONICS WORLD LAB TESTED

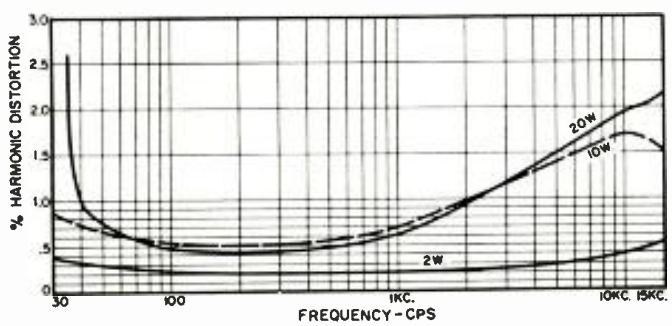
# Dual 20-Watt Amplifier Kit

IT CERTAINLY is of interest to note the progress made by the high-fidelity component industry during the past years. Some feel that the industry actually started with the introduction of the Williamson 15-watt amplifier approximately twelve years ago. From this point the development progressed rapidly both in quality of reproduction and, most noticeably, in the increase in power output. Just prior to the stereo disc, power amplifiers were being marketed with power output ratings as high as 75 watts. In fact, we published an article about a high-fidelity amplifier with an output of 120 watts. These were in monophonic days when power amplifiers were not usually integrated with their preamplifiers and their quality of sound reproduction, particularly as far as distortion was concerned, was the best available.

The stereo disc brought about economic changes. We then required two of everything, bringing the price to a point beyond the reach of the average high-fidelity enthusiast. The industry quickly realized the situation and the need for cutting cost of components. As a result the integrated amplifier became the vogue. Power output ratings also dropped considerably. Since price reduction was the keynote, quality no longer could equal the much higher-priced individual components in fashion during the monophonic era. The industry did not err and the tremendous sale of integrated systems today has proven them correct.

*PACO Electronics Co., Inc.*, a division of *Precision Apparatus Co., Inc.*, is a recent newcomer to the list of high-fidelity component manufacturers. They are following the trend in announcing their Model SA-40, a dual 20-watt integrated stereo amplifier system. This new unit combines in a single package practically all the basic controls and flexibility of operation that anyone would desire in a high-fidelity system. One can use it strictly for monophonic as well as for stereophonic reproduction. It includes some 14 different inputs; three dual high-level and four dual low-level.

Fig. 1. Distortion characteristics of the amplifier for 2-, 10-, and 20-watt conditions. 30 cps to 15 kc. were the limits of our tests.




The results of our lab tests are as follows:

*Frequency Response:* ±.2 db from 30 cps to 15 kc. This flat frequency response was obtained by adjusting the tone controls slightly from their mechanical mid-positions. The correct settings for tone controls were as follows: bass (left and right channel) at approximately an 11:30 o'clock position; treble (right channel) at mid-position and treble (left channel) at approximately a 1:00 o'clock position.

*Rumble Filter:* down 7.6 db at 30 cps.

*Loudness Control:* this is operated by a separate slide switch and is quite effective at the low frequencies only.

*Bass Control:* −19.5 db and +16.6 db at 30 cps.

*Treble Control:* −15 db and +17.5 db at 15 kc.

*RIAA Equalization:* flat within ±1.6 db from 100 cps to 15 kc. Below 100 cps it drops off to −3.3 db at 30 cps. According to the manufacturer this was purposely done since many tone arms have their resonant frequencies in this range. By reducing the gain, the resonance effects are reduced. For those who have high-quality tone arms, flat response can be obtained by adjusting the bass tone control slightly.

*Channel Separation:* −44 db at 1000 cps.

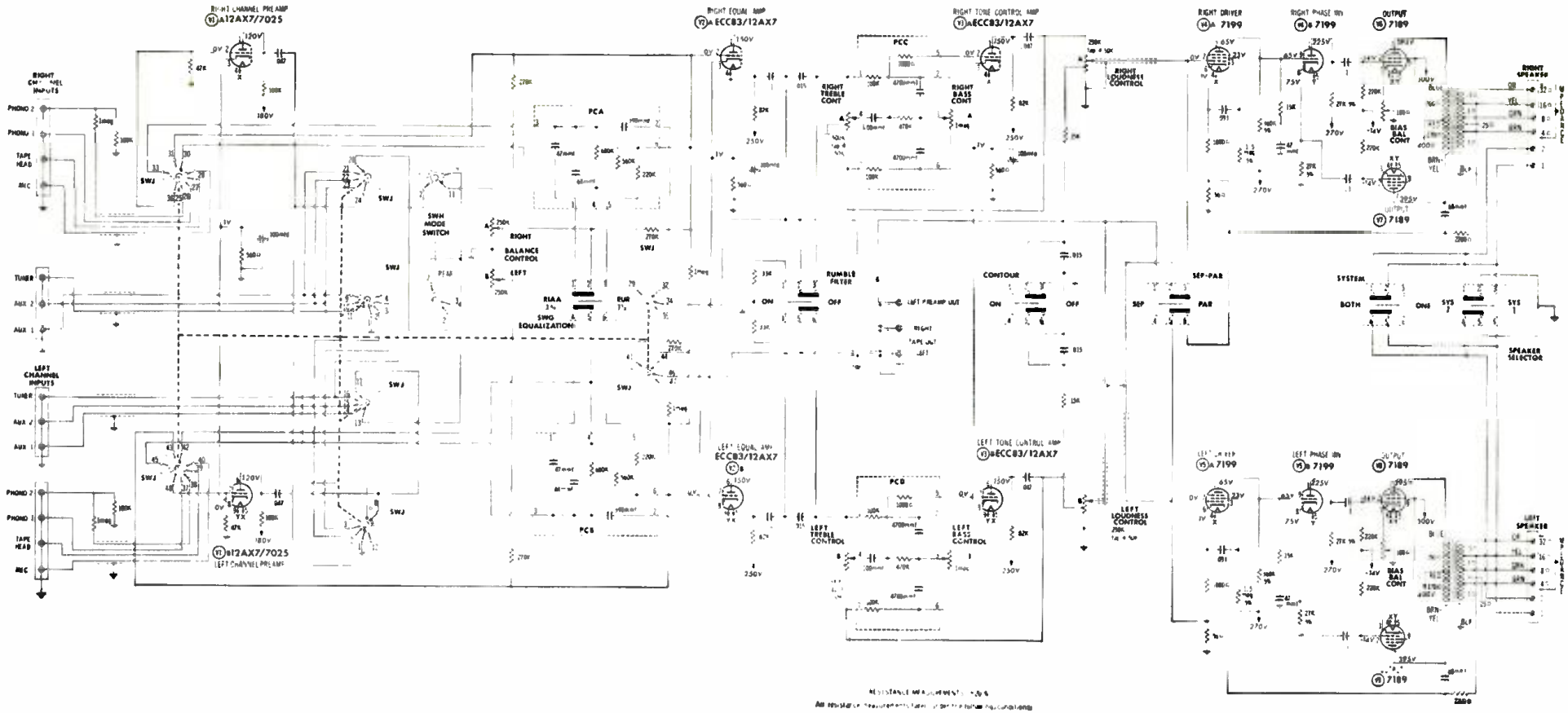
*Sensitivity:* for 20-watt output—tape head, 4.8 mv.; phono 1, 4.5 mv.; phono 2, 121 mv.; mierophone, 2.68 mv.; and auxiliary 1, 2, and tuner, 610 mv.

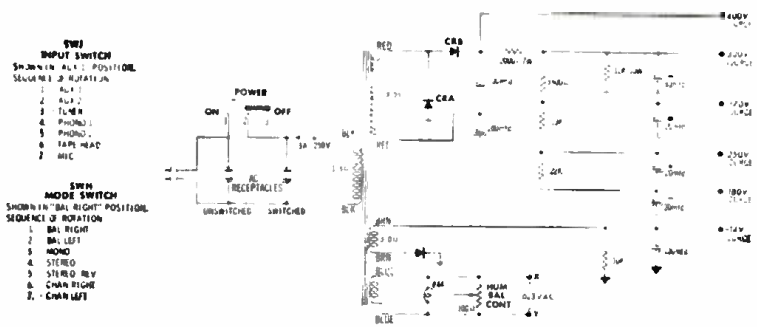
*Hum and Noise:* all high level inputs approximately −55 db for both open and shorted input conditions. Phono 1 and microphone, −47 db for shorted input and −36 db for open circuited input. Phono 2, −28 db for shorted input and −27.7 db for open circuited input. Tape head, −39.5 db for shorted input and −27.2 db for open circuited input. All of these figures are down from 2 watts. By adding 10 db to each figure, the characteristics would be relative to 20 watts output.

*Harmonic Distortion:* The test results obtained are all shown in Fig. 1. The results are extremely good, being for the greater part below our 2% limit. The only critical point is the sharp rise at 35 cps for 20 watts output.

*IM Distortion (60-6000 cps at a 4:1 ratio):* .98% for 2 watts output; 2.88% for 5 watts; 3.6% for 10 watts; 3.02%

(*Continued on page* 139)





Complete schematic diagram of the PACO Model SA-40 integrated high fidelity amplifier system. Nine tubes are used, with the output tubes being 7189's operated in push-pull with fixed bias.

RESISTANCE READINGS

| Tube | Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 | Pin 7 | Pin 8 | Pin 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| V1 | 12AX7 | *130K | 47K | 560Ω | *2Ω | *2Ω | *130K | 47K | 560Ω | *2Ω |
| V2 | 12AX7 | *100K | 520K | 560Ω | *2Ω | *2Ω | *100K | 270K | 560Ω | *2Ω |
| V3 | 12AX7 | *100K | 750K | 560Ω | *2Ω | *2Ω | *100K | 750K | 560Ω | *2Ω |
| V4 | 7199 | *33K | *400K | *1 meg | *2Ω | *2Ω | 1800Ω | 100K | 27K | 400K |
| V5 | 7199 | *33K | *400K | *1 meg | *2Ω | *2Ω | 1800Ω | 100K | 27K | 400K |
| V6 | 7189 | NC | 220K | 50Ω | *2Ω | 2Ω | NC | *200Ω | NC | *200Ω |
| V7 | 7189 | NC | 220K | 50Ω | *2Ω | 2Ω | NC | *170Ω | NC | *200Ω |
| V8 | 7189 | NC | 220K | 50Ω | *2Ω | 2Ω | NC | *200Ω | NC | *200Ω |
| V9 | 7189 | NC | 220K | 50Ω | *2Ω | 2Ω | NC | *170Ω | NC | *200Ω |

* MEASURED FROM POSITIVE (+) TERMINAL OF CRB
• MEASURED WITH HUM BAL CONTROL AT APPROX. CENTER OF ROTATION
NC NO CONNECTION

# Do You Know Enough About Capacitors?

By **SOL HELLER**

**In these "simple" troubleshooting and replacement problems, would you proceed correctly every time?**

DO YOU FEEL there is nothing to replacing a defective capacitor except substituting a similar unit? Or do you have the capacity to recognize that there is more to a capacitor than capacitance? Here is a quiz that may turn up some surprises for you. On the other hand, getting all the answers right should give you a charge.

**QUESTION:** *A service technician hesitates to use a .01-μf. paper capacitor as a replacement because it has been lying around (unused) on his shelf for ten years. Is his hesitation justified?*

**ANSWER:** With the exception of electrolytic units, capacitors deteriorate only during the time voltage is applied to them. The technician should show no hesitation about using the capacitor. Besides, if he does so little business that he still stocks a component he bought ten years ago, how can he afford to do anything else?

**QUESTION:** *Under what conditions is it preferable to connect an audio power output tube plate capacitor between plate and screen, rather than plate and ground, or plate and cathode?*

**ANSWER:** When a capacitor of the proper working voltage is not available, or when concern is felt, for some reason, regarding the possibility of a breakdown in the replacement capacitor, the plate-to-screen connection may be used. The d.c. voltage across the capacitor is much smaller in the latter case than it would be if the negative end of the capacitor were connected to ground, or to the cathode of the audio power output tube.

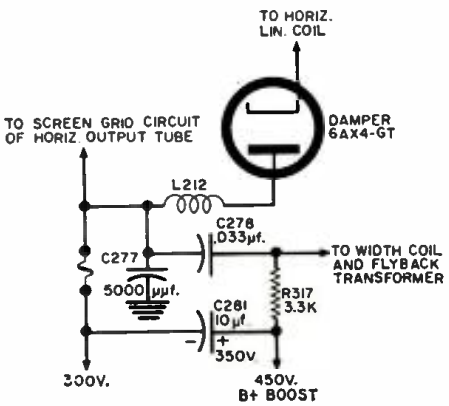
**QUESTION:** *Can a conventional 10-μf. electrolytic capacitor be used to replace $C_{281}$ in the circuit shown in Fig. 1?*

**ANSWER:** No. When the receiver is fully warmed up, the negative side of the capacitor is at "B+" potential, while the positive side is at the higher boosted "B+" voltage. A conventional capacitor could be used *if* this condition prevailed at all times, since the negative side of the capacitor would always be at a lower potential than the positive side. The condition does not prevail at all times, however. During the time the receiver is warming up, the boost voltage is *lower* than "B+." The negative side of $C_{281}$ is consequently connected to a higher positive potential than the positive side. The capacitor operates at this reversed polarity for about 10 to 15 seconds. A conventional electrolytic capacitor would bite the dust prematurely if exposed to such topsy-turvy conditions. A special semi-polarized unit is used by some set makers and available from them.

**QUESTION:** *$C_1$ in the vertical oscillator circuit shown in Fig. 2 is a ceramic disc coupling capacitor. What type of capacitor can be substituted for it when vertical drift is a problem, and tests have indicated that the vertical oscillator tube is not responsible?*

**ANSWER:** Substitution of a silver mica capacitor would be a logical procedure. The mica type has a very high electrical stability. A 1000-μμf. unit, for instance, will exhibit a capacitance change of less than .1% over a frequency range extending from low frequencies to 2 mc. The effect of a 1°C change in temperature is a change in capacitance of only 60 parts in a million. The tolerance of the replacement capacitor is not important—the vertical hold control setting will produce the correct frequency of operation even if the capacitor is 10 or 20% off its nominal capacitance. The important thing is that the capacitance, *whatever* it is, doesn't change with temperature.

Fig. 1. If you're alert, you would know what to look out for in replacing $C_{281}$.




**QUESTION:** *What harm, if any, is there in using a somewhat larger value of capacitance than called for in replacing the coupling capacitor between horizontal oscillator and horizontal output tube ($C_1$, Fig. 3).*

**ANSWER:** A larger value of coupling capacitance will increase the amount of horizontal sweep signal applied to the horizontal output tube. The horizontal drive control may have to be reset to some point close to one end of its range, leaving an insufficient margin for readjustments necessitated by aging or replacement of tubes or components in this circuit.

**QUESTION:** *Why is it undesirable to mount an electrolytic capacitor in an area where considerable heat is likely to develop during receiver operation?*

**ANSWER:** Heat is bad because it pro-

motes drying out of the electrolyte. This increases the series resistance offered by the capacitor; and the power factor (ratio of resistance to impedance in the capacitor) goes up in consequence. A higher power factor is undesirable, since larger $I^2R$ losses occur across the increased resistance of the capacitor, and produce still further heating of the unit. Heat also tends to increase the leakage current of the capacitor (see Fig. 4), which promotes greater $I^2R$ losses in the capacitor, and additional heating of the unit.

Excessive heating spells death to electrolytic capacitors. In some types, every 10°C increase in temperature causes a 50% decrease in life expectancy; others are less affected by temperature. In general, however, keeping cool is as important for capacitors as it is for people.

**QUESTION:** *A technician, in replacing a power supply electrolytic capacitor that has failed prematurely, decides to leave off the insulating cardboard that was present around the original unit. Does this procedure make sense?*
**ANSWER:** It does. The cardboard insulation prevented the capacitor from dissipating heat adequately, and could be responsihle for premature failure. But watch for exposed voltage.

**QUESTION:** *What kind of electrolytic capacitor will function more satisfactorily than other kinds under high-temperature conditions?*
**ANSWER:** A capacitor that has a hermetically sealed metal can for its container. This construction minimizes loss of electrolyte, and therefore increases life expectancy. Any capacitor with a voltage rating 50 to 100 volts higher than the operating voltage can be used at temperatures up to 185°F. Temperatures in excess of 140°F may damage a conventional capacitor if its voltage rating is not much above the operating voltage.

**QUESTION:** *Are there any applications in which it would make a difference whether an electrolytic capacitor was fabricated with an etched-foil anode or a plain-foil anode?*
**ANSWER:** Yes. Dry electrolytic capacitors have anodes made of plain, etched, sprayed, or fabricated foil. An etched-foil anode is one that has been made very rough by special processing. The resultant surface undulations give the anode (which forms one plate of the capacitor) a much larger effective area. The electrolyte (which forms the second plate of the capacitor) follows the undulations. The capacitor, in consequence, has a much larger capacitance than a plain-foil unit of the same size would have, permitting compactness.

However, an etched-foil capacitor will have a considerably higher total impedance than a plain-foil equivalent, making the former inferior for certain applications. A unit that does not have an etched foil would be preferable for bypassing and decoupling in audio-frequency and vertical sweep circuits. The catalogues of parts supply houses are often useful in determining whether a specific electrolytic capacitor does or does not use an etched-foil anode.

**QUESTION:** *What effects, if any, do low temperatures have on electrolytic capacitors?*
**ANSWER:** For most conventional types, the capacitance decreases rapidly below temperatures of −5°C. We can conceive of a situation where a battery portable in which an electrolytic capacitor has been replaced is returned to the service technician for further work

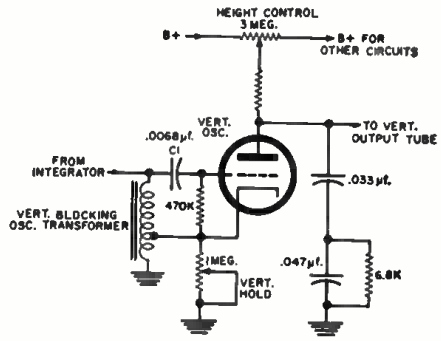



Fig. 2. The proper replacement for one capacitor here can lick vertical drift.

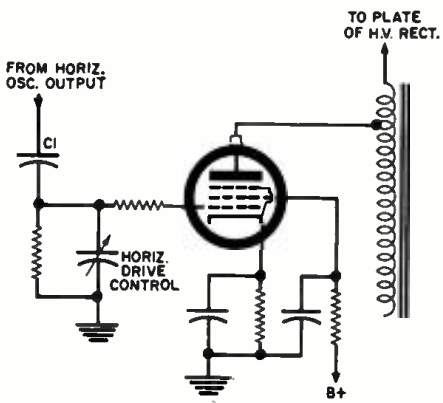



Fig. 3. A common procedure used in replacing $C_1$ could cause later difficulty.

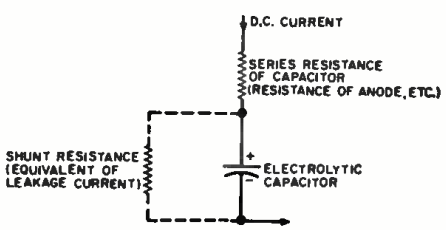
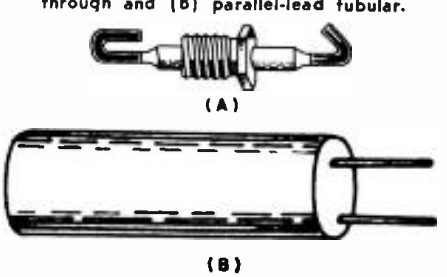



Fig. 4. An improperly mounted electrolytic may start a vicious trouble cycle.

Fig. 5. Special problems go with special units, like (A) the ceramic feedthrough and (B) parallel-lead tubular.



(A)

(B)

because it didn't operate satisfactorily outdoors in very cold weather. This temporary condition clears up when the receiver and its owner sensibly return to a comfortable position by the fireside, or when the weather gets a little warmer. If necessary, higher-cost tantalum capacitors may be used. Some of these are rated for operation at −55°C, or even lower.

**QUESTION:** *In the case of a ceramic feedthrough type of capacitor (as shown in Fig. 5A), are there any visual indications that might point to the need of replacement?*
**ANSWER:** This type should be replaced if the silver-coated surface is peeled, or if the ceramic is cracked, or if the center conductor of the unit is loose.

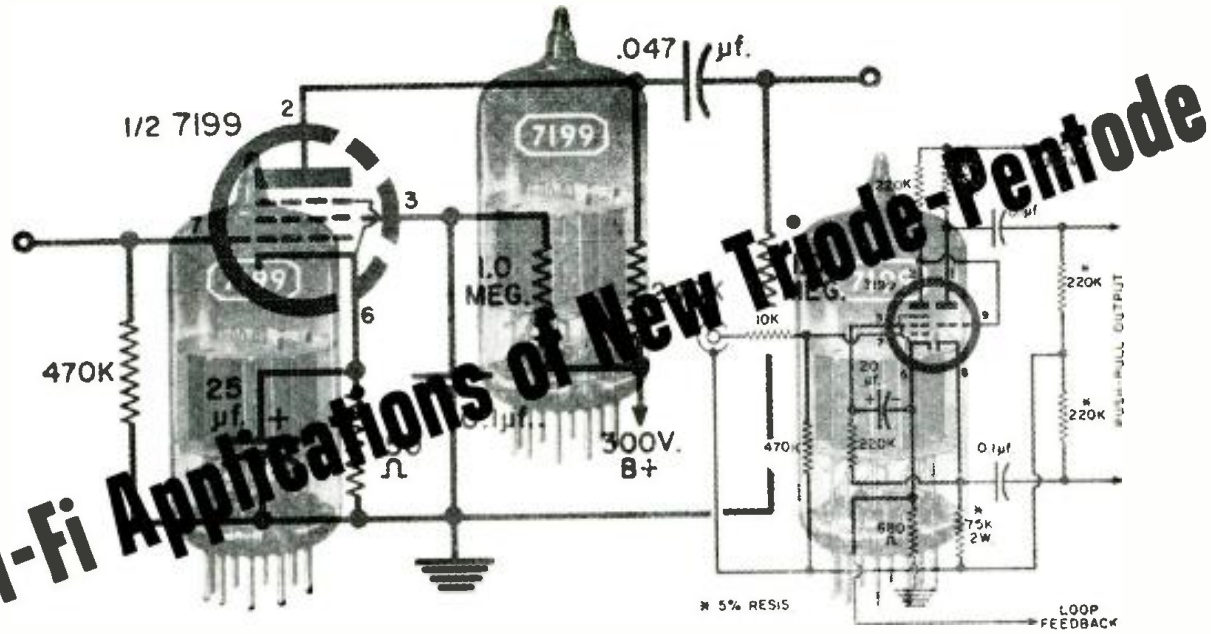
**QUESTION:** *Does it make a difference in which position an electrolytic capacitor is mounted?*
**ANSWER:** It may, especially if the unit is a wet electrolytic. An incorrect mounting position may reduce the effective capacitance. The unit should be mounted in an upright position in such a way that the vent (for escaping gas) is unobstructed.

**QUESTION:** *True or False: When an electrolytic capacitor begins to cause circuit malfunction, it is always necessary to replace it.*
**ANSWER:** False. Take the case where the only change causing the trouble is an increase in r.f. impedance of the unit, impairing its ability to bypass higher frequencies. Bridging it with a non-electrolytic type of smaller value hut of the proper voltage rating (for example, a .1-μf. paper unit) will generally eliminate the trouble.

**QUESTION:** *True or False: If a replacement filter capacitor doesn't function properly as soon as it is put into a radio (i.e., hum is heard), it should be replaced immediately.*
**ANSWER:** False. It should be given a chance to re-form. When an electrolytic capacitor has been idle for several months, initial leakage current may be high enough to introduce hum because the component has de-formed while not in use. If the receiver is left in operation for 20 minutes or so, the capacitor will generally be restored to normal functioning.

**QUESTION:** *True or False: When a capacitor that is mounted on a printed board is to be replaced, it may become necessary to consider more of its characteritics than is ordinarily the case.*
**ANSWER:** True. The physical configuration may become important in addition to the electrical properties. Take the paper tubular capacitor with phenolic case shown in Fig. 5B. Parallel leads permit the unit to be plugged into a printed board, after which it is soldered in place. It would be quite difficult to fit a conventional capacitor of the same nominal value with axial leads into the proper space, in most cases.

-30-




# Hi-Fi Applications of New Triode-Pentode

By **WAYNE AUSTIN** / Electron Tube Div., Radio Corp. of America

**Low-noise 7199 tube provides more gain and other advantages in voltage-amplifier, phase-splitter, and tone-control stages.**

A NOTABLE trend in high-fidelity-amplifier design has been the use of triode-pentode types in voltage-amplifier/phase-splitter circuits, tone-control circuits, and other circuits operating at low and moderate signal levels which have heretofore been the domain of twin-triode types. The reason for this trend is a simple one. A triode-pentode provides the same space economy and wiring convenience as a twin-triode and offers the designer of high-fidelity audio equipment several additional advantages. For example, the greater voltage gain available allows the designer wider latitude in the use of inverse feedback, corrective networks, and other means for obtaining low harmonic distortion, good frequency-response characteristics, and stability. A pentode also produces less intermodulation distortion than a triode operating at a comparable signal level[1] and introduces fewer Miller Effect problems because of its extremely small grid-plate capacitance.

Until recently, practically the only triode-pentodes available to the designer of high-fidelity equipment were types designed primarily for r.f., i.f., and converter service, such as the 6AN8, 6BH8, 6BR8, 6CQ8, and 6U8-A. Although these types have been used in a number of well-designed high-fidelity amplifiers, their performance has left something to be desired, because they do not have the extremely low leakage noise, freedom from heater hum, and anti-microphonic construction which are essential in tubes for high-fidelity a.f. service.

## New Tube Type

Recently, however, a triode-pentode specifically designed and controlled in manufacture for high fidelity a.f. service was brought out by *RCA*. This tube, the *RCA*-7199, is a 9-pin miniature type containing a medium-*mu* triode and a sharp-cut-off, high-transconductance pentode. It employs a specially designed electrode and mount structure having very low microphonism, an internal-lead and basing arrangement designed to minimize interelectrode leakage noise, and special heaters designed to produce extremely low magnetic hum.

The maximum hum and noise for the 7199, expressed as equivalent voltages at the control grids of the two units are 100 microvolts for the pentode unit and 150 microvolts for the triode unit. Median values for the type are only 35 microvolts for the pentode unit and 10 microvolts for the triode unit. These hum and noise voltages are for grid-circuit resistances of 50,000 ohms.

Because of its high transconductance (7000 μmhos), the pentode unit of the 7199 can provide large voltage gains (values of 100 to 350 are typical). It can also deliver output signals as large as 90 volts peak-to-peak with low distortion. The triode unit has a *mu* of 17, and can handle large signal voltages. This combination of characteristics, together with its very low hum and noise, make the 7199 especially suitable for use as a voltage amplifier and cathode follower, or a voltage amplifier and phase splitter (the phase splitter is a form of cathode follower). It is also extremely useful in tone-control circuits of the Baxandall type.[2]

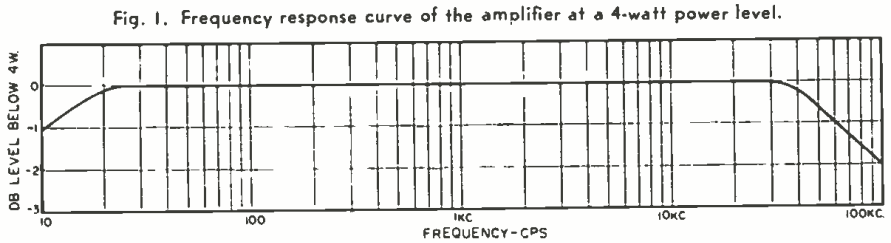
## Hum and Noise Performance

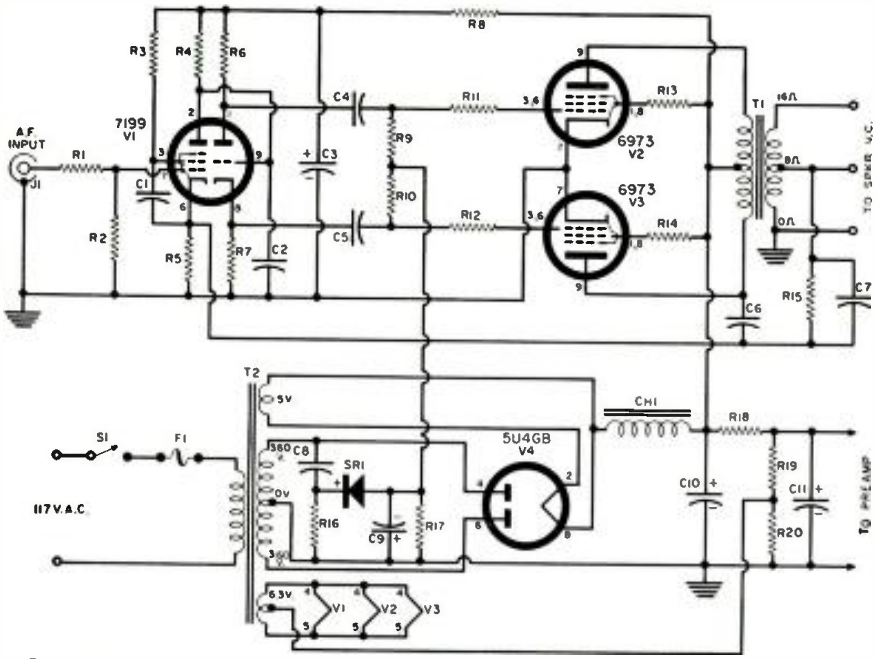
The hum-and-noise performance that can be expected from the 7199 when precautions are taken in circuit layout and wiring to eliminate hum and noise from other sources is illustrated by the following example:

Assume that the pentode unit of the 7199 is to be used in the input stage of an amplifier having a sensitivity of 100 millivolts r.m.s. (The rated power output or voltage output of the amplifier need not be specified.) The amplifier has an input resistance of 50,000 ohms. Based on the maximum value of hum and noise for the pentode unit (100 microvolts), the signal-to-noise ratio at the amplifier input, in decibels, will be:

$$20 \log \frac{0.1}{0.0001} = 20 \log 1000, \text{ or } 60 \text{ db.}$$

Fig. 1. Frequency response curve of the amplifier at a 4-watt power level.






$R_1$—10,000 ohm, ½ w. res.
$R_2$—470,000 ohm, ½ w. res.
$R_3$—820,000 ohm, ½ w. res.
$R_4$—220,000 ohm, ½ w. res.
$R_5$—820 ohm, ½ w. res.
$R_6$, $R_7$—15,000 ohm, 2 w. res. ± 5%
$R_8$—3900 ohm, 2 w. res.
$R_9$, $R_{10}$—100,000 ohm, ½ w. res. ± 5%
$R_{11}$, $R_{12}$—1000 ohm, ½ w. res.
$R_{13}$, $R_{14}$—100 ohm, ½ w. res.
$R_{15}$—8200 ohm, ½ w. res.
$R_{16}$—15,000 ohm, 1 w. res.
$R_{17}$—68,000 ohm, ½ w. res.
$R_{18}$—4700 ohm, 2 w. res.
$R_{19}$—270,000 ohm, 1 w. res.
$R_{20}$—47,000 ohm, ½ w. res.
$C_1$, $C_4$, $C_5$—.25μf., 600 v. paper capacitor
$C_2$, $C_6$—3.3 μμf., 400 v. mica capacitor
$C_3$, $C_{11}$—40 μf., 450 v. elec. capacitor
$C_7$—150 μμf., 400 v. mica capacitor
$C_8$—.02 μf., 600 v. paper capacitor
$C_9$—100 μf., 50 v. elec. capacitor
$C_{10}$—80 μf., 450 v. elec. capacitor
$CH_1$—Filter choke, 3 hy. @ 160 ma., 75 ohms (Triad C13X or equiv.)
$F_1$—3 amp., 150 v. fuse
$SR_1$—20 ma., 135 v. selenium rectifier
$T_1$—Output trans to match speaker v.c. to 6600-ohm plate-to-plate tube load (Stancor A8056 or equiv.)
$T_2$—Power trans., 360-0-360 v. @ 120 ma.; 5 v. @ 3 amps.; 6.3 v. @ 3.5 amps. (Stancor PC 8410 or equiv.)
$S_1$—S.p.s.t. switch
$J_1$—Phono jack
$V_1$—7199 tube (RCA)
$V_2$, $V_3$—6973 tube (RCA)
$V_4$—5U4GB tube
NOTE: Values for $C_4$, $C_5$, $C_7$ are matched to the Stancor A8056 transformer only.

Fig. 2. A 15-watt amplifier using the 7199 as voltage amplifier and phase splitter.

Based on the median value of hum and noise for the pentode unit (35 microvolts) this ratio will be:

$$20 \log \frac{0.1}{0.000035} = 20 \log 2850,$$ or approximately 69 db.

If the pentode stage has a gain of at least 20 db (a voltage gain of 10), hum and noise originating in the grid circuits of succeeding stages can be neglected and the signal-to-noise ratio at the amplifier output will be the same as that at the input. Since the pentode unit of the 7199 can easily provide voltage gains of more than 100, this assumption is justified. Hum and noise at the output of the amplifier, therefore, will be at least 60 db below rated output. This value is the accepted minimum for high-fidelity reproduction.

It is evident from the foregoing example, that if the pentode unit of the 7199 tube is used in the input stage of a preamplifier, or in any other application where the input signal level is only a few millivolts, the hum and noise at the output of the following amplifier may be substantially less than 60 db below rated output. For high-fidelity reproduction, therefore, the pentode unit of the 7199 should not be used in any stage where the input-signal level is substantially less than 100 millivolts.

## Applications

An example of the use of the 7199 as a voltage amplifier and phase splitter is shown in Fig. 2. In this high-fidelity 15-watt power amplifier, designed by Leonard Kaplan of the Electron Tube Division of *RCA*, (See "A Low-Cost Hi-Fi Amplifier" in the May 1958 issue) the pentode unit of the 7199 (the voltage amplifier) is direct-coupled to the triode unit (the phase splitter), which drives a pair of 6973 high-fidelity beam power tubes operating in class AB, with fixed bias. The amplifier uses 18 db of degenerative feedback between the voice coil and the voltage-amplifier cathode. At 15 watts output, total harmonic distortion (measured at 1000 cps) is less than 0.5 per-cent, and intermodulation distortion is less than 0.5 per-cent. Hum and noise are extremely low: 84 db below rated output with input shorted. As shown in Fig. 1, the frequency response of the amplifier at 4 watts output is flat over the entire audio spectrum and down less than 2 db at 10 cps and 60,000 cps; at 15 watts output it is flat from 20 cps to 15,000 cps, and down less than 1 db at 15 cps and 20,000 cps. The amplifier has a sensitivity (input voltage required for full output) of 1.2 volts r.m.s. and a damping factor of 12.

A slightly different voltage-amplifier—phase-splitter circuit which is also capable of very good performance is shown in Fig. 3. In this circuit grid-No. 2 voltage for the pentode unit of the 7199 is obtained through a 220,000-ohm resistor from the cathode of the triode unit. Since the voltage at the triode cathode contains a.f. signal components which are in-phase with those at grid-No. 2 of the pentode, this arrangement provides positive feedback between the two units which can be used to obtain increased over-all gain at the lower audio frequencies. The frequency at which this feedback becomes effective depends on the value of the grid-No. 2 bypass capacitor. If this frequency is higher than the ripple frequency in the "B" supply circuit, it may be necessary to increase the value of the capacitor or use additional filtering in the "B" supply circuit to prevent motorboating.

The pentode and triode units of the 7199 tube can, of course, be used independently. The circuit of a general-purpose voltage amplifier stage, using the pentode unit, is shown in Fig. 4. This circuit provides a voltage gain of approximately 300, and can deliver output voltages of 90 volts peak-to-peak with very low distortion.

### REFERENCES

1. "Radiotron Designer's Handbook," Fourth Edition, Edited by F. Langford-Smith, Chapter 12, page 511.
2. Ibid., page 1183.

—30—

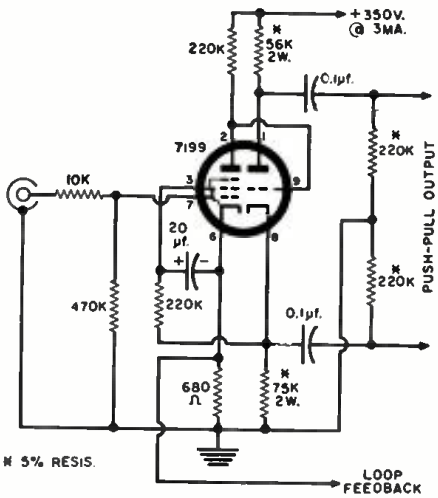
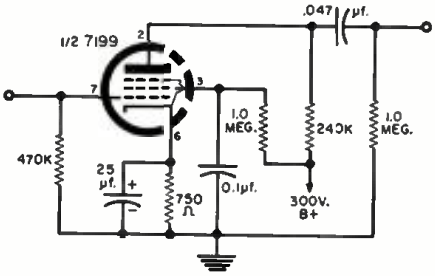



Fig. 3. Another combined pentode voltage amplifier and triode phase-splitter circuit.

Fig. 4. General purpose voltage amplifier.




Close-up view of the 25-watt mobile transistorized amplifier designed for p.a. work.

# TRANSISTORS OR TUBES For Mobile P.A. Systems

By **SAMUEL CURCHACK,**
Project Engineer, Bogen-Presto Co.
Div. of The Siegler Corp.

Author is pointing to one of output transistors mounted on chassis of BT25 amplifier.

**For compact equipment that must be light and sparing of battery power, here is why transistors have the edge.**

WHEN discussing high-fidelity or public-address systems, there is much that can be said in favor of *both* transistor and tube amplifiers. However, when we speak of *mobile* amplifier systems, until such time as power and space become unlimited, we feel that the future belongs entirely to the semiconductor.

There are some good reasons for taking this point of view. Mobile use, in most cases, demands that the equipment be compact, light in weight, and sparing of battery power.

If the amplifier is to be operated from an automotive vehicle, space is often at a premium. An amplifier that can be mounted in and controlled from a compartment in the dashboard is certainly to be preferred to equipment that requires storage in the trunk of a car. A p.a. system that during standby draws from the battery the same amount of current as is drawn by a panel lamp certainly offers advantages over one that demands, when idling, that the vehicle's engine be kept idling too in order to charge the battery.

If the p.a. system is entirely self-contained and is to be hand-held and operated, there is, of course, more reason why it should be small, lightweight, and draw only the minimum amount of current required for most efficient operation.

For the home or auditorium, this reduction in weight and size hardly justifies the added expense of high-power transistorized audio systems; and electric power is so inexpensive that we rarely worry about efficiency. However, in portable p.a. systems, it is this efficiency factor that makes the use of a transistorized power amplifier mandatory, in the author's opinion. In addition to saving battery power, the high efficiency feature contributes considerably both to the compactness of the equipment and reduction of its weight. It is for this reason that it might be worthwhile to examine this factor just a little more thoroughly than is usually done when comparing the operation of transistor and tube equipment.

"Efficiency," simply stated, is the ratio of the amount of power realized from the amount of power consumed. When we talk of "speaker efficiency," we want to know how many acoustical watts we get out as compared to the electrical watts delivered by the amplifier. When we speak about "amplifier efficiency," we are interested in the amount of power delivered by the amplifier as compared to the power drawn from the power line or battery. This "amplifier efficiency," expressed as an equation is equal to: $Watts_{output}/Watts_{input} \times 100\%$.

Often, in comparing transistors with tubes, this question of "over-all" efficiency, which is a true measure of the performance of the equipment, is over-

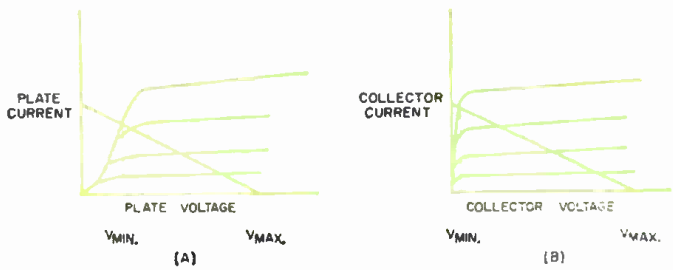
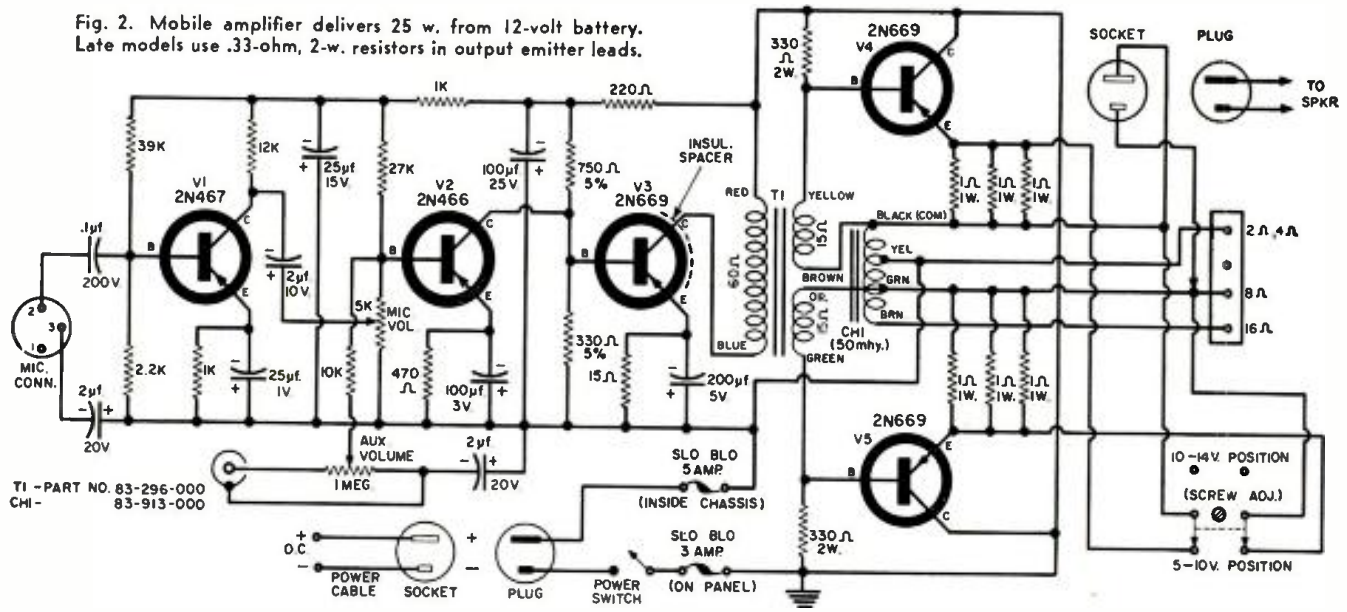



Fig. 1. Load lines for (A) power pentode and (B) power transistor. Note that $V_{min}/V_{max}$ approaches zero in the case of the transistor.

Fig. 2. Mobile amplifier delivers 25 w. from 12-volt battery. Late models use .33-ohm, 2-w. resistors in output emitter leads.




looked. What we usually see instead is the formula for the efficiency of an amplifier operated in class B. Push-pull class B operation is almost always chosen for mobile equipment because, theoretically, it is 57% more efficient than class A. Inasmuch as this contributes, in part, to the over-all efficiency, we will investigate it first. For simplicity, we will consider only the case of true class B operation.

In practice, class B can be used only for speech reproduction. Since "center clipping" occurs when the load is transferred from one of the push-pull pair to the other, a slight forward bias is usually applied to the tubes or transistors. This eliminates crossover distortion which is extremely objectionable for musical reproduction. The resultant mode of operation is termed class AB, but since the bias applied is usually of minor proportions, the formula for true class B operation may be applied.

This formula may be reduced to almost identical form for both transistors and vacuum tubes. It then reads: $N_p = 78.5\ (1 - V_{min.}/V_{max.})\%$; where $N_p$ = efficiency, $V_{max.}$ = supply voltage (plate or collector voltage at current cut-off), and $V_{min.}$ = voltage drop across the tube or transistor when it is delivering peak power to the load.

When we compare load lines for a power pentode (Fig. 1A) and a power transistor (Fig. 1B), we see that the ratio $V_{min.}/V_{max.}$ can be appreciable for the vacuum tube and negligible for the transistor. It is for this reason that efficiencies closely approaching the theoretical maximum are possible with the latter.

The figure $N_p$ is often quoted when comparing the two devices. Thus, a typical practical figure for tubes might be on the order of 55% and for transistors, 75%. In both cases, transformer losses have been neglected. These figures, however, are misleading and put the tube in a better light than it actually deserves.

Consider first the amount of current required by the heaters. This is taken direct from the battery and for a 25-watt mobile p.a. tube amplifier about 40 watts may be drawn just to heat the filaments. This energy is being used whenever the amplifier is on, irrespective of whether or not it is producing sound. Thus, the transistor, requiring no heater power, is already "ahead" by relieving the battery of a large drain.

In addition, tubes require high anode voltages to generate appreciable amounts of power. Thus, in vehicular operation, where the supply is usually 12 volts, conversion to high voltage must take place first. In most cases, this requires at least three more major components than does the transistor supply—a vibrator, a transformer, and a rectifier tube with its associated filtering circuit. In addition to the lowered efficiency incurred by losses in each of these components, this extra circuitry imposes other disadvantages: the vibrator is always a possible source of noise—it may require replacement several times during the life of the equipment; the rectifier tube, which is also subject to failure, generates additional heat; all of these components (which do not exist in the transistorized circuit) go to increase the size of the equipment.

It might be interesting to compare the losses incurred in the two types of amplifiers—each producing 25 watts of output power. Some typical figures are given in Table 1. From these representative values we can see that when full power is realized from the output, the tube amplifier may draw almost three times as much current from the batteries as will the transistorized device.

However, the duty cycle of speech is roughly 20%. Thus, the amplifier is being used only one-fifth of the time that the battery power is on. It is during this remaining 4/5th time that the vacuum-tube p.a. system is most wasteful of power; even though no current is being used to produce speech, the filaments and power supply must remain activated. From Table 1 we can see that it is possible to draw, during this period, about 20 times the amount of current that is drawn by the semiconductor device.

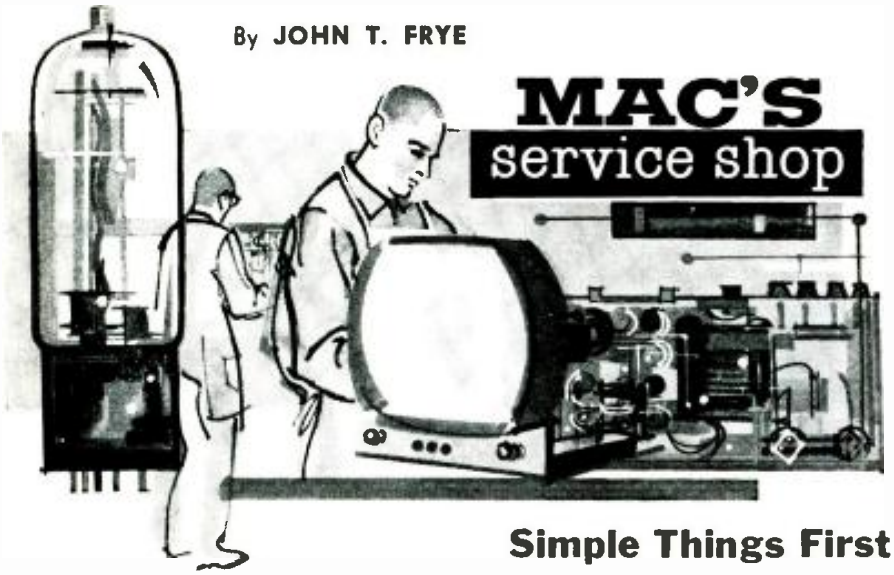
There are other reasons why the transistor is to be preferred for mobile applications. For emergency purposes

(*Continued on page* 126)

Table 1. Comparison between power requirements, efficiency of tubes and transistors.

| | TUBE CIRCUIT | TRANSISTOR CIRCUIT |
|---|---|---|
| Power required at output stage to yield 25 watts of signal. A 10% transformer loss is assumed for both circuits. | 55 watts | 38 watts |
| Battery drain to provide 25 watts of signal at power supply output. | 69 watts | 38 watts |
| Filament power required. | 40 watts | 0 watts |
| Other standby or bias power required. | 5 watts | 2 watts |
| Total power required for full output. | 114 watts | 40 watts |
| Over-all efficiency at full output. | 25/114 = 22% | 25/40 = 62% |
| Power consumption during standby (approx.). | 45 watts | 2 watts |

By JOHN T. FRYE




# Simple Things First

BARNEY had been muttering to himself for the past quarter of an hour, and finally Mac, his employer, walked over to the boy's end of the bench to see what all the fuss was about.

"Oh how I hate intermittents!" Barney said fervently. "One time this little a.c.-d.c. receiver will play okay for hours on end; the next time it won't even start. Right now the only sound you can get out of it is a low hum. I've changed all the tubes one at a time; so I know tubes are not the trouble, but look at this reading on the oscillator grid of the 12BE6."

He touched the probe of the v.t.v.m. to the grid lug of the socket, and the meter indicated some forty positive volts.

"When the radio's playing, I get seven or eight negative volts here," the red-headed youth continued. "That's the normal grid-leak voltage developed by oscillator action across this 22,000-ohm resistor between grid and ground. But when the radio goes dead, this voltage suddenly switches from minus eight to plus forty volts. I was sure it was an intermittent internal short in the tube, but the same thing happens with a new tube. Now I've decided it has to be an intermittent breakdown in the socket insulation; so I guess I may as well start changing the socket —and that's a job I despise."

"Easy, boy, easy!" Mac said mildly. "Have you checked the diagram?"

"Oh come now, Mac," Barney said with a superior smile; "I'm a big boy now, remember, and this is just a little a.c.-d.c. receiver. Its simple diagram is tattooed on my brain. Think of how many hundreds of these things I've serviced."

"I'm thinking; and for every one you've serviced, I've serviced ten; but I'm still going to look at the diagram," Mac said with a disarming grin.

He took the service sheet from the file and merely glanced at it before he slid it across to his assistant. As Barney stared down at the diagram, a brick-red flush crept up out of his collar and spread over his face, dimming his freckles to invisibility.

"Well what do you know!" he exclaimed. "That grid leak returns to the cathode instead of to ground, and the cathode goes to ground through the primary of a two-winding oscillator coil. I'll bet a nickel that primary is opening up leaving the cathode floating, and the high cathode voltage under these circumstances is conveyed through that 22,000-ohm grid leak to the oscillator grid."

A simple check with the ohmmeter confirmed this suspicion, and Barney was lucky enough to find the primary winding break right at the end where it tied to a terminal. A drop of solder solved the problem. As the crestfallen boy replaced the receiver in the cabinet, Mac observed:

"I don't know what I'm going to do with you if you don't learn to go to the service literature when the going gets tough. Here I've invested hundreds of dollars in that literature with the sole aim of helping us to do our job better and faster, and then you blithely ignore the whole thing and depend upon your alleged omniscient knowledge of how the circuit must be. Actually this business of returning the grid resistor to the cathode instead of directly to ground is very, very common; but your preconceived notion that it *had* to return to ground kept you from even thinking about that possibility. You were looking for a 'far-out' cause of the trouble, such as a defective tube socket. I'll bet you haven't found more than three tube sockets with broken-down insulation in all the time you've been working for me."

"I have in transmitters," Barney defended himself lamely.

"We're working on receivers, not transmitters," Mac relentlessly pointed out; "and I've told you over and over always to look for simple causes of trouble first. Save the odd-ball, freakish possibilities for investigation until after all the ordinary, likely things have been checked out. Hey! Wait a minute. What was that whistle?"

Barney had the set back in the cabinet and was tuning it back and forth across the band as a final check. As he crossed a station near the middle of the band a heterodyne was heard so loud that it blocked out reception of the station.

"That's just the second harmonic of the 455-kc. i.f. beating with the station on 910 kc.," Barney explained. "You can hear that little heterodyne on lots of sets. Probably this one doesn't have enough decoupling in the detector circuit and some of the i.f. is feeding back through the a.v.c. system to the receiver input."

"I wouldn't call that screech 'a little heterodyne,'" Mac observed acidly. "You'll never convince me a manufacturer would let a receiver go out in that condition. Take off the back."

When two screws were removed and the back, carrying the antenna, was pulled away from the cabinet, the heterodyne disappeared and the station could be heard clearly.

"Apparently the signal is being radiated directly into the loop," Mac said as his gentle fingers probed around in the receiver. Suddenly he held up the end of the broken little copper-ribbon ground lead of the 12AV6 tube shield and stared quizzically at the other technician.

"This just ain't my day," Barney sighed as he reached for the solder gun. "I must have broken that lead when I was changing tubes. It's easy to do. With the shield floating, the 455-kc. signal on the diode plates of the 12AV6 could radiate directly into the loop winding only an inch or so away. Once more I was looking for a more complicated cause of trouble than an ungrounded tube shield. Why don't you fire me?"

"Don't tempt me," Mac answered as he tried to scowl. "I probably would if it weren't for that Japanese radio sitting over there on my end of the bench."

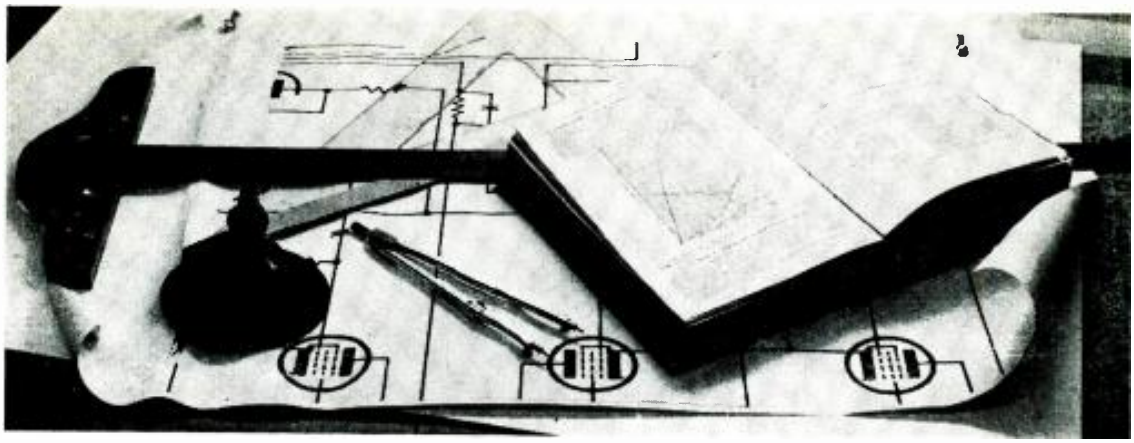
"What's that got to do with it?"

"Well, a little old lady brought that in yesterday with the explanation that her son, quartered in Japan, had sent it home to her. It was a nice-looking little two-band, three-way portable. She had unpacked it and plugged it in, and it started to play right off, but after a few minutes it quit. She was sure some little thing had shaken loose in transit.

"Well, as we both know, almost every time we get tangled up with one of these foreign sets we lose money. Most of the time there is no adequate service literature on the set; the parts arrangement and circuitry are frequently different from that with which we are familiar; and we often run up against defective parts for which substitutes cannot be obtained. I explained this to the woman, but she said her son had written that one of the selling points of this receiver was that he had been told that all parts for it could be readily obtained in the United States. Against my better judgment, I took the set.

"When I plugged it in, there was only hum. I raised the line voltage a bit,

(*Continued on page* 151)



# Some Thoughts on Amplifier Design

By **STEWART HEGEMAN** Dir. of Eng., Citation Kit Div., Harman-Kardon, Inc.

**Multiple feedback loops with up to 32 db of feedback with stability, extended frequency response, and low impedance power supply are used in new hi-fi kit line.**

MUCH of the author's professional listening experience as a recording engineer has been involved in detecting flaws. When monitoring an original recording one cannot take time to listen to the performance, for all attention is given to listening to imbalances between instruments due to microphone placement. This type of critical auditioning is continued through all the steps of the manufacturing process, from the master tape to the completed recording. The emphasis in this type of listening is on distortion, noise, dynamic and frequency range, and over-all tone quality. It is usually days before one has the opportunity to relax and listen to the *performance* in the quiet surroundings of his own living room.

When professional monitoring is done over extended periods of time, listening fatigue becomes a very important factor. Small amounts of distortion, which might be tolerated under ordinary listening conditions, not only become annoying but actually affect one's judgment; and it is for this reason that the author has become increasingly concerned with the development of superior sound equipment. This form of professional listening generates very specific and personal requirements in terms of over-all performance of the sound reproducing chain and, as a result, the author has come to recognize the basic importance of two principles.

## Distortion & Frequency Response

The first principle concerns distortion. It is interesting to note that the relatively high level of distortion in some components in the system does not mask the possibly minute level of distortion in other components. Therefore, although speakers, cutters, and cartridges have higher inherent distortion than amplifiers, the listening quality of the system can benefit from the reduction of distortion in any part of the chain. It may be important, at this time, to indicate what is meant by "distortion." In the broad sense, distortion is any deviation from the original. Not only does it include harmonic and intermodulation distortion, but also restricted dynamic range, restricted frequency response, deviation in phase response, restrictive distribution patterns of both microphones and speakers, and transient distortion.

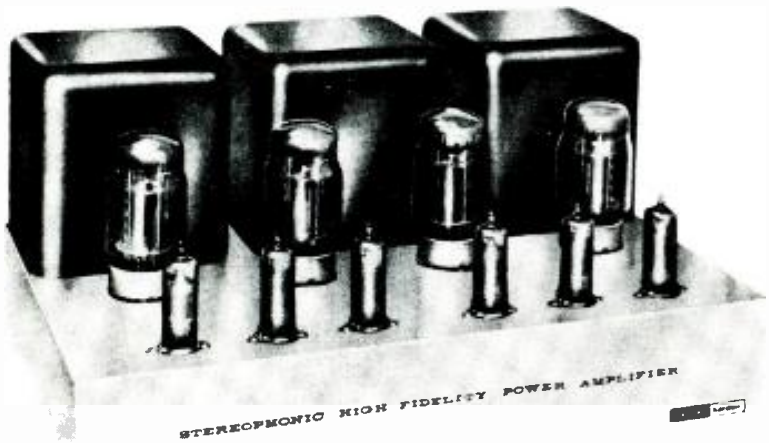
The second and equally important principle concerns frequency response. The bandwidth required for satisfactory reproduction is considerably beyond the single-frequency hearing capabilities of the human ear. Components of several octaves below 20 cycles are of great importance to musical perception and unquestionably contribute to more realistic, sharper, and more transparent reproduction.

Since the basic amplifier forms the foundation of any complete component line, we thus decided to start off with a 120-watt (dual 60-watt) stereo amplifier as the introductory item in our new line of kits. To produce a top-quality power amplifier in kit form, it is necessary to use high-quality materials and carefully engineered assembly and wiring techniques. It is also necessary to realize the improved performance possible with increased degrees of feedback.

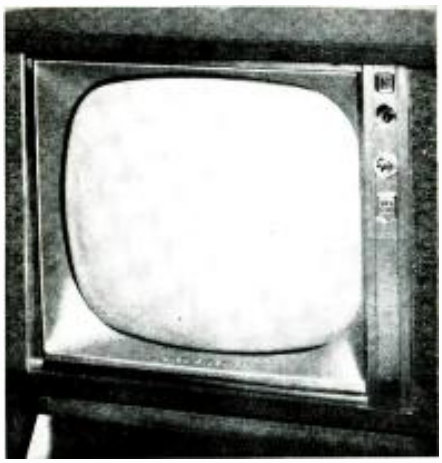
## Feedback Techniques

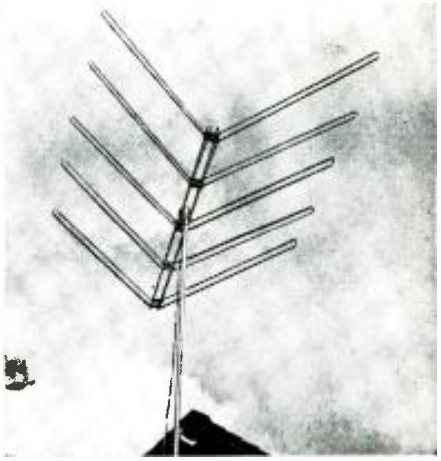
Current conventional power-amplifier design is based on "single loop" feedback techniques. "Linearization" is obtained by over-all feedback from the voice-coil terminals to the cathode of the input tube and, due to stability

(*Continued on page* 106)




The introductory unit in Harman-Kardon's new "Citation" line of kits is this 120-watt (dual 60-watt) stereo power amplifier.





TV set, train, and antenna—each has a reference "ground," but this ground may be a different concept in each case.

# "Grounds" for Confusion

By ROBERT GARY / **One word, many meanings: the type of equipment or type of voltage involved may decide what ground is.**

A WELL-KNOWN quote by a well-known writer informs us that "a rose is a rose." Is not a ground also a ground? And, if that is the beginning and the end of the matter, why should any confusion exist about so simple a concept? However, if you choose even the clear-cut rose as a theme and let your mind play with it idly for a minute, you can come up with a surprising range of variety in associated ideas. "Sweet Rosie O'Grady," for example, has little to do with the legendary rose fields of Bulgaria that provide essential oils for the perfume industry. Start with the word "ground" and you will come up with an even greater variety of notions, even if you limit yourself to what this word means in the language of electronics.

You may think of the concept as it appears in manuals on telegraphy. This is the earth ground or ground return, in which a single-wire line is used, with earth ground being used as the second line. This also ties in with the notion of the lightning arrester developed by Ben Franklin, the device being basically a good conductor to ground. Yet the concept seems a far cry from that of a TV receiver chassis, which had better be a good ground for the r.f. and other signals circulating in the receiver—but which may be "hot" or "cold" with respect to the ground on which the technician stands.

Even if we confine ourselves to the ground within a single item of electronic equipment, such as a radio, audio amplifier, or TV chassis, we may run into confusing effects. For example, two points may both appear to be at ground potential on a schematic diagram; yet, if these two are too close physically—or perhaps too far apart—oscillation may develop. If they are both at ground, why should it matter how near or far apart they are? Why does touching a "grounded" chassis sometimes detune a circuit using this ground? If an a.c.-d.c. receiver has a resistor and capacitor network going from the chassis to the grounded side of the power line, can the chassis be considered as a ground? Does a power transformer ground a set just because its center tap is connected to the chassis? Why do certain broadcast receivers operate better if a wire is connected to a water-pipe ground? These questions may certainly puzzle the layman and sometimes even confuse the student of electronics or the technician.

The problem arises because ground may be one or many things to different people in the same or different electrical circuits. A good starting point is the fact that electric current must have a complete circuit in order to flow, and we usually regard this circuit as being divided into a double path. In d.c. work, for example, we say that current goes from the generator or other source to the load over one path and then returns through the other. An oversimplified understanding of this action leads many of us to think that the return path is "cold" because the current has done its work and no longer has any energy left. We then begin to assume a "safe" return or ground path containing no power, which can be overlooked.

A quick look at the popular schematic representation of this action (Fig. 1A) may mislead some people. However, if we re-draw the circuit as in Fig. 1B, we take into account the fact that, between any point in the circuit and any other point—even if both points are on the same "ground" line—there are inevitably some electrical factors introduced, such as resistance, capacitance, and inductance, no matter how small they may be. Thus some form of circuit action may take place between any two points, however slight it may be, and the energy within the circuit may be active anywhere.

A good example of this can be observed by a study of the tracks of any electrified railroad. The "hot" power is delivered through a suspended overhead cable or an insulated third rail, while the return path goes through the tracks. The tracks are, of course, "grounded." However, where rails are joined, heavy bronze cables carry the "cold" return current across the junction. Should there ever be a gap in the metal return path, the arcing across it will be every bit as severe as if the top wire were broken.

A ground, in this sense, is simply one side of a two-wire system. For our purposes, we usually choose the side to which the electrical resistance from the ground (earth, or its equivalent) on which we stand is the least. A good example of this is the automobile. Its battery, radio, and other electrical equipment are all grounded to the car body; but, because of the nonconductive rubber tires, the car itself is not connected to the earth at all. This sometimes causes shocks or small arcs when a conductor—such as a person—supplies the connection between the "grounded" car and the actual ground. For this reason, some autos use ground straps which drag along under the vehicle and electrically connect the car body to the pavement.

To further illustrate the problem of clearly defining a ground point, con-

sider the case of a u.h.f oscillator circuit, as shown in Fig. 2. The circuit is shown in Fig. 2A as it would appear on a schematic diagram. Fig. 2B is the true electrical equivalent of all portions of the circuit outside the tube envelope. For convenience's sake we have lumped the stray and wiring inductances, capacitances, and resistances that would actually be significant at these frequencies together. The obvious components are still identified for us ($C_1$, $L_1$, $R_1$, etc.) but they are heavily outnumbered by the inevitable resistances, capacitances, and inductances that are nevertheless present—and we have not necessarily shown all of the latter.

Already, in comparing Fig. 2A with Fig. 2B, we can see how two different engineers, each concerned with various aspects of the circuit, could take divergent viewpoints concerning the nature of ground. Let us see how the same circuit would be viewed by still another person—a safety engineer whose sole business is the question of shock hazard. To him, everything but the plate and supply voltages (Fig. 2C) could conveniently be assumed as being at "ground" potential. We can simplify even further if we think in terms of grounding the receiver to protect against lightning hazards. Here the chief circuit element to be considered would be the insulation resistance between the primary and secondary of a transformer.

## Shock Hazards and Ground

Much has been written in the past on the subject of the shock hazard of electrical appliances. Like the weather, this topic has received a lot more discussion than earnest attempts at a cure. But before we can think of eliminating shock hazards we should understand exactly what they are. Basically there are three ways one can get an

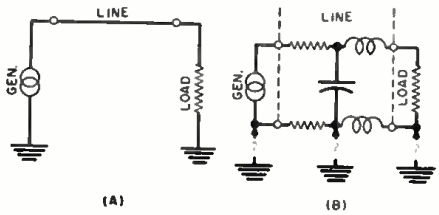



**Fig. 1. Notion of ground (A) as unipotential return path. However, no two ground points (B) are actually the same.**

electrical shock and, although this may seem facetious, they are by touching one side of the line, by touching the other side of the line, or, through special talent, by touching both sides. If we could assume that one side of the power line is properly connected to the earth on which our body stands, then it would be perfectly safe to touch that grounded side of the line, but the other side would still be "hot." We see that grounding one side of the power line immediately reduces the shock hazard by 50 per-cent. All appliances that operate directly from the power line, such as toasters, broilers, and the like, could have their case and chassis connected to the grounded side of the line, and this would limit the hazard to contact with the "hot" side. Should a "hot" wire accidently touch the grounded chassis, this would cause a short circuit and the nearest fuse would blow, but there would be no danger to any human. Similarly, if radio and TV receivers could be grounded directly to the power line, there would be no shock hazard in touching the chassis, metal cabinet, or uninsulated controls.

It has long been proposed that all house wiring make use of polarized outlets and plugs so that the correctly grounded side of the line is always connected to the chassis or cabinet. Some progress has been made in this direction in that most newly designed sockets and plugs use one wide and one narrow contact blade. But, since so much unpolarized wiring exists and since the correct grounding of one side of the power line is not always guaranteed, the introduction of polarized wiring still seems to lie in a nebulous future. The military services have standardized all of their specifications so that polarized plugs and grounded power lines are required in all new equipment.

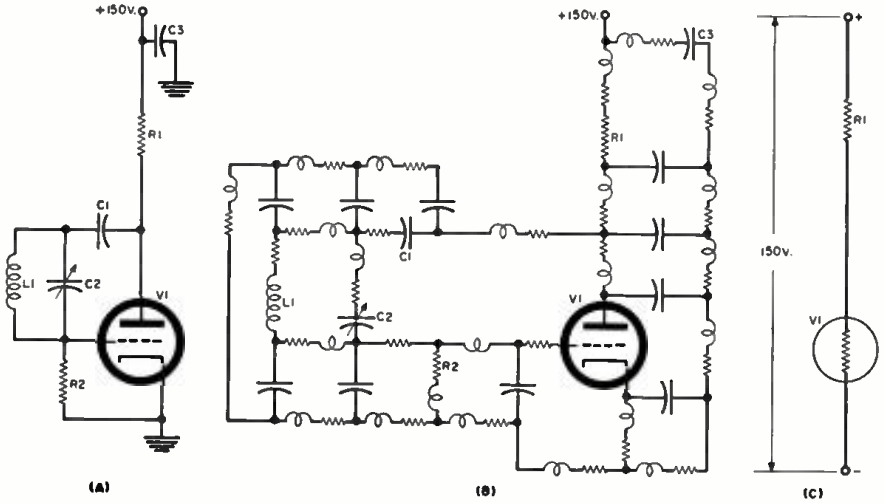
Recently many TV manufacturers have returned to the use of power transformers to effectively isolate the receiver power supply from the a.c. power line. Fig. 3A shows the a.c. voltages on a typical full-wave rectifier circuit and indicates why there is no shock hazard here between the chassis and the earth, regardless of whether one side of the power line is grounded or not. The capacitors $C_1$ and $C_2$ represent the leakage of the transformer. Since this is usually quite low, a very high impedance isolates the secondary from the a.c. power line. A few TV receivers use simple, isolation transformers. These perform the same function as the isolation transformer that every safety-conscious service technician keeps around. The voltages on such a transformer are shown in Fig. 3B. It is true, in any electrical device, that the power-line wires themselves must be properly insulated, but, as we showed before, a short circuit would merely blow the fuse.

Having observed the voltage relationships with respect to ground when a power transformer is used, consider now the arrangement of Fig. 4, which shows a technique used with many so-called "hot" chassis in a.c.-d.c. sets. This is a rather elegant approach, because some attempt has been made here to isolate the chassis from the power line. The network of the resistor and the capacitor (220,000 ohms and .01 μf., in Fig. 4A) helps keep 60-cps voltages off the chassis while providing a low-impedance path for r.f. and i.f. signals to one side of the power line, which is therefore essentially at ground for these higher frequencies.

The problem with this arrangement can be seen by inspecting Fig. 4B, in which the *RC* network has been reduced to an equivalent impedance of 170,000 ohms (calculated for 60 cps) for simplification. Some potential does indeed continue to exist between one side of the power line and the chassis. However, even if the receiver involved happens to be plugged in with the polarity shown, the chassis will not be quite as hot as would be the case without the network. The impedance of 170,000 ohms will be in series with any person who accidentally contacts the chassis and a point at earth ground potential at the same time. This impedance will serve to drop a good deal of the voltage, so that a full 117 volts would not be impressed across the unfortunate individual, and will also serve to limit the maximum amount of current that would flow through him. Also, if the capacitor should break down, a direct connection to one side of the power line becomes possible.

In many other receivers, the chassis is actually connected directly to one side of the line, and then all metal portions of the chassis, controls, mounting hardware, and the like must be covered with insulation. This usually protects the customer from shock, but the service technician must use an isolation

**Fig. 2. A u.h.f. oscillator circuit may look like any of the three representations below, depending on the viewpoint of the person who is dealing with it.**



transformer as soon as he needs to handle the chassis.

It is true that rubber-soled shoes insulate the body from ground and thereby eliminate some of the hazard, but it is always possible to touch some grounded object inadvertently while touching the "hot" chassis. While most such accidents are not lethal, technician time can be spent in better ways than in recovering from electric shock.

## Grounding Antennas

In looking over the signal-input circuit of most TV receivers, we notice that neither of the two conductors of the 300-ohm antenna lead-in is grounded. The elements of the antenna themselves are also ungrounded, except possibly for some parasitic portions such as reflectors and directors through the mast. At the tuner, however, the center tap of the antenna-input circuit is connected to the chassis ground. This makes both sides of the transmission line "hot" for r.f., but grounds them as concerns low frequencies. If lightning should strike, the path would be through both conductors, the TV chassis, and the power line to earth ground.

To avoid this hazard, most outdoor antenna installations include—or should include—a lightning arrester, which short-circuits the path from the antenna to a ground, but presents sufficient impedance for r.f. so that the signal path is still direct to the receiver. A typical equivalent circuit of such a protected installation is shown in Fig. 5. Simply, an alternate path to earth is provided for lightning through two resistances. These may be actual resistors or high-resistance spark gaps, as indicated by the broken lines. In either case, the resistance prevents bypassing of r.f. to the earth but breaks down and shorts out under the stress of lightning.

Some TV installations still use a coaxial cable from the antenna to the receiver and then the outer conductor is usually grounded at the receiver chassis. If the TV set uses a power transformer it would be perfectly safe to connect the shield of the coaxial cable directly to a water pipe, drain, or other good external ground.

The phenomenon of grounding one side of an a.c.-d.c. radio's loop antenna will work safely only if the loop is connected to the set through capacitors, or is otherwise isolated. Then the grounding merely serves to establish one of the loop terminals at external ground, making the other side "hot." It will usually be noticed that, depending on the side connected to ground, the tuning controls and the radio chassis itself will become more or less sensitive to body capacity.

The aforementioned practice of grounding one side of an antenna to improve signal pick-up raises still another point for consideration. Why does this work and how can we get along without this type of ground in the case of aircraft radios, battery portables, automobile receivers, and other units that do not normally come into actual

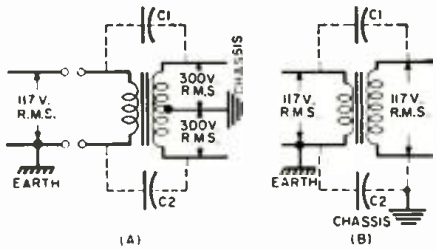



**Fig. 3. How power transformers serve to isolate earth ground from chassis ground.**

contact with the earth? The magic word that begins to provide the answers is "counterpoise." For an antenna to work best, it must have the greatest possible signal voltage developed across it. This means that, in effect, the "top" of an antenna system (that portion which is normally farthest from the earth) must be at the greatest possible potential difference from the "bottom" of the system. To establish this relationship, we seek a large body as a counterpoise that is not likely to be at or near the same potential with respect to transmitted signal that will appear at the "top" of the antenna. Where it may be used, the earth itself serves very well as such a counterpoise. Thus, the required counterpoise has come to be known as ground, because earth ground is the frequently used medium.

However, where it is not convenient to use earth ground, some other body of reasonable size is chosen as the counterpoise. This may be the body or shell of an orbiting satellite, of an airplane, or of a car—or it may simply be the chassis of a portable radio serving as its own "ground"—or should we say counterpoise? Actually, the confusion

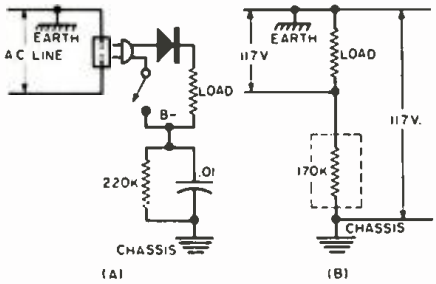
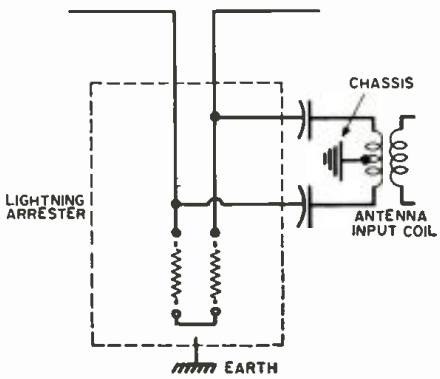



**Fig. 4. An RC network (A) provides only partial earth-to-chassis isolation, as equivalent circuit at 60 cps (B) demonstrates.**

**Fig. 5. Arrester provides lightning with a breakdown path to earth-ground.**




arises from the fact that, since earth ground was once the almost universally used counterpoise, we have come to call every such counterpoise a ground—whether it is or not.

When these "grounds" are brought near the earth's ground, the tuning as well as the set's sensitivity changes. Another effect observed with such devices is the accumulation of a static electric charge. Airplanes have short wire strips attached to their trailing wing edges to discharge such static electricity into the surrounding air during flight. During landings, the aircraft is carefully grounded to the runway to avoid, on a more violent scale, the shocks we often experience during dry winter days when getting out of a car.

## Grounding in the Shop

Although technicians, experimenters, and hams should be well aware of the shock hazards around the home, and especially in their work, trivial as well as serious accidents do happen. In presenting the following suggestions, we hope to help in reducing the number of electrical accidents, and also make the work of the technician easier.

Some of our readers may think that rubber mats on the floor or the wearing of rubber soles insulate a man from ground so that, if he touches something "hot," he will feel no shock. This is true to some extent, and the wearer of rubber soles is definitely somewhat safer than the barefoot technician. But there are usually a host of other grounded items with which the "safe" person may make inadvertent contact while believing he can touch the "hot" points with immunity. We feel that a properly grounded and carefully fused a.c. power line, a grounding strap within easy reach, and an isolation transformer are the best insurance against shock. The antenna lines, all test equipment, and metal shelves should be grounded. Although not essential, we favor a grounded piece of sheet metal as a base on which to put sick chassis.

If there are portions of the set which should be insulated, we add the necessary insulation in the form of cardboard and Bakelite strips. This has the advantage that it pinpoints any "hot" danger spots and reminds us of them during work. Metal parts that lie loosely on an insulator can get a static charge from nearby high-voltage fields and then, when the unsuspecting hand reaches for them, nasty "bites" result. The author has a half-inch scar to illustrate this particular effect and therefore is now well supplied with ground clips, sheet-metal work bases, and other protective devices.

One last word to those who can touch a 117-volt line with apparent immunity. Body-moisture content varies with age, climate, living habits, and a host of other factors. If you were getting no more than a mild tingle from 117 volts three years ago, don't believe that you have life-long immunity to electric shock. Even a lion tamer may wind up his career with a "bite." —30—

# SAVE 1/2 THE TIME

## Make Twice The Profit!

in TV Trouble-Shooting

**THIS EASY**
**SIGNAL INJECTION**
**POINT-TO-POINT**
**DIRECT VIEWING**
**WAY**


## MODEL 1075
# B&K TELEVISION ANALYST

### *New Technique Makes TV Servicing Easier, Faster, More Profitable*

Thousands of service technicians already save thousands of hours every day with the amazing B&K TELEVISION ANALYST. Enables you to inject your own TV signal at any point and watch the resulting test pattern on the picture tube itself. Makes it quick and easy to isolate, pin-point, and correct TV trouble in any stage throughout the video, audio, r.f., i.f., sync, and sweep sections of black & white and color television sets—*including intermittents*. Makes external scope or wave-form interpretation unnecessary. Enables any serviceman to cut servicing time in half, service more TV sets in less time, really satisfy more customers, and make more money. Color generator provides both rainbow pattern and color bars.

**MODEL 1075 TELEVISION ANALYST.** Complete with standard test pattern, white dot, white line, and color-bar slide transparencies, and one clear acetate. Net, **$259.95**

*See your B&K Distributor or Write for Bulletin ST24-N*

### *Solve Rough Sweep Output Problems*


**NEW Model A107**
**DYNA-SWEEP**
**CIRCUIT ANALYZER**

Saves many hours of service work. Provides vertical and horizontal sync and driving pulses that enable you more easily and quickly to check out every stage in the sync and sweep sections of a television receiver.

Tracks down troubles in the horizontal and vertical output circuit including defective output transformer and yoke; checks for shorted turns, leakage, opens, short circuits, and continuity. Includes unique high-voltage indication. Eliminates trial and error replacements.

**Model A107 Dyna-Sweep.** Companion unit for use only with B&K Model 1075 Television Analyst for driving source. **Net, $49.95**

**Model 1070 Dyna-Sweep.** Same as Model A107 but has its own horizontal and vertical driving pulse, and is used independently of the Model 1075. **Net, $69.95**

**B&K MANUFACTURING CO.**
**1801 W. BELLE PLAINE AVE • CHICAGO 13, ILL.**
*Canada: Atlas Radio Corp., 50 Wingold, Toronto 10, Ont.*
*Export: Empire Exporters, 277 Broadway, New York 7, U.S.A.*

# New Transistor Clock Radio Kit


## EVERYTHING A CLOCK-RADIO CAN OFFER . . . AND PORTABLE TOO!

- Completely portable, all-transistor circuit
- Runs up to 500 hours on standard batteries
- Deluxe features at half the cost
- Easy to assemble

HEATHKIT TCR-1

**$45.95**

### "YOUR CUE" TRANSISTOR CLOCK RADIO KIT (TCR-1)

Take all the deluxe features found in the most expensive clock-radios, add the convenience of complete portability, plus a modern 6-transistor battery operated circuit . . . then slash the price at least in half, and you have the new Heathkit "Your Cue" Transistor Portable Clock Radio.

Packing every modern clock-radio feature into a compact, beautifully styled turquoise and ivory plastic cabinet, "Your Cue" lulls you to sleep, wakes you up, gives you the correct time and provides top quality radio entertainment in and out-of-doors. It can also be used with the Heathkit Transistor Intercom system, opposite page, to provide music or a "selective alarm" system for one or more rooms covered by the intercom system.

An "Alarm-set" hand, hour hand, minute hand and sweep second hand grace the easy-to-read clock dial. All controls are conveniently located and simple to operate. The "lull-to-sleep" control sets the radio for up to an hour's playing time, automatically shutting off the receiver when you are deep in slumber. Other controls set "Your Cue" to wake you to soft music, or conventional "buzzer" alarm. A special earphone jack is provided for private listening or connection to your intercom or music system. At all times crystal-clear portable radio entertainment is yours at the flick of a switch.

The modern 6-transistor circuit features prealigned IF's for ease of assembly. A tuned RF stage and double tuned input to the IF stage assure top performance. The built-in rod-type antenna pulls in far-off stations with outstanding clarity while a large 4" x 6" speaker provides tonal reproduction of unusual quality.

Six easily obtainable penlight-size mercury batteries power the radio receiver up to 500 hours, while the clock operates up to 5 months from a single battery of the same type. Ordinary penlight cells may also be used with reduced battery life.

The handsome two-tone cabinet, measuring only 3½" H. x 8" W. x 7½" D. fits neatly into the optional carrying case for beach use, boating, sporting events, hunting, hiking, or camping.

Wherever you are, you'll find "Your Cue" your constant companion. Shpg. Wt. 5 lbs.


**HEATH COMPANY**/Benton Harbor, Mich.

a subsidiary of Daystrom, Inc.

# New Transistor Intercom Kit

## TALK WITH ANY OR ALL FIVE STATIONS WITH YOUR OWN INTERCOM SYSTEM

- Battery Power Permits Placement Anywhere
- Versatile Unit has Many Important Uses
- Complete Privacy of Conversations Assured

### TRANSISTOR INTERCOM KIT (XI-1 and XIR-1)

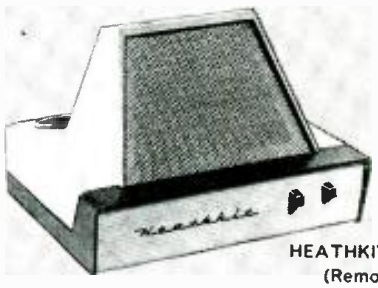
A flexible, versatile transistor intercom, has been developed by Heath engineers to enable you to set up your own communications system at an unbelievably low price.

Consisting of a master unit (XI-1) and up to five remote stations (XIR-1), the system is designed for any remote unit to call the master, for any remote station to call any other remote station, or for the master unit to call any single remote unit or any combination of remote units. Complete privacy is assured, since a call to a remote station cannot be interrupted or listened to while the remote unit is in operation unless switched in by the master unit. Used with clock-radio, opposite page, it can serve as a music or "selective alarm" system.

Transistor circuitry means long life, instant operation and minimum battery drain. Eight ordinary, inexpensive "C" flashlight batteries will run a unit for up to 300 hours of normal "on" time. Circuitry is especially designed for crisp, clear intelligible communication and the instant operation feature allows tuning of the units off between calls, extending battery life. Use of battery power does away with power cords, allowing each unit to be placed where most convenient. Only two wires are required between the master unit and each remote station. Beautifully styled, the Heathkit Intercom presents a new approach in design. Both master and remote stations have two-piece cases in ivory and turquoise for a rich, quality appearance. Batteries not included. Shpg. Wt. 6 lbs.

HEATHKIT XI-1 (Master)

**$27.95**



HEATHKIT XIR-1 (Remote)

**$6.95**

Shpg. Wt. 4 lbs.

### AC POWER SUPPLY (XP-1)

A permanent power supply for 24-hour operation of the XI-1 Intercom on household current. Converts 110 V. AC to well filtered 12-volt DC output, eliminating the need for batteries. Power supply is small, compact and fits in space normally occupied by batteries.

HEATHKIT XP-1 ..... $9.95

## NEW IMPROVED DESIGN

New

### STEREO-MONO PREAMP KIT (SP-2A, SP-1A)

Get the SP-2A Stereo Preamp kit now, or the SP-1A monophonic version which you can easily convert to stereo whenever you choose by assembling the second channel (C-SP-1A) and plugging it into your SP-1A.

The SP-2A permits stereo, two channel mixing, or either channel monophonic use, and includes a remote balance control.

Six inputs (12 in the stereo version) accommodate tape, magnetic phono and microphone, plus three separate high level inputs. Level controls provided on "mag. phono" and high level inputs. Switch selects NARTB equalization for tape head input, and RIAA, LP or 78 RPM compensation for mag. phono input

HEATHKIT SP-1A (monophonic) Shpg. Wt. 13 lbs. ..... $37.95

HEATHKIT C-SP-1A (not shown) (converts SP-1A to SP-2A) Shpg. Wt. 4 lbs. .... $21.95

HEATHKIT SP-2A (stereo)
Shpg. Wt. 15 lbs.

**$56.95**

$5.70 down. $6.00 mo.

## THE WORLD'S BIGGEST BARGAIN IN A HI-FI AMPLIFIER

New

### 55 WATT HI-FI AMPLIFIER KIT (W-7A)

Utilizing advanced design in components and tubes to achieve unprecedented performance with fewer parts, Heathkit has produced the world's first and only "dollar-a-watt" genuine high fidelity amplifier. Meeting full 55-watt hi-fi rating and 50-watt professional standards, the new improved W-7A provides a comfortable margin of distortion-free power for any high fidelity application.

The sleek, modern styling of this unit allows unobtrusive installation anywhere in the home. The clean, open layout of chassis and precut, cabled wiring harness makes the W-7A extremely easy to assemble. Shpg. Wt. 28 lbs.

**SPECIFICATIONS—Power output:** Hi-Fi rating, 55 watts. Professional rating, 50 watts. **Power response:** ±1 db from 20 cps to 20 kc at 55 watt output. **Total harmonic distortion:** Less than 2% from 30 cps to 15 kc at 55 watts output. **Intermodulation distortion:** Less than 1% at 55 watt output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 80 db below 55 watts, unweighted. **Damping factor:** Switch on front panel for selecting either maximum (20:1) or unity (1:1). **Output impedances:** 4, 8 and 16 ohm, and 70-volt line. **Power requirements:** 117 volts, 50/60 cycles, 90-160 watts. **Dimensions:** 8½" D. x 6⅞" H. x 15" W.

HEATHKIT W-7A

**$54.95**

# New HEATHKIT® Stereo Amplifiers

HEATHKIT SA-2

**$52.95**

## *YOUR BEST DOLLAR VALUE IN STEREO...*

### 14/14 WATT STEREO AMPLIFIER KIT (SA-2)

Complete control is at your fingertips with this versatile Stereo Amplifier-Preamplifier. Providing 14 watts per stereo channel, or 28 watts total monophonic, the SA-2 offers every modern feature in a master stereo control center at a price to please the budget minded. The unit offers selection of dual channel stereo operation, monophonic operation using both channels simultaneously, or using either channel for monophonic program material independent of the other channel. A 4-position input selector switch provides choice of mag. phono, crystal phono, tuner, and high level auxiliary input for tape recorder, TV, etc. Other features include RIAA equalization on mag. phono, channel reversing function, clutched volume control, ganged dual tone controls, speaker phase reversal switch and two AC outlets. Handsomely styled black and gold vinyl-clad steel cabinet. Shpg. Wt. 23 lbs.

**SPECIFICATIONS—Power output:** 14 watts per channel "hi-fi"; 12 watts per channel, "professional", 16 watts per channel, "utility". **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2% 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Controls:** dual clutched volume; ganged bass, ganged treble; 4-position selector; speaker phasing switch. **AC receptacle:** 1 switched, 1 normal. **Inputs:** 4 stereo or 8 monophonic. **Outputs:** 4, 8 and 16 ohms. **Dimensions:** 4½" H. x 15" W. x 8" D. **Power requirements:** 117 volts, 50/60 cycle, AC, 150 watts (fused).

## New

HEATHKIT SA-3

**$29.95**

### ECONOMY STEREO AMPLIFIER KIT (SA-3)

This amazing performer delivers more than enough power for pure, undistorted room-filling stereophonic sound at the lowest possible cost. Featuring 3 watts per stereo channel and 6 watts as a monophonic amplifier, the SA-3 has been proven by exhaustive tests to be more than adequate in volume for every listening taste.

You will find its ease of assembly another plus feature. Heathkit construction manuals, world famous for their clarity and thoroughness, lead you a simple step at a time to successful completion of the kit. Larger than life-size diagrams show you exactly what each part looks like, where it goes, and how it is installed.

The amplifier is tastefully styled in black with gold trimmed control knobs and gold screened front and rear panel. A tremendous buy at this low Heathkit price! Shpg. Wt. 13 lbs.

**SPECIFICATIONS—Power output:** 3 watts per channel. **Power response:** ±1 db from 50 cps, 20 kc at 3 watts out. **Total harmonic distortion:** less than 3%, 60 cps, 20 kc. **Intermodulation distortion:** less than 2% @ 3 watts output using 60 cycle & 6 kc signal mixed 4:1. **Hum and noise:** 65 db below full output. **Controls:** dual clutched volume, ganged treble, ganged bass, 7-position selector; speaker phasing switch; on-off switch. **Inputs (each channel):** tuner, crystal or ceramic phono. **Outputs (each channel):** 4, 8, 16 ohms. **Finish:** black with gold trim. **Dimensions:** 12½" W. x 6¾" D. x 3¼" H.

## New

HEATHKIT XR-2P

(6 lbs.)

**$29.95**

HEATHKIT XR-2L (7 lbs.) **$34.95**

### 6-TRANSISTOR PORTABLE RADIOS (XR-2P and XR-2L)

New, improved styling, new vernier tuning, up to 1,000 hours on flashlight batteries . . . are just a few of the plus features you get with these new transistor portables. Carry them with you wherever you go; to the beach, on trips, boating, etc. These new, improved models bring you the outstanding performance of the preceding models plus brand new styling and the additional convenience of vernier tuning for smooth, effortless station selection. The XR-2P features a mocha and beige high-impact plastic case. The XR-2L has a sunset tan color leather case with an identical beige plastic front. Six Texas Instrument transistors are used for high sensitivity and selectivity. A large 4" x 6" PM speaker with heavy magnet provides excellent tone quality. The roomy chassis makes it unnecessary to crowd components, adding greatly to ease of construction. The six standard size "D" flashlight batteries used for power provide extremely long battery life and can be purchased anywhere. Fun to build, and fun to use . . . order one today!

## New

HEATHKIT DS-1

**$69.95**

$7.00 DN., $7.00 MO.

- Indicates Depth and Type of Bottom From 0 to 100 Feet
- Detects Submerged Objects (fish, logs, etc.) and Their Depth
- Completely Transistorized . . . Operates From Flashlight Batteries

### TRANSISTOR DEPTH SOUNDER (DS-1)

Weekend boatsman or professional . . . fisherman or skindiver . . . here's the depth sounder for you. Depth is indicated by a flashing neon lamp rotating behind a transparent circle in the molded black plastic dial face. A large bezel around the dial enables the viewer to easily read the indicator in bright light or sunshine. The transducer uses a barium titanate element mounted in a fluted, molded epoxy resin housing with solid brass through-hull fitting and mounting hardware. While designed for permanent mounting on the bottom of the boat, temporary outboard mounting of the transducer is also possible. The completely transistorized circuit operates from 6 flashlight cells and one long-life battery. Comes complete with splash-proof cabinet, hardware and gimbal-type mounting bracket. Shpg. Wt. 10 lbs.

# New HEATHKIT Amplifiers & Tuners

## A NEW AMPLIFIER AND PREAMP UNIT PRICED WELL WITHIN ANY BUDGET

### 14-WATT HI-FI AMPLIFIER KIT (EA-3)

This thrilling successor to the famous Heathkit EA-2 is one of the finest investments anyone can make in top quality high fidelity equipment. It delivers a full 14 watts of hi-fi rated power and easily meets professional standards as a 12-watt amplifier.

Rich, full range sound reproduction and low noise and distortion are achieved through careful design using the latest developments in the audio science. Miniature tubes are used throughout, including EL-84 output tubes in a push-pull output circuit with a special-design output transformer. The built-in preamplifier has three separate switch-selected inputs for magnetic phono, crystal phono or tape, and AM-FM tuner. RIAA equalization is featured nn the magnetic phono input. Shpg. Wt. 15 lbs.

**NOTE THESE OUTSTANDING SPECIFICATIONS—Power output:** 14 watts. Hi-Fi: 12 watts. Professional: 16 watts. Utility. **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms.

HEATHKIT EA-3

**$29.95**

## NEVER BEFORE HAS ANY HI-FI AMPLIFIER OFFERED SO MUCH AT SO LOW A PRICE

New

### "UNIVERSAL" 14-WATT HI-FI AMPLIFIER KIT (UA-2)

Meeting 14-watt "hi-fi" and 12-watt "professional" standards, the UA-2 lives up to its title "universal" performing with equal brilliance in the most demanding monophonic or stereophonic high fidelity systems. Its high quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Buy two for stereo. Shpg. Wt. 13 lbs.

**SPECIFICATIONS—Power output:** Hi-Fi rating, 14 watts; Professional rating, 12 watts. **Power response:** ±1 db from 20 cps to 20 kc at 17 watts output. **Total harmonic distortion:** Less than 1% from 20 cps to 20 kc at 14 watts output. **Intermodulation distortion:** Less than 1% at 14 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 73 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms. **Damping factor:** Switched for unity or maximum; maximum damping factor 15:1. **Input voltage for 14 watt output:** .7 volts. **Power requirements:** 117 volts 50/60 cycles, 55 watts. **Dimensions:** 10" W. x 6½" D. x 4¾" H.

HEATHKIT UA-2

**$22.95**

## MORE STATIONS AND TRUE FM QUALITY ARE YOURS WITH THIS FINE TUNER KIT

New

### HIGH FIDELITY FM TUNER KIT (FM-4)

This handsomely styled FM tuner features better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with on-off switch, flywheel tuning and prewired, prealigned and pretested tuning unit. Clean chassis layout, prealigned intermediate stage transformers and assembled tuning unit makes construction simple—guarantees top performance. Flywheel tuning and new soft, evenly-lighted dial scale provide smooth, effortless operation. Vinyl-covered case has black, simulated-leather texture with gold design and trim. Multiplex adapter output also provided. Shpg. Wt. 8 lbs.

**SPECIFICATIONS—Tuning range:** 88 to 108 mc. **Quieting sensitivity:** 2.5 uv for 20 db of quieting. **IF frequency:** 10.7 mc. **Image ratio:** 45 db. **AFC correction factor:** 75 kc per volt. **AM suppression:** 25 db. **Frequency response:** ±2 db 20 to 20,000 cps. **Harmonic distortion:** Less than 1.5%, 1100 uv, 400 cycles 100% modulation. **Intermodulation distortion:** Less than 1%, 60 cycles and 6 kc mixed 4:1 1100 uv, 30% modulation. **Antenna:** 300 ohms unbalanced. **Output impedance:** 600 ohms (cathode follower). **Output voltage:** nominal .5 volt (with 30% modulation, 20 uv signal). **Power requirements:** 105-125 volts 50/60 cycle AC at 25 watts. **Overall dimensions:** 4½" H. x 13¼" W. x 5½" D.

HEATHKIT FM-4

**$34.95**

**HEATH COMPANY**/Benton Harbor, Mich.

a subsidiary of Daystrom, Inc.

# New HEATHKIT Tape Recorders

- Choice of 3 Outstanding Models
- Compare With $350-$400 Machines
- Preassembled Tape Mechanism
- Choice of Monophonic or Stereo models
- Complete versatility
- Easy to assemble, easy to use

### PROFESSIONAL QUALITY TAPE RECORDER KITS (TR-1 Series)

Enjoy the incomparable performance of these professional quality tape recorders at less than half the usual cost. These outstanding kits offer a combination of features found only in much higher priced professional equipment, generally selling for $350 to $400. Not the least of these special features is the handsome styling which characterizes the kits . . . a semi-gloss black panel is set off by a plastic escutcheon in soft gold, which is matched by black control knobs with gold inserts. The mechanical assembly, with fast forward and rewind functions, comes to you completely assembled and adjusted; you build only the tape amplifier. And, you'll find this very easy to accomplish, since the two circuit boards eliminate much of the wiring. Separate record and playback heads and amplifiers allow monitoring from tape while recording and a "pause" control permits instant starting and stopping of tape for accurate cueing and tape editing. A digit counter is provided for convenient selection of any particular recording. Push-pull knob provides instant selection of 3¾ or 7½ IPS tape speed. Safety interlock on record switch reduces possibility of accidental erasure of recorded tapes. Shpg. Wt. 30 lbs.

**SPECIFICATIONS—Tape speed:** 7.5" and 3.75" per second. **Maximum reel size:** 7". **Frequency response (record-playback):** ±2.5 db, 30 to 12,000 cps at 7.5 IPS; ±2.5 db, 30 to 6,500 cps at 3.75 IPS. **Harmonic distortion:** 1% or less at normal recording level; 3% or less at peak recording level. **Signal-to-noise ratio:** 50 db or better, referred to normal recording level. **Flutter and wow:** 0.3% RMS at 7.5 IPS; 0.15% RMS at 3.75 IPS. **Heads (3):** Erase, record, and multiple stereo playback (TR-1C, monophonic playback). **Playback equalization:** NARTB curve, within ±2 db. **Inputs (2):** microphone and line. **Input impedance:** 1 megohm. **Model TR-1D & TR-1E outputs (2):** A and B stereo channels. **Model TR-1C output (1):** monophonic. **Output levels:** approximately 2 volts maximum. **Output impedance:** approximately 600 ohms (cathode followers). **Recording level indicator:** professional type db meter. **Bias erase frequency:** 60 kc. **Timing accuracy:** ±2%. **Power requirements:** 105-125 volts AC, 60 cycles, 35 watts. **Dimensions:** 15½" W. x 13½" D. Total height 10¾". **Mounting:** requires minimum of 8½" below and 1½" above mounting surface. May be operated in either horizontal or vertical position.

**MODEL TR-1C Monophonic Tape Deck:** Monophonic Record and Playback. **$159.95** $16.00 DWN. $14.00 MO.

**MODEL TR-1D Two Track Stereo Tape Deck:** Monophonic Record and Playback, plus Playback of 2-track Pre-recorded Stereo Tapes (stacked). **$169.95** $17.00 DWN. $15.00 MO.

**MODEL TR-1E Four Track Stereo Tape Deck:** Monophonic Record and Playback, plus Playback of 4-track Pre-recorded Stereo Tapes (stacked). **$169.95** $17.00 DWN. $15.00 MO.

**MODEL C-TR-1C Conversion Kit:** Converts TR-1C to TR-1D (see TR-1D description above). Shpg. Wt. 2 lbs. . . . . **$19.95**

**MODEL C-TR-1D Conversion Kit:** Converts TR-1D to TR-1E (see TR-1E description above). Shpg. Wt. 2 lbs. . . . . **$14.95**

**MODEL C-TR-1CQ Conversion Kit:** Converts TR-1C to TR-1E (see TR-1E description above). Shpg. Wt. 2 lbs. . . . . **$19.95**

### STEREO-MONO TAPE RECORDER KITS (TR-1A Series)

Here are the tape recorders the avid hi-fi fan will find most appealing! Their complete flexibility in installation and many functions make them our most versatile tape recorder kits. This outstanding tape recorder now can be purchased in any one of three versions. You can buy the new two-track (TR-1AH) or four-track (TR-1AQ) versions which record and play back both stereo and monophonic programming, or the two-track monophonic record-playback version (TR-1A) and later convert to either two-track or four-track stereo record-playback models by purchasing the MK-4 or MK-5 conversion kits. The tape deck mechanism is extremely simple to assemble. Long, faithful service is assured by precision bearings and close machining tolerances that hold flutter and wow to less than 0.35%. Power is provided by a four-pole, fan-cooled induction motor. One lever controls all tape handling functions of forward, fast-forward or rewind modes of operation. The deck handles up to 7" tape reels at 7.5 or 3.75 IPS as determined by belt position. The TR-1A series decks may be mounted in either a vertical or horizontal position (mounting brackets included). The TE-1 Tape Electronics kits supplied feature NARTB equalization, separate record and playback gain controls and a safety interlock. Provision is made for mike or line inputs and recording level is indicated on a 6E5 "magic eye" tube. Two circuit boards simplify assembly.

**MODEL TR-1A:** Monophonic two-track record/playback with fast forward and rewind functions. Includes one TE-4 Tape Electronics kit. Shpg. Wt. 24 lbs. **$99.95** $10.00 DWN. $9.00 MO.

**TR-1A SPECIFICATIONS—Frequency response:** 7.5 IPS ±3 db 50 to 12,000 cps; 3.75 IPS ±3 db 50 to 7,000 cps. **Signal-to-noise ratio:** better than 45 db below full output of 1.5 volts/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

**MODEL TR-1AH:** Two-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

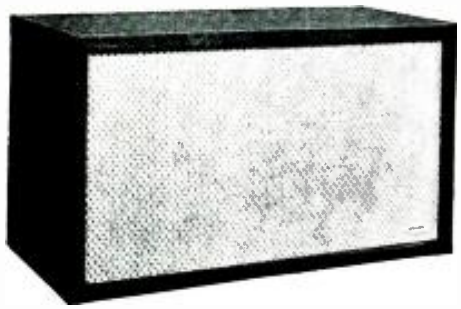
**TR-1AH SPECIFICATIONS—Frequency response:** 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ± db 40 to 10,000 cps. **Signal-to-noise ratio:** 45 db below full output of 1 volt/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

**MODEL TR-1AQ:** Four-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

**TR-1AQ SPECIFICATIONS—Frequency response:** 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ±3 db 40 to 10,000 cps. **Signal-to-noise ratio:** 40 db below full output of .75 volts/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase:** 60 kc (push-pull oscillator).

**HEATH COMPANY**/Benton Harbor, Mich. a subsidiary of Daystrom, Inc.

# New "Acoustic Suspension" Hi-Fi Speaker System Kit



HEATHKIT AS-2U (unfinished)

**$69.95**

HEATHKIT AS-2M (mahogany) **$79.95**
HEATHKIT AS-2B (birch) **EACH**

## NOW—FOR THE FIRST TIME —EXCLUSIVELY FROM HEATH

### ACOUSTIC SUSPENSION HI-FI SPEAKER SYSTEM KIT (AS-2)

A revolutionary principle in speaker design, the Acoustic Research speaker has been universally accepted as one of the most praiseworthy speaker systems in the world of high fidelity sound reproduction. Heathkit is proud to be the sole kit licensee of this Acoustic Suspension principle from AR, Inc., and now offers for the first time this remarkable speaker system in money-saving, easy-to-build kit form.

The 10" Acoustic Suspension woofer delivers clean, clear extended-range bass response and outstanding high frequency distribution is provided by the specially designed "cross-fired" two-speaker tweeter assembly.

Another first in the Heathkit line is the availability of preassembled and prefinished cabinets. Cabinets are available in prefinished birch (blond) or mahogany, or in unfinished birch suitable for the finish of your choice. Kit assembly consists merely of mounting the speakers, wiring the simple cross-over network and filling the cabinet with the fiberglass included. Shpg. Wt. 32 lbs.

**SPECIFICATIONS—Frequency response (at 10 watts input):** ±5 db, 42 to 14,000 cps; 10 db down at 30 and 16,000 cps. **Harmonic distortion:** below 2% down to 50 cps, below 3% down to 40 cps at 10 watts input in corner room location. **Impedance:** 8 ohms. **Suggested amplifier power:** 20 watts minimum. **Suggested damping factor:** high (5:1 or greater). **Efficiency:** about 2%. **Distribution angle:** 90° in horizontal plane. **Dimensions:** 24" W. x 13½" H. x 11¾" D.

# New Test Equipment

HEATHKIT FMO-1 Price to be announced

## AN INSTRUMENT LONG-AWAITED BY SERVICE TECHNICIANS EVERYWHERE!

### HEATHKIT FM TEST OSCILLATOR KIT (FMO-1)

Here in one compact, easy-to-use instrument are provided all the test signals and sweep frequencies required for fast, easy alignment and troubleshooting of RF, IF and detector sections of FM tuners and receivers. An instrument unique in the test equipment field . . . being the only one of its type designed especially for FM service work.

**SPECIFICATIONS—Output frequencies:** for RF alignment, 90 mc (FM band low end), 100 mc (FM band middle range), 107 mc (FM band high end). **Modulation:** 400-cycle incidental FM. **IF and detector alignment:** 10.7 mc sweep. **Sweep width markers:** 200 kc to over 1 mc, variable, 10.7 mc (crystal), 100 kc sub-markers. **Modulation:** 400-cycle AM. **For other applications:** 10.0 mc (crystal) and harmonics, 100 kc, 400-cycle audio. **Controls:** main frequency selector, modulation switch/concentric level control, marker oscillator switch/concentric level control, sweep width—power switch, output control, AF-RF (source impedance) switch. **Power supply:** transformer, selenium rectifier. **Power requirements:** 105-125 V, 50/60 cycles, 12 watts. **Cabinet size:** 7⅞" H. x 4¾" W. x 4¾" D.

HEATHKIT RF-1

**$27.95**

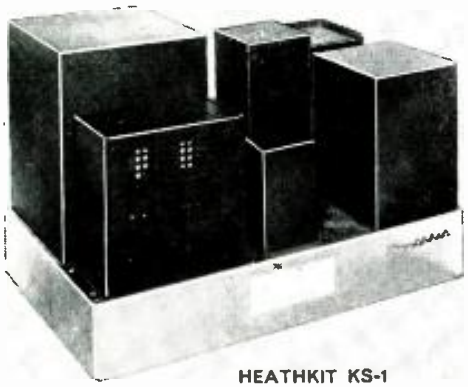
## PREASSEMBLED AND ALIGNED BANDSWITCH/COIL ASSEMBLY

### RF SIGNAL GENERATOR KIT (RF-1)

Moderately priced, and capable of precision performance the RF-1 provides highly accurate and stable RF signals for trouble-shooting and aligning RF and IF circuits of all kinds. Modulated or unmodulated RF output of at least 100,000 microvolts is available, controlled by both fixed-step and continuously variable controls. A built-in 400 cycle audio generator with 10-volt output provides internal modulation of RF signal and is available separately for audio tests. A preassembled bandswitch and coil assembly, aligned to factory precision standards, eliminates the need for special alignment equipment. Shpg. Wt. 7 lbs.

**SPECIFICATIONS—Frequency range:** Band A, 100 kc to 320 kc; Band B, 310 kc to 1.1 mc; Band C, 1 mc to 3.2 mc; Band D, 3.1 mc to 11 mc; Band E, 10 mc to 32 mc; Band F, 32 mc to 110 mc. **Calibrated harmonics:** 110 mc to 220 mc. **Accuracy:** 2%. **Output:** impedance, 50 ohms, voltage, in excess of 100,000 uv on all bands. **Modulation:** internal, 400 cycles approx. 30%, depth, external, approx. 3 V across 50 k ohm for 30%. **400 cycles audio output:** approx. 10 V open circuit. **Tube complement:** V1 12AT7 RF oscillator, V2 6AN8 modulator and output. **Power requirements:** 105-125 V 50,60 cycles AC, 15 watts. **Aluminum cabinet dimensions:** 6¾" W. x 9½" H. x 5" D.

# New HEATHKIT Ham Radio Gear



HEATHKIT KS-1

**$169.95**

## TOP POWER WITH ECONOMY AND SAFETY

### KILOWATT POWER SUPPLY KIT (KS-1)

The KS-1 is designed as a companion to the "Chippewa" Linear Amplifier and is also suitable for supplying plate power to most other RF amplifiers in the medium to high power class. The KS-1 features an oil-filled, hermetically sealed plate transformer to minimize corona, a swinging choke in the filter circuit for good regulation, and a 60-second time delay relay to permit adequate heating of the mercury vapor rectifiers before application of plate voltage. All components are conservatively rated and well insulated for long life and dependable service. Shpg. Wt. 105 lbs.

**SPECIFICATIONS—Maximum DC power output:** 1500 watts. **Nominal DC voltage output:** 3000 or 1500 volts. **Maximum DC current output:** Average 500 ma, peak 1000 ma. **Regulation:** 180 to 600 ma (typical linear amplifier), 8%; 0 to 300 ma (typical class C amplifier), 10%; 0 to 500 ma, 15%. **Ripple:** Less than 1%. **Tube complement:** (2) 866A mercury vapor rectifiers. **Recommended ambient temperature:** 50 to 100 degrees F. **Circuit:** Two half-wave mercury vapor rectifiers in a full wave, single-phase configuration with swinging choke input filtering. **Line power requirements:** 115 V, 50/60 cycles, 20 amperes; 230 V, 50,60 cycles, 10 amperes. **Chassis size:** 17¾" W. x 12" H. x 13" D.

HEATHKIT KL-1

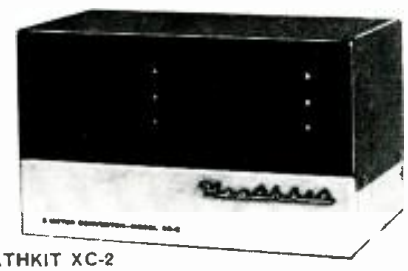
**$415.00**

## MOVE TO THE TOP IN TRANSMITTING POWER

### "CHIPPEWA" KILOWATT LINEAR AMPLIFIER KIT (KL-1)

The KL-1 operates at maximum legal amateur power inputs in SSB, CW or AM service using any of the popular CW, SSB and AM exciters as a driver. Premium tubes (4—400's) push the "Chippewa" to top performance levels while a centrifugal blower provides more than adequate cooling. Shpg. Wt. 70 lbs.

**SPECIFICATIONS—RF section:** Driving power required (10 meters); Class AB1 (tuned grid) 10 watts peak; Class C (tuned grid) 40 watts; Class AB1 (swamped grid) 60 watts peak. **Power input:** Class AB1 (SSB-voice modulation) 2000 watts PEP; Class AB1 (SSB-two tone test) 1300 watts; Class AB1 (AM linear) 1000 watts; Class C (CW) 1000 watts. **Power output (20 meters):** Class AB1 (SSB-voice modulation) 900 watts PEP; Class AB1 (SSB-two tone test) 550 watts; Class AB1 (AM linear) 300 watts; Class C (CW) 750 watts. **Output impedance:** 50 to 72 ohms (unbalanced). **Input impedance:** 50 to 72 ohms (unbalanced). **Band coverage:** 80, 40, 20, 15 and 10 meters. **Panel metering:** 0 to 50 ma, grid current; 0 to 100 ma screen current; 0 to 5000 volt plate voltage; 0 to 1000 ma plate current. **Tube complement:** Final tubes, (2) 4-400A; clamp tube, (1) 6DQ6; voltage regulators, (4) OD3, (2) OC3. **Power requirements:** AC (power supply primary circuit), 250 watts, 115 volt, 50/60 cycles; DC, 3000 to 4000 volts, 450 ma. **Cabinet size:** 19½" W. x 11⅞" H. x 16" D.



HEATHKIT XC-2

**$36.95**

### 2-METER CONVERTER KIT (XC-2)

Extends coverage of the Heathkit "Mohawk" Receiver to the 2-meter band. May also be used with receivers tuning a 4 mc segment between the frequencies of 22 and 35 mc when appropriate crystal is used. Shpg. Wt. 7 lbs.

**SPECIFICATIONS—Noise figure:** 4.5 db; 1 uv signal provides 20 db thermal noise quieting. **Sensitivity:** approx. .1 uv input will provide a signal better than 6 db over noise level. **Gain:** approx. 40 db. **Pass band:** essentially flat 144 to 148 mc; approx. 35 db down at 143 and 149 mc. **Image rejection:** better than 100 db (tunable). **Output impedance:** 50 to 75 ohms. **Input impedance:** 50 to 75 ohms; 300 ohms with balun. **Frequency:** input, 144 to 148 mc; output, 22 to 26 mc with crystal supplied. **Tubes:** 6AM4, 6BS8, 6EA8, 12AT7. **Crystal:** .005% 3rd overtone. **Power requirements:** 150 volts DC at 50 ma (dropping resistor supplied for 210 VDC RX-1 operation) 6.3 volts AC/DC at 1.375 amps. **Size:** 9" W. x 5½" H. x 4¾" D.

HEATHKIT UT-1

**$28.95**

### "BEST BUY" UTILITY POWER SUPPLY KIT (UT-1)

This power supply is ideal for converting the Heathkit "Cheyenne" and "Comanche" mobile transmitter and receiver to fixed station operation; or may be used to provide necessary filament and plate voltage for a wide variety of amateur equipment. Features silicon diode rectifiers, high capacity filters for superior dynamic regulation, and line filtering to minimize TVI and reduce receiver line noise. On ICAS basis, provides 150 watts DC plus filament power for 6.3 volt or 12.6 volt filament applications (6.3 VAC., 8 amps. or 12.6 VAC., 4 amps.; 600 VCD., 250 ma or 600 VDC., 200 ma and 300 VDC., 100 ma). Less than 1% ripple; excellent regulation. Housed in attractive green and gray-green cabinet measuring 9" long, 4¾" wide, 6" high. Shpg. Wt. 15 lbs.

# New Citizen's Band Transceiver

## WIRED OR KIT FORM

HEATHKIT CB-1
**$42.95**
(kit model)

HEATHKIT W-CB-1
**$60.95**
(wired model)
$6.10 dwn., $6.00 mo.

Both models include transceiver, crystal, microphone and two special power cords.

- No Tests to Take—No Operator's License Required
- Any Citizen 18 or Older Can Have Own Station
- Hundreds of Business and Personal Uses

### CITIZEN'S BAND TRANSCEIVER KIT (CB-1)

The Heathkit CB-1 Citizen's Band Transceiver is a compact radio transmitter and receiver combination designed to operate on the new 11-meter "Citizen's Band". No tests to take, no special knowledge or operator's license required . . . you need only fill out forms we supply, and mail them to FCC to apply for station license. Operates just like any short wave radio used by police and other communication services. Front panel switch selects both "transmit" and "receive". Two or more Heathkit Transceivers provide you with your own 2-way radiotelephone system for making necessary business and personal contacts with family, friends or associates. A Heathkit accessory power supply makes the CB-1 completely portable for use in cars, trucks, boats, etc., using 6 or 12 volt batteries. With appropriate accessory antenna, the CB-1 can be used for communicating between truck and office, home and automobile, boat and shore, farm-house and field . . . literally hundreds of useful applications. Comes complete with microphone, 2 power cords for mobile or fixed operation, station ID card, call letters, and crystal for one channel and FCC application form. Order power supply and antenna separately. Attractively styled in two-tone "mocha" and "beige". Shpg. Wt. 10 lbs.

**SPECIFICATIONS—Receiver type:** Superregenerative detector w /rf stage. **Power input:** 5 watts maximum to plate of final RF amplifier (FCC requirement). **Transmitter frequency control:** Third overtone type quartz crystal operating within 0.005% of marked channel frequency between −20° and +130° F. **Modulation:** AM plate and screen modulation automatically limited to less than 100% (FCC requirements). **Power supply:** Internal 117 V. 50/60 cycles, AC (35 watts). For 6 V battery power, use Model VP-1-6 Vibrator Power Supply (6.5 amps); for 12 V battery power, use VP-1-12 (4 amps). **Total B+ requirements:** 260 volts at 60 ma; total heater requirements, 6.3 volts at 1.8 amps, or 12.6 volts at 0.9 amps. **Power rectifier:** 2 silicon diodes in full wave voltage doubler circuit. **Microphone:** Combination hand-held and desk type, ceramic element, plastic case, with cord and connector. **RF output impedance:** 50 ohms. **Speaker size:** 3½" (round). **Undistorted audio power output:** Approximately 1 watt. **Line cords:** Two supplied, one for AC operation, one for battery operation. Power circuits automatically switched when appropriate line cord is plugged in. **Cabinet dimensions:** 8" H. x 6" D. x 9¾" W.

### SPECIFY FREQUENCY CHOICE
(1st and 2nd choice)

### CLASS D CITIZEN'S BAND FREQUENCIES

| | | | |
|---|---|---|---|
| 26.965 mc | 27.035 mc | 27.115 mc | 27.185 mc |
| 26.975 mc | 27.055 mc | 27.125 mc | 27.205 mc |
| 26.985 mc | 27.065 mc | 27.135 mc | 27.215 mc |
| 27.005 mc | 27.075 mc | 27.155 mc | 27.225 mc |
| 27.015 mc | 27.085 mc | 27.165 mc | *27.255 mc |
| 27.025 mc | 27.105 mc | 27.175 mc | |

*This channel shared with Class C Radio Control.

### ANTENNAS

**CBU-1 "UTILITY" ANTENNA.....$9.95**
Good coverage, portable antenna for temporary mobile or fixed installations. 45½" base-loaded antenna, 12' connecting cable, mounting bracket and clip. 3 lbs.

**CBM-1 "MOBILE" ANTENNA.....$19.95**
Best coverage mobile installation. Easy to install spring base, ¼ wave, 9' whip; 15' connecting cable and necessary hardware. 7 lbs.

**CBF-1 "FIXED LOCATION" ANTENNA...$19.95**
Excellent coverage, ¼ wave "ground plane", 9' elements; 50' connecting cable and mounting bracket. 7 lbs.

### WIRED AND KIT FORM POWER SUPPLIES FOR MOBILE USE

6 volt Vibrator Power Supply for use with 6 volt batteries.
**KIT—Model VP-1-6. Shpg. Wt. 4 lbs.....$7.95**
**WIRED—Model WVP-1-6. Shpg. Wt. 4 lbs.....$11.95**

12 volt Vibrator Power Supply for use with 12 volt batteries.
**KIT—Model VP-1-12. Shpg. Wt. 4 lbs.....$7.95**
**WIRED—Model WVP-1-12. Shpg. Wt. 4 lbs.....$11.95**

HEATHKIT

## ORDER BLANK

NOTE: all prices and specifications subject to change without notice.

Enclosed find ( ) check ( ) money order. Please ship C.O.D. ( )

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

On Parcel Post Orders include postage for weight shown. All prices are NET F.O.B. Benton Harbor, Michigan, and apply to Continental U.S. and Possessions only. 20% Deposit required on all C.O.D. orders.

**HEATH COMPANY** BENTON HARBOR 15, MICH.
a subsidiary of Daystrom, Inc.

Name_____

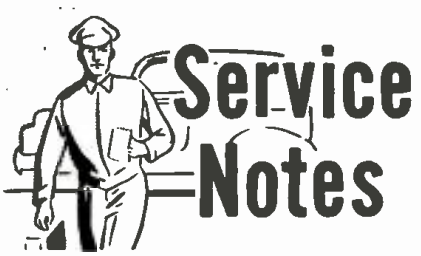
Address_____

City & Zone_____ State_____
(PLEASE PRINT)

SHIP VIA
☐ Parcel Post
☐ Express
☐ Freight
☐ Best Way

| QUANTITY | ITEM | MODEL NO. | PRICE |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | ☐ SEND FREE HEATHKIT CATALOG | POSTAGE | |
| | | TOTAL | |

**HEATHKITS are also available at your Dealer** see listing on next page




## R.F. INTERFERENCE IN HI-FI

In high-gain audio-amplification systems, undesired detection of r.f. signals can take place in one or more stages. This is especially noticeable when using such signal sources as low-level phonograph cartridges or magnetic tapes. The following procedure for locating the stage or stages where the detection occurs and eliminating it has been worked out specifically for *Magnavox* high-fidelity instruments, but the general technique is applicable to all similar equipment:

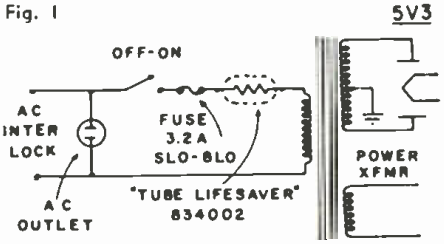
With the function control set to "Phono" or "Tape," rotate the "Loudness" control to determine whether it has any effect on the volume of the interfering signal. If it does, the offending stage is narrowed down to those preceding the control. If it has no effect, the unwanted detection is taking place beyond this point. Next, disconnect the signal lead between the radio chassis and the power amplifier. If the interfering signal disappears with this lead disconnected, detection is taking place in the audio-amplification stage or stages of the tuner. If the signal does not disappear, a stage in the power amplifier is at fault.

Once the offending stage has been located, a suppressor resistor inserted in series with its grid should eliminate the symptom. To accomplish this, remove connections made at the grid, solder a resistor (a satisfactory value will usually be between 50,000 and 100,000 ohms) directly to the grid, and solder the removed leads and components to the opposite side of the resistor.

## HOFFMAN: RECTIFIER FAILURE

In some cases, there are repeat failures of the 5AU4 in 1957 models. The cause is generally high line voltage. However, the best remedy is replacement of the 5AU4 with a 5V3 rectifier,

Fig. 1 — 5V3




since the latter has higher maximum ratings.

For maximum protection, two additional changes are also advisable. A new thermistor device (*Hoffman* Part No. 834002) should be wired in series with the a.c. line cord. This will pro-

tect the entire receiver against surges occurring before warm-up. Since the device whose number is given is designed for the 1957 receivers, it should be wired in after the accessory plug on receivers having such a plug. A 3.2-ampere time-delay fuse will also protect against surges after warm-up. Both changes are shown in Fig. 1.

### G-E: SHRUNKEN RASTER

When the raster on a TV receiver using the M-4 chassis shows reduction in both the horizontal and vertical directions, and a check shows that second-anode voltage for the picture tube is also low, a likely cause is not apt to be apparent. The trouble may lie in the vertical-output circuit—specifically, in the retrace-blanking network connecting to the grid of the CRT. If capacitor $C_{211}$ in Fig. 2 (.01 μf., 1600 volts)

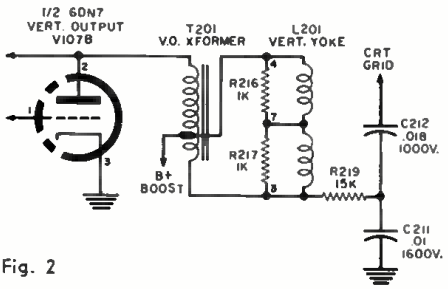



Fig. 2

shorts, the boosted "B+" supply will be loaded, and this will affect the high-voltage circuit as well as the horizontal sweep. When this defect occurs, resistor $R_{219}$ (15,000 ohms) should also be checked after the capacitor is replaced. The latter may also have been damaged as the short will cause excessive current to pass through it.

### RCA: POOR FOCUS, COLOR TV

If, in the 800 series of color receivers, poor focus not due to a defective focus control is encountered together with some evidence of irregular horizontal linearity, check for leakage or partial shorting in capacitor $C_{115}$ (560 μμf., ± 10%, 2000 v.) in the yoke. If it must be replaced, also check resistor $R_{125}$, as excessive current resulting from leakage in the capacitor may have damaged the resistor.

### EMERSON: PIX OVERLOAD

When TV receivers using the 1203-41H and 120342R chassis are operated in areas where the signal strength is high, there may be a tendency for the picture to pull, jitter, or show other signs of video overload. This condition may be minimized by changing the value of one resistor and adding another, to improve a.g.c. action. Resistor $R_{72}$, originally a 1-megohm unit, may be changed to 470,000 ohms, ½ watt. A 22-megohm resistor (½ watt) should also be connected between pin 9 of $V_{5}$, the sync separator, and the junction of $C_{71}$, $R_{72}$, and the i.f. board. The latter resistor should be designated $R_{15}$ on the schematic, to correspond with this change, as described, made in later production. —30—

# The Photomultiplier and its uses

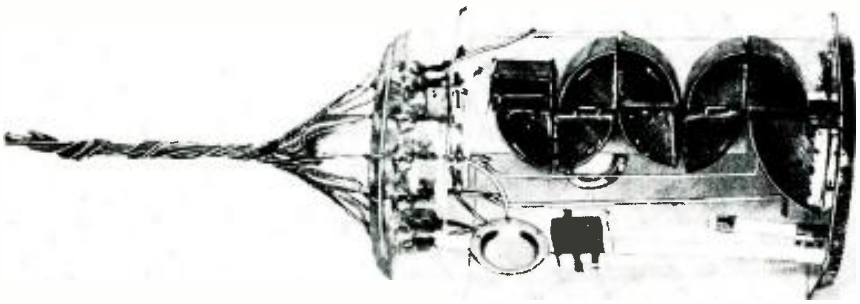
By **ED BUKSTEIN** / Northwestern TV & Electronics Inst.

**An extremely sensitive version of the phototube, the photomultiplier is employed in medicine, in the scientific research lab, and in industry.**

IN A medical clinic, a doctor positions an instrument to study the heart action of his patient. In a research laboratory, a scientist adjusts an electronic device to measure the age of a fossil bone fragment. In an ordnance plant, an electronic instrument detects an improperly filled fuse and energizes a rejection mechanism. All of these instruments, and many more, are designed around the photomultiplier tube —an extremely sensitive version of the phototube.

The basic phototube is a diode. It contains a chemically coated cathode which emits electrons when illuminated and an anode to collect these electrons.


▲ Fig. 1. The General Electric 931-A photomultiplier. The grille structure visible in photo allows light to pass to cathode and provides electrostatic control field.



◀ Fig. 2. The dynode structure of the DuMont type 6292 photomultiplier is visible in photo. This is a 10-dynode tube that can provide a current gain of 2 million.

The plate current of the tube therefore depends upon the presence and quantity of light. This is the tube used in burglar alarm systems, automatic door openers, and foul detectors in bowling alleys. It is a useful tube and a reliable one, but its operation requires relatively high levels of light intensity. For those applications involving extremely low levels of light intensity, the photomultiplier is used.

As shown in Fig. 3, electrons emitted from the cathode do not go directly to the plate. Instead, they go in succession to a series of intermediate electrodes known as "dynodes." The characteristic feature of the dynode is that it emits several secondary electrons for each electron striking it. One electron from the cathode, for example, may release four secondary electrons from the first dynode. Each of these four will then release four electrons from the next dynode, bringing the total to sixteen. When these sixteen strike the next dynode, 64 secondary electrons will be emitted, etc. Since the number of electrons is increased at each dynode, millions of electrons may eventually reach the plate for each electron emitted from the cathode. It is for this reason that considerable plate current will flow even with very little illumination of the cathode. The electron multiplication or current gain of the photomultiplier depends upon the number of dynodes and the ratio of secondary-to-incident electrons for each dynode.

Mathematically, the current gain of the photomultiplier is expressed as: $G = R^n$ where $R$ is the ratio of secondary-to-incident electrons for each dynode and $n$ is the number of dynodes.

A ten-dynode tube having a 4 to 1 ratio of secondary emission will therefore have a gain of $4^{10}$ or approximately one million.

Each dynode of the photomultiplier is operated at a higher positive potential than the preceding dynode, usually about 100 to 150 volts higher. This, and the geometry of the tube, cause the electrons to move in succession from one dynode to the next. The dynode structure of the type 6292 photomultiplier is visible in the photograph of Fig. 2. This is a ten-dynode tube capable of providing a current gain of 2,000,000 when operated at 145 volts-per-dynode. At 105 volts-per-dynode, the current gain is 215,000. As these figures indicate, the gain of a photomultiplier can be controlled by varying the dynode voltages. Most of the commercially available photomultipliers have either nine or ten dynodes and provide current gains ranging from 200,000 to 2,000,000. The characteristics of several types are listed in Fig. 4. The wavelength (color) of maximum response is determined by the chemical

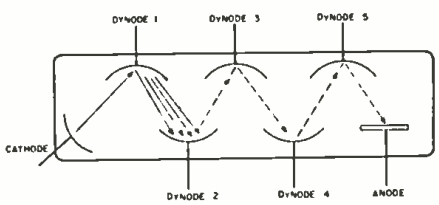



Fig. 3. Electrons emitted from the cathode of the photomultiplier tube pass in succession from one dynode to the next. Because each dynode emits more electrons than it receives, the number of electrons reaching the anode is much greater than the number leaving the cathode. Five dynodes are shown here for simplicity; most photomultipliers have either 9 or 10 dynodes.

composition of the cathode and is listed for each type in Fig. 4. Also shown is the relationship between color and wavelength in angstroms. The angstrom is a subdivision of the meter and is commonly used to specify the wavelength of infrared, visible light, ultraviolet, and x-rays. Ten billion angstroms are equivalent to one meter.

The type 931-A photomultiplier is shown in Fig. 1. The grille structure

visible in the photograph permits light to pass through to the cathode and also serves to establish an electrostatic field to control the electron paths. In the 931-A, the cathode faces the side of the glass envelope, but many photomultipliers are constructed with a *head-on* or *end-window* type of cathode. In these types, the cathode is a semitransparent coating deposited on the inside of the glass envelope at the end of the tube opposite the base. This type of construction is particularly useful in those applications in which the photomultiplier is mounted in a probe, as in the scintillation counter used for measuring radioactivity.

Because each electrode in the photomultiplier must be more positive than the preceding electrode, a high-voltage power supply is required. A voltage divider connected across the power supply provides the required voltage for each electrode. Voltage regulator tubes are sometimes connected across the high-voltage supply to improve stability. Half-wave, full-wave, and voltage-doubler rectifiers are commonly used in the high-voltage supply. As shown in Figs. 5 and 6, grounded-positive supplies are often used to permit the anode to be operated close to ground potential.

## Applications

In many of its applications, the photomultiplier is used in conjunction with x-ray equipment. It may, for example, be used as an automatic x-ray exposure control. A chemical screen, similar to those used in cathode-ray tubes, is excited to fluorescence by the x-ray bombardment it receives. The resulting light illuminates the cathode of the photomultiplier and the plate current is used to charge a capacitor. This charge eventually overcomes the bias of a thyratron which operates a relay to terminate the exposure. Since the light produced by the fluorescent screen is proportional to the x-ray intensity, the exposure time is automatically controlled with respect to the intensity of radiation. A vacuum-tube voltmeter connected to the anode of the photomultiplier converts the circuit to an x-ray measuring instrument. Variations of this circuit are used for thickness measurement of sheet metal. Here, the sheet of metal moves between the x-ray tube and the fluorescent screen. Since the thickness of the metal determines the extent to which the x-rays penetrate, the scale of the v.t.v.m. may be calibrated to read in thousandths of an inch or any other convenient unit. The combination of x-ray tube, fluorescent screen, and photomultiplier is also widely used for inspecting packages for proper filling. In this application, each package is inspected as it moves along a conveyer belt. An improperly filled package, by allowing more x-radiation to reach the fluorescent screen, causes a reject device to energize and remove that package from the conveyor. This technique has recently been applied to the problem of inspecting fuses in ordnance manufacture.

| TYPE | DYNODES | MAX. RESPONSE | CURRENT GAIN |
|---|---|---|---|
| 1P21 | 9 | 4000 A | $2 \times 10^6$ |
| 1P28 | 9 | 3400 A | $1.25 \times 10^6$ |
| 931-A | 9 | 4000 A | $8 \times 10^5$ |
| 5819 | 10 | 4400 A | $5 \times 10^5$ |
| 6199 | 10 | 4400 A | $6 \times 10^5$ |
| 6217 | 10 | 5400 A | $6 \times 10^5$ |

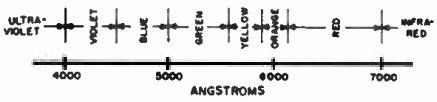
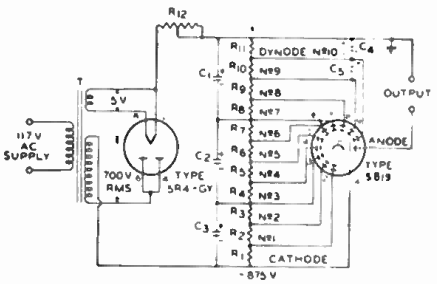
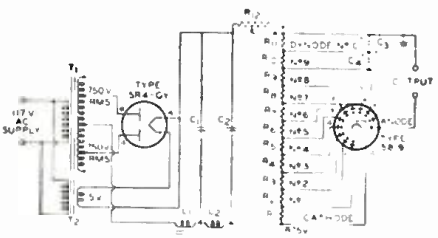



Fig. 4. Tabulation shows characteristics of several commercially available photomultipliers. Also shown below is the relationship between color and wavelength.




*R1—100,000 ohm, ½ w. res.*
*R2, R3, R4, R5, R6, R7, R8, R9, R10—50,000 ohm, ½ w. res.*
*R11—33,000 ohm, ½ w. res.*
*R12—100,000 ohm, 1 w. adj. res. (Centralab A122 or equiv.)*
*C1, C2, C3—16 µf., 450 v. elec. capacitor*
*C4, C5—8 µf., 150 v. elec. capacitor*
*T1—Power trans. 350-0-350 v. @ 70 ma.; 5 v. @ 3 amps. (UTC R-102 or equiv.)*

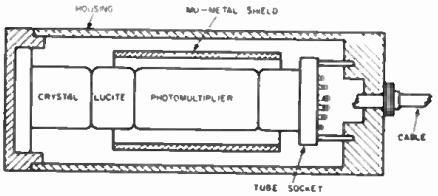
Fig. 5. Half-wave power supply for photomultiplier tube. $R_{12}$ controls dynode voltages and therefore varies the current gain of tube. A meter, relay, or load resistor may be connected across output terminals, depending on the use. (Courtesy: RCA)




*R1—39,000 ohm, 2 w. res.*
*R2, R3, R4, R5, R6, R7, R8, R9, R10—18,000 ohm, 1 w. res.*
*R11—12,000 ohm, 1 w. res.*
*R12—200,000 ohm, 12 w. adj. res. (General Radio Type 471-A or equiv.)*
*C1, C2—2 µf., 1000 v. capacitor*
*C3, C4—8 µf., 150 v. elec. capacitor*
*L1, L2—20 hy., 40 ma. filter choke*
*T1—Plate trans. 900-750-0-750-900 v. @ 200 ma. (UTC S-45 or equiv.)*
*T2—Fil. trans. 5 v. c.t. @ 3 amps (UTC FT-6 or equiv.)*

Fig. 6. Full-wave power supply for photomultiplier. Two-section choke-input filter gives better regulation. (Courtesy: RCA)

Fig. 7. Scintillation counter probe. Flashes of light produced by crystal are coupled to photomultiplier through Lucite "light pipe." Mu-metal is for magnetic shielding.




The photomultiplier is also widely used for measuring the density of photographic plates and films. In this application, the instrument is known as a photoelectric densitometer. Light passing through the photographic negative illuminates the cathode of the photomultiplier. The reading of the v.t.v.m. connected to the photomultiplier is therefore determined by the density of the negative. This technique is used not only in photographic darkrooms but also in scientific laboratories for measuring the density of spectrographic plates. Used in conjunction with a time-delay relay, the photomultiplier can be used to automatically control exposure time for photographic printing processes.

The scintillation counter, big brother to the Geiger counter, also uses a photomultiplier. As shown in Fig. 7, the photomultiplier is used in conjunction with a crystal, usually thallium-activated sodium iodide. The crystal produces a brief flash of light each time it is bombarded by a particle or *gamma* ray emitted from a radioactive substance. The light, coupled through a lucite "light pipe," illuminates the cathode of the photomultiplier. The resulting pulses of plate current are amplified and applied to a meter or counting circuit. This instrument is so sensitive that it can be used for aerial prospecting. It is also useful for contamination studies and hazards-monitoring, as well as other similar type applications.

Medically, the scintillation counter is used in thyroid studies. Radioactive iodine-131, injected into the body, tends to accumulate in the thyroid glands. The scintillation counter is then used to measure the concentration of this substance in the region of the thyroids. Other radio-isotopes show an affinity for other parts of the anatomy. Radio-di-iodofluorescein, for example, tends to concentrate in brain tumors, which can then be localized by exploring the surface of the scalp with the scintillation probe.

The scintillation counter is also useful for determining the age of biological specimens. Living substances absorb radioactive carbon from the atmosphere. At the time of death, this process of absorption ceases and the amount of radioactivity begins to decrease. Since the rate of decrease is known, age can be determined by measuring the remaining radioactivity. This technique, known as *carbon-14 dating*, permits dating of objects excavated from the ruins of early civilizations.

In the flying-spot scanner, an instrument used for generating a television picture signal for test purposes, the photomultiplier is illuminated by light passing through a slide or transparency. As shown in Fig. 8, a cathode-ray tube is used as the light source. Vertical and horizontal sweep circuits, similar to those used in a TV receiver, cause the spot of light to sweep across the transparency in a standard scanning pattern. The varying densities

encountered by the spot of light as it scans the transparency modulate the illumination reaching the photocathode. The output signal of the photomultiplier therefore contains the picture information. Cathode-ray tubes especially designed for this application are characterized by high brilliance and very short persistence.

The photomultiplier tube has become familiar to the automotive industry as a result of its use in the automatic headlight dimmer. Here, the photocathode is illuminated by the headlights of an on-coming car. The output of the photomultiplier is amplified and used to control the light-dimming relay.

In chemical and industrial plants, the photomultiplier is used to measure the concentration of toxic gases in the air and to sound an alarm when the concentration approaches the danger level. In this application, an ultraviolet-sensitive photomultiplier is illuminated by a source of ultraviolet radiation. Toxic agents, such as mercury vapor and carbon disulphide, absorb the ultraviolet rays and decrease the illumination of the photocathode. Dust measuring instruments are similar in design except that visible light rather than ultraviolet is employed.

In summary then, it can be seen that the photomultiplier tube, which is an extremely sensitive phototube, has many uses in medicine, in the research laboratory, and in industry. —30—

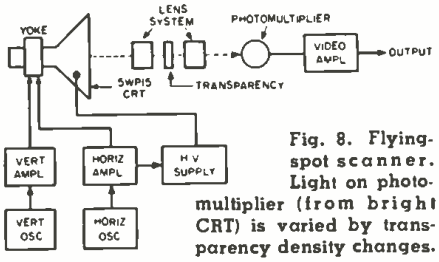
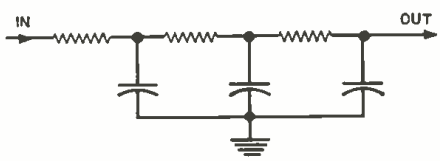



Fig. 8. Flying-spot scanner. Light on photomultiplier (from bright CRT) is varied by transparency density changes.

## VERTICAL-HORIZONTAL FAULT

By ROBERT JAMES

**THE TIME this puzzler took was worth the lesson. A TV set came into the shop with vertical roll, which was traced to the printed-circuit vertical-integrating network. With the latter replaced, vertical hold was restored—but the horizontal became critical. It was finally found that the integrator, shown correctly wired in the illustration, had been put in backwards. Thus the capacitor on the output**




**side directly shunted horizontal pulses from the sync section. The fault was corrected by reversing input and output leads. The network works one way only. While inadvertent reversal of input and output leads will still provide adequate integration of vertical pulses, the isolating resistor is needed at the input to block horizontal pulses.** —30—


# NEW EXPERIMENT IN TELEPHONY

*It could speed up "dialing." Bell Laboratories people created it—and now it's being tested.*

The telephone you see above embodies an important new concept. It "dials" by means of push buttons—promises more convenient telephoning. Bell System engineers are currently testing it for public reaction. Bell Telephone Laboratories developed it.

The Laboratories' invention of the transistor makes it possible. For the transistor permits a new kind of calling signal generator, mounted within the instrument.

To insure ease of operation, psychologists studied human reactions to various finger pressures and sizes and arrangements of buttons. All factors affecting speed and accuracy were thoroughly evaluated. Electrical and mechanical engineers brought together the human and physical factors, created a practical piece of apparatus. Industrial designers worked out the functional shape.

The new instrument sends a calling signal quite different from that of your present telephone. This poses a problem. Complex automatic switching must be changed to handle the new signals as well as the old ones. Switching engineers must devise ways to make this change in *thousands* of central offices—economically.

Most of the challenges have been met. Final judgment on this new concept depends on the outcome of field tests. Meanwhile, Bell Laboratories continues in its task of originating and developing devices to improve your Bell System telephone service.

**BELL TELEPHONE LABORATORIES**

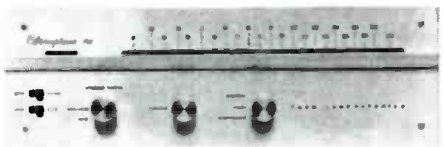
WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

# Hi-Fi-Audio Product Review

## STEREO FM TUNER

*Karg Laboratories, Inc.*, South Norwalk, Conn. has added a new FM tuner, the Model CT-1, to its line of audio gear.

The new unit offers front-panel switching facilities for monophonic or stereo-FM broadcasting and features twin audio channels for stereo; a socket for plugging in a companion multiplex



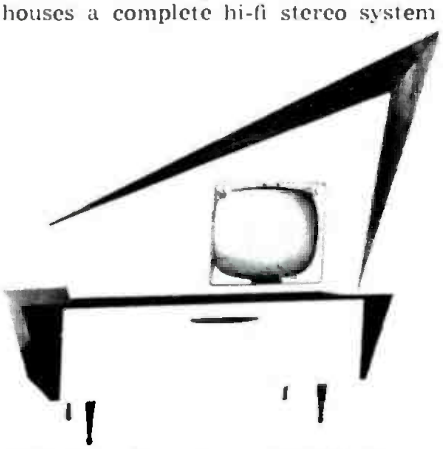
adapter for FM stereo; r.f. and oscillator coils printed on a phenolic base for stability; and a.f.c. which includes a d.c. amplifier in the control circuit to insure adequate hold even on weak signals. There is also a switched muting circuit; flywheel tuning; a 10" dial calibrated in single megacycles; filtered fluorescent bar tuning indicator at dial level; and a dial ratio of 11:1.

Sensitivity is 1.5 microvolt by the new IHFM standard provided by the use of a low-noise r.f. amplifier followed by three high-gain i.f. stages and a new dual-function limiter design. A catalogue on this new CT-1 stereo FM tuner is available on request.

## ARKAY STEREO CONSOLE

*Arkay International, Inc.*, 88-06 Van Wyck Expressway, Richmond Hill 18, N. Y. has recently introduced a new stereo console which has been designated as the "Fantasia."

Acoustically engineered, the console houses a complete hi-fi stereo system



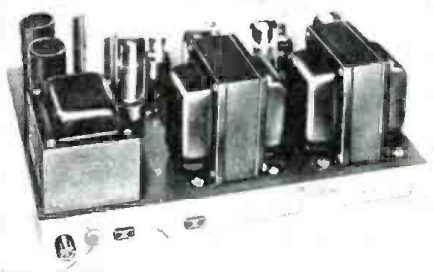
(including the stereo AM-FM tuner, stereo amplifier and preamp, record changer, tape deck, and stereo speaker system) plus a 21" television receiver. The console is supplied completely assembled although all of the stereo components can be had in either kit or wired form.

Over-all dimensions of the console are 72" high, 66" wide, and 18" deep. The upper wing-shaped section, which houses the television set, swivels in any direction for comfortable viewing and can be separated from the lower section if desired. The console is in satin-finished walnut with contrasting white drop-down door with walnut handle and trim.

## EICO'S STEREO AMP

*Electronic Instrument Co., Inc.*, 33-00 Northern Blvd., Long Island City 1, N. Y. has added the Model HF-87 stereo amplifier to its line of audio components available in kit and wired form.

The amplifier uses the cathode-coupled phase-inverter-driven circuit with a preceding direct-coupled voltage amplifier. The output stage uses "Ultra-



Linear" connected, self-biased push-pull EL34's. The amplifier is characterized by low distortion (IM distortion is 1% at 70 watts and harmonic distortion is less than 1% from 20-20,000 cps within 1 db of 70 watts) and stability (stability margin is the same as the feedback—17 db).

The HF-87 can be used as a dual 35-watt amplifier for stereo applications or as a single 70-watt mono amplifier. A service selector switch on the chassis permits choice of mode. Other convenience features include an input level control for each channel to permit adjustment of sensitivity and a power "on-off" switch.

The kit comes complete with detailed step-by-step wiring instructions and copious pictorials. Write the manufacturer direct for additional details and prices.

## SPEAKER-CONE DOPE

*Porter & Dietsch, Inc.*, 2459 University Ave., St. Paul 14, Minn. has developed a new chemical which, applied to the cone of any speaker, is said to lower cone resonance from 10 to 40 cps, thus improving bass frequency response of the unit.

The treatment consists of applying the contents of three clearly marked bottles by means of a brush which

comes with the kit. One "Flexicone" kit will treat one 15" speaker, two 12" speakers, four 8" speakers, or six 6" units. The company guarantees the product to be harmless to the hands, clothing, and the speaker. The principle involved is one of softening the speaker cone, allowing it to move more freely.

The product is designed for audio service shops as well as for the "do-it-yourself" audiophile. For a booklet on this product, write the manufacturer direct.

### STEREO ANALYZER

*Winston Electronics*, division of *Jetronic Industries*, 4000 N.W. 28th St., Miami 42, Fla. is now offering a new

multi-purpose "Hi-Fi Stereo Analyzer" for the servicing and testing of audio systems.

The Model 800 includes an audio signal generator with ranges from 20 to 30,000 cps; an a.c. vacuum-tube voltmeter with six ranges from .01 to 300 volts r.m.s. full scale; an audio wattmeter with scales from .15 milliwatt to 150 watts full scale; IM and harmonic distortion measurements; 4-, 8-, 16-, and 600-ohm terminations rated at 32 watts; and decibel meter ranges from −40 to +52 db.

Built-in switching provides complete flexibility. For additional information on the Model 800, including price, contact the manufacturer direct.

### STEREO AMPLIFIER KIT

*Heath Company* of Benton Harbor, Mich. has just added a "deluxe" 14-watt stereo amplifier to its line of "Heathkits."

The SA-1 is a two-channel amplifier-preamplifier combination that incorporates six switch-selected inputs for

each channel to accommodate records, tapes, tuners, etc. Two magnetic phono inputs are featured, one for monophonic cartridge and the other for a stereo cartridge, each RIAA equalized. The tape head input is NAB (NARTB) equalized. The remaining three inputs are designated as Auxiliary 1, 2, and

3 and may be used for any high-level sources. All inputs, except for the "tape head," feature individual level controls.

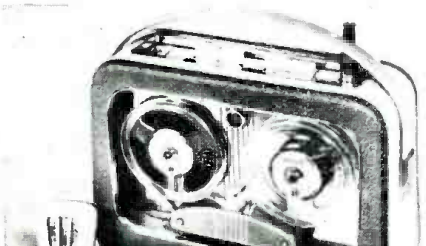
A four-position function switch selects "Stereo Normal," "Stereo Reverse," "Channel A," or "Channel B" operation. Thus, any monophonic source can be fed to either channel individually or to both channels simultaneously. Adjustment of the individual channel controls gives a pseudo-stereo effect to monophonic sources.

The circuit incorporates low-noise EF-86's in the input stages and individual hum-balance controls for each channel. Cathode follower outputs are provided for tape recording from any stereo or mono source. The output transformers are tapped for 4-, 8-, and 16-ohm speakers.

Three printed circuit boards make assembly of this amplifier-preamp easy and foolproof.

### PORTABLE TAPE RECORDER

*Ercona Corporation*, 16 W. 46th Street, New York 36, N. Y. is handling the U. S. distribution of the Austrian-



built "Stuzzi Magnette" transistorized tape recorder.

Weighing only 8 pounds, the new unit includes a self-contained high flux loudspeaker system which is driven by a 7-transistor, 2-diode amplifier circuit. The double-track, dual-speed (3¾ and 1⅞ ips) unit offers push-button control of stop, record, replay, fast-forward, reverse, and amplifier-only functions. A three-digit counter with zero setting, vu level indicator, plus a pause button and safety control to prevent accidental erasure are also included.

Frequency response is 50 to 9000 cps at 3¾ and 60-4000 cps at 1⅞ ips. Battery life is up to 100 hours and up to two hours of material may be recorded on a single reel. The recorder comes equipped with a moving-coil microphone, reel of tape, empty reel, shielded connecting cable with plugs, and a book of operating instructions.

### 28-WATT STEREO AMPLIFIER

*Allied Radio Corporation*, 100 N. Western Ave., Chicago 80, Ill. has announced the release of a 28-watt stereo amplifier in its "Knight" line of audio equipment.

The KN-728 provides 28 watts of stereo or monophonic sound with a peak rating of 56 watts. An input-paralleling switch permits instant switching from stereo to mono operation.

The dual preamp control section features complete control facilities including master volume, single-knob balance, stereo reverse, and rumble filter. Frequency response is 30 to 18,000 cps ±1 db. Harmonic distortion

is 1% at 1000 cycles, measured at 14-watt output while IM distortion is 3% maximum. Hum and noise is 70 db below full output on each channel. There are five inputs per channel (NAB tape head, magnetic phono, ceramic or crystal phono, tuner, and auxiliary). Two tape recorder outputs permit "off-the-air" stereo recordings.

For additional information on the KN-728, write the manufacturer.

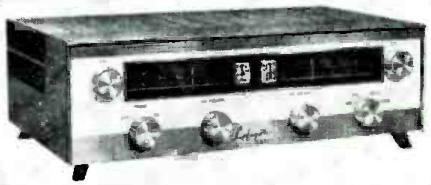
### NEW LAFAYETTE TUNERS

*Lafayette Radio Corporation*, 165-08 Liberty Ave., Jamaica 33, N. Y. has recently introduced two new tuners for the audiophile.

The Model LT-80 is an FM-only tuner which provides a sensitivity of 1.5 μv. for 20 db quieting. The circuit features an Armstrong grounded-grid, low-noise front-end; triode mixer; tuned dual limiters; Foster-Seeley discriminator; and three-gang tuning capacitor. It also includes a.f.c. and a.f.c. defeat along with a precision tuning meter to assure pin-point tuning accuracy. Frequency response is 20 to 20,000 cps ± .5 db.

The second unit, the Model LT-77, is an AM-FM stereo tuner. The AM and FM sections are completely independent permitting the reception of simulcasts or monophonic AM and FM broadcasts. A multiplex output has been provided for the reception of stereo FM.

Controls provide for every tuner function including individual volume



controls, function switch, and flywheel tuning. Sensitivity on FM is 1.5 μv. for 20 db quieting. Radiation meets FCC requirements, while twin tuning meters assure pin-point tuning accuracy. The Model LT-77 is housed in a low silhouette enclosure finished in gold and white with contrasting dial face.

Write the company for full specifications and prices on either or both of these tuners.

### NEW G-E STEREO AMPS

The Audio Components Section of *General Electric Company*, Bridgeport, Conn. has recently introduced two new stereophonic amplifiers featuring dual

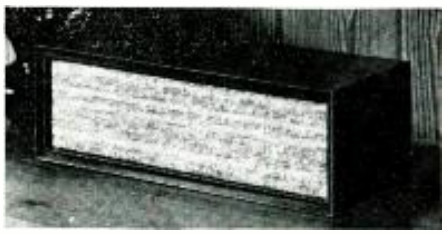
concentric bass and treble controls.

The Model G-7700 series is available in white vinyl-on-steel case with gold and ivory control panel or in beige vinyl-on-steel case with gold and beige control panel. The Model G-7600 is styled in saddle brown vinyl-on-steel case with gold and brown control panel.

Both series include a balance control to adjust for different speaker efficiencies and for variations in channel levels from the signal source; an input selector for stereo or mono tape, phono, tuner, or auxiliary; a mode selector for stereo channel reverse, normal or parallel, and monaural two channels or either channel only; a contour control to automatically boost bass response at lower loudness levels, and a rumble filter.

### FISHER SPEAKER SYSTEM

*Fisher Radio Corporation*, 21-21 44th Drive, Long Island City 1, N. Y. is now offering a new "wide-surround" speaker system which is designed to be used



with hi-fi systems where space is at a premium.

The Model WS-1 units reproduce essentially only the middle and high frequencies (250 to 15,000 cps) but, because of the non-directional character of bass frequencies, the illusion of bass frequency reproduction is sustained.

The speaker system can be used with any stereo console or amplifier equipped 4-, 8-, or 16-ohm speaker terminals. The enclosure measures 11 1/2" x 3 7/8" x 4 3/8". It can be used horizontally or vertically for table, floor, or wall installation. It is available in walnut, mahogany, teak, or cherry finishes and priced by the pair. Write the manufacturer for complete details.

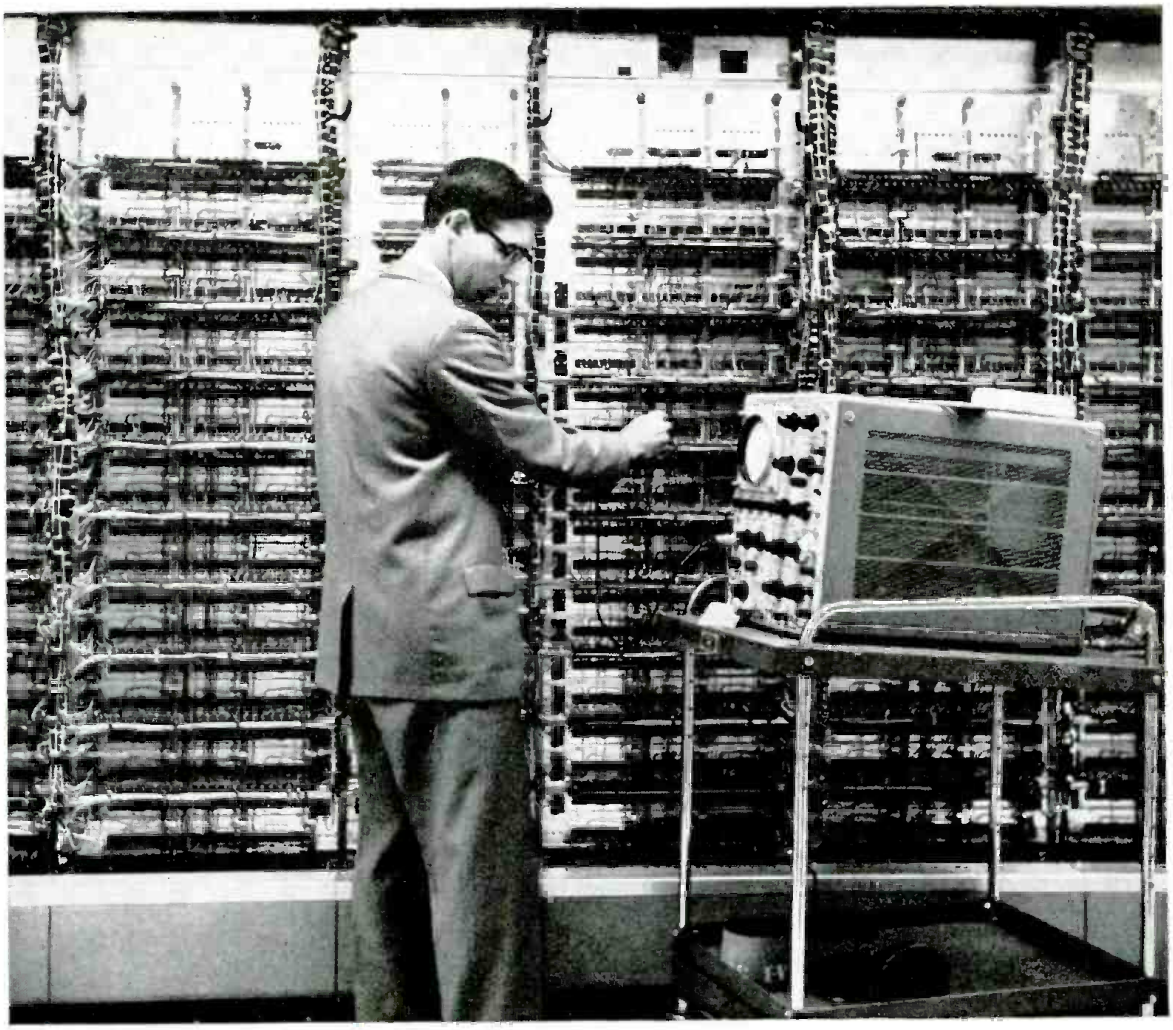
## AUDIO CATALOGUES

### SCOTT STEREO BOOKLET

*H. H. Scott, Inc.'s* Architectural Division at 111 Powdermill Road, Maynard, Mass. has issued a new booklet, entitled "How to Use Stereo Components in Your Decorating Plans," which is available without charge on request.

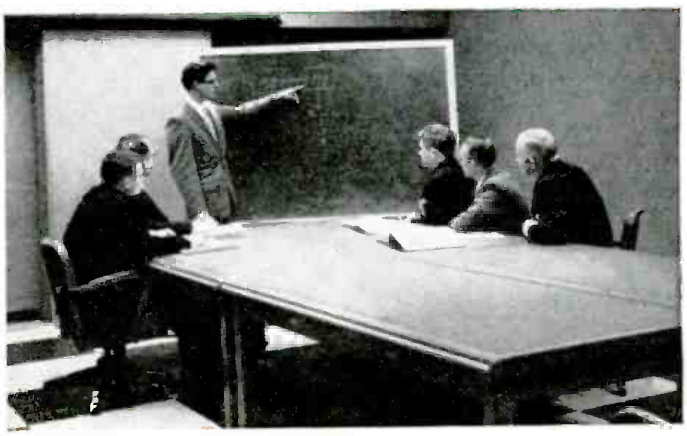
The booklet includes photographs of actual installations, room plans, decorating plans, and suggestions for converting many different kinds of furniture to house audio components. Both contemporary and traditional settings are pictured. —30—

*On page 88 of our November 1959 issue, we inadvertently gave an incorrect address for Scia Electronics Co. in connection with the item on "Turntable Speed Indicator." The correct address is 545 West End Ave., New York 24, N.Y. instead of Chicago. Our apologies for any inconvenience we may have caused our readers.*



Watching oscilloscope, Bill Wilkerson tests SAGE computer circuitry.

Adjusting SAGE computer operating console.



Bill Wilkerson instructs Field Engineers on new computer program.

# How far can you go in electronics... without a degree?

**Three years ago, young Air Force veteran William H. Wilkerson set out to find a career in electronics, but he had no industrial experience and no engineering degree. Today, he has a solid electronics education, he is supervising the maintenance of a highly advanced electronic computer, and his future is bright. Here's how it happened...**

### SOUGHT ELECTRONICS CAREER

"I was anxious to go to college when I left the service in 1956," recalls Bill Wilkerson. "The Air Force had given me some fine training in electronics, enough to arouse my interest and make me want to learn a lot more. An engineering education seemed to be the answer, but family responsibilities made college impossible.

"I still wanted to work in electronics, however, so I started looking into technician jobs. Most big companies offered me no more than a seat at a test bench eight hours a day—dull, routine work that provided little or no opportunity to learn and grow. All the interesting assignments, it seemed, called for a college degree. Then I had an interview with IBM and found just what I was looking for in the SAGE Field Engineering Program."

### WHAT IS SAGE?

SAGE is a vital part of our country's air defense. To help guard against surprise aerial attacks, SAGE partitions America into several defense sectors. At the heart of each sector is one of the fastest and most reliable electronic computers in the world. This computer receives radar data from many points, checks this against known air traffic in its sector, and makes it possible for Air Force operators manning the computer to identify immediately all flying objects as friendly or hostile. If need be, the computer can also guide a BOMARC missile to an enemy target.

### THOROUGH COMPUTER TRAINING

On joining IBM, Bill Wilkerson was given 20 weeks' computer training as a Field Engineer. He learned how to maintain the various electronic units used in a SAGE computing system, how the SAGE computer itself helps diagnose and locate problem areas, and how to make fast, precise repairs without interfering with computer operation. "It was an excellent education—both in the theoretical and practical aspects of electronics," he says. "Furthermore, you have plenty of opportunities to keep up with new developments in this fast-changing field. After assignment to a SAGE site, for example, you may take courses—during regular working hours—on such subjects as improved output methods or new magnetic 'memory' devices. You may also be selected for additional training to learn the total functioning of a large-scale electronic data processing system."

### ASSIGNMENTS ROTATED

Bill Wilkerson is now a Field Engineering Group Supervisor at a SAGE site. "I help my Group Manager keep the computer in top working condition," he explains. "Together, we provide technical supervision to the Field Engineers in our group and schedule daily maintenance checks to spot computer problems before they develop into breakdowns. An important part of my job is to make up daily assignment sheets, carefully rotating responsibilities so that each Field Engineer moves from one computer unit to another. This 'cross-training' gives each man a chance to become familiar with all the parts of a large-scale computing system and helps him add to his general electronics knowledge."

### RAPID ADVANCEMENT

"When I was first interviewed, I was told that IBM promotes from within," Bill Wilkerson says. "I've found this to be true. In the SAGE computer program, you begin as a Units Field Engineer. Then, depending on your abilities, you can advance rapidly to Systems Field Engineer, Group Supervisor, Group Manager, and on up the line. Every employee receives frequent career counseling to review his progress and to chart his future. In this Company, there are plenty of opportunities for the man who wants to grow and is willing to apply himself."

Bill Wilkerson cites his own career as an example. Since joining IBM three years ago, he's had several promotions, culminating in his present supervisory post. "It's a wide-open field," he says.

### A BRIGHT FUTURE

Although other areas for promotion are open to him, Bill Wilkerson would like to stay in technical management because, as he says, "Frankly, I hardly believed back in '56 that a man like myself without a college education could go so far so fast, have still higher goals—and find such solid help in reaching them."

* * * *

If you have a minimum of 3 years' technical schooling—or equivalent experience—you may be eligible for advanced training for 20 weeks as a Computer Units Field Engineer. Starting salaries are based on your education and experience. While training you will also receive a living allowance.

From then on, you can go as far as your abilities and ambition will take you. And, as you may already know, at IBM you receive company-paid benefits that set standards for industry today.

**WRITE TODAY TO:** **Mr. N. H. Heyer, Dept. 650-M**
**Federal Systems Division**
**IBM Corporation**
**Kingston, N. Y.**

You'll receive a prompt reply. Personal interviews arranged in all areas of the United States.

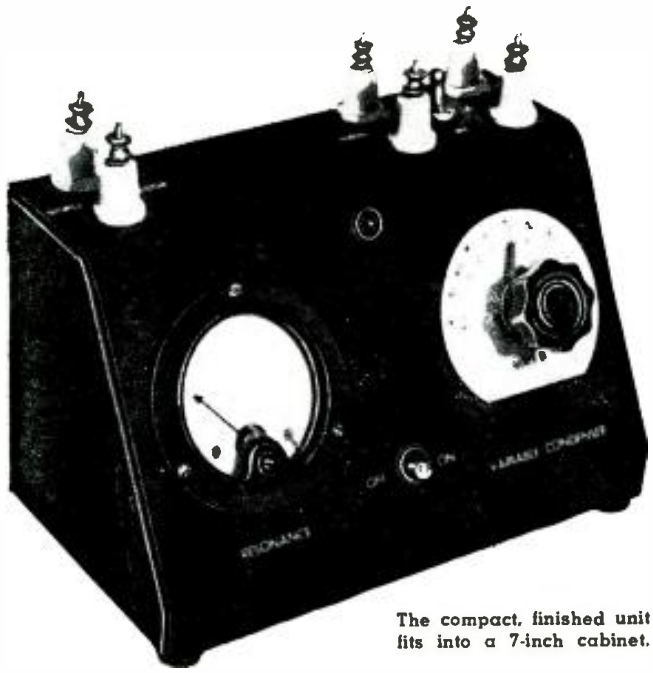
IBM®

INTERNATIONAL BUSINESS MACHINES CORPORATION

# The Resonance Meter

By **JOSEPH L. REIFFIN,**
**W5CWP**

**This easily built unit does many jobs in ham shack or service shop normally provided only by laboratory instruments.**



**The compact, finished unit fits into a 7-inch cabinet.**

OF ALL the phenomena of electronics, that of resonance is one of the most widely used and observed and many instruments for the measurement of resonance have been devised. Some are inexpensive and simple to operate, while others are both expensive and complicated. One would suspect that the inexpensive and simple devices are lacking in some degree, else there would be no need for the more elaborate units. That is true and the "Resonance Meter" described here is intended to bridge the gap. It is quite inexpensive to build, simple to operate, and provides a number of functions that are not easily performed by the less costly instruments now available.

The grid-dip meter is probably the most popular instrument in current use for measuring resonance. Many radio amateurs, serious hobbyists, and service technicians have a "grid-dipper" available for measurements of resonance involving coils, r.f. chokes, antennas, and the like. This relatively simple instrument does a fine job but has a number of limitations that somewhat restrict its use.

For example, it is extremely difficult, if not impossible, to measure the resonant frequency of a coil that is completely shielded, with a grid-dip meter. Also the degree of accuracy of the resonance reading is dependent, to a great extent, on the amount of coupling between the circuit being measured and the instrument. This introduces a variable that is difficult to control.

The "*Q*" meter is one of the most accurate devices available for the measurement of resonance of combinations of inductance and capacitance. Those who have ever used a "*Q*" meter will readily attest to the ease and accuracy with which the resonant frequency of an unmarked i.f. transformer is found, to cite one example. Or, to use another example, how easy it is to find how much capacitance is required to tune a given coil to a desired frequency. Like most good things, unfortunately, good "*Q*" meters are quite expensive.

The "Resonance Meter" described here can be built for less than $20, using all new components. The well stocked "scrounge-box" could reduce that cost considerably.

Basically, the "Resonance Meter" is an amplifier so designed and constructed that the frequency-determining inductance and capacitance can be conveniently plugged into the circuit. The output of this amplifier is fed to a cathode-follower stage, and then to a meter that measures the output voltage. By careful selection of the values of resistance and capacitance used in the amplifier circuit, the usable frequency range extends all the way from the higher audio frequencies to above 50 megacycles. Particular care is re-

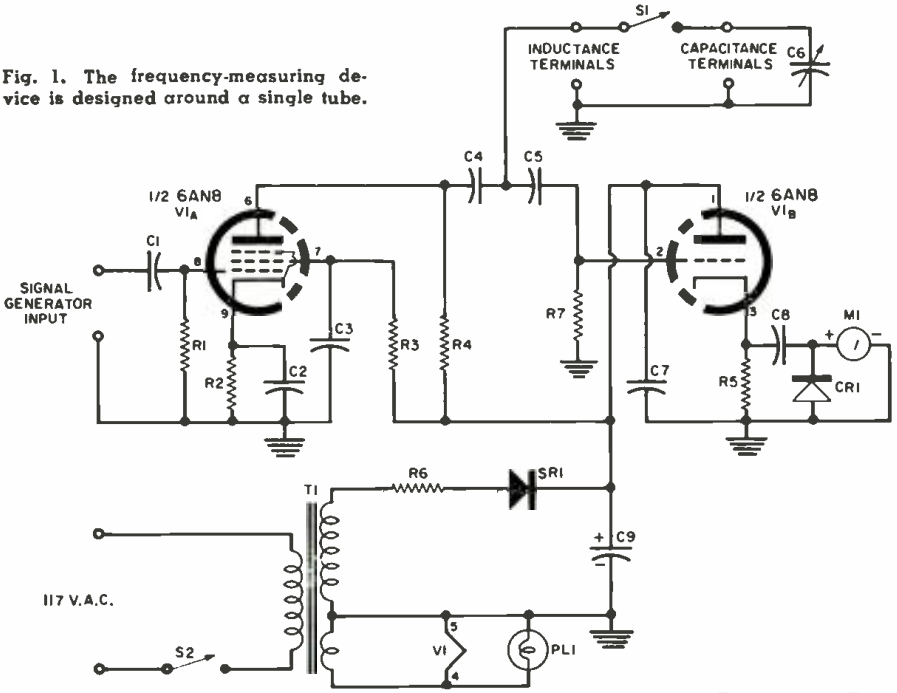



**Fig. 1. The frequency-measuring device is designed around a single tube.**

*$R_1$—470,000 ohm, ½ w. res. $R_2$—150 ohm, ½ w. res. $R_3$—47,000 ohm, ½ w. res.*
*$R_4$—33,000 ohm, 1 w. res.*
*$R_5$—1000 ohm, 1 w. res. $R_6$—22 ohm, 1 w. res.*
*$R_7$—1 megohm, ½ w. res.*
*$C_1$, $C_3$, $C_5$—1500 µµf. disc ceramic capacitor*
*$C_4$, $C_5$, $C_7$, $C_8$—.01 µf. disc ceramic capacitor*
*$C_6$—5-100 µµf. var. capacitor (Hammarlund HF-100)*
*$C_9$—50 µf., 250 v. elec. capacitor*
*$CR_1$—1N34 germanium diode*
*$SR_1$—Silicon rectifier (Sarkes Tarzian M150, Texas Instruments 1N2069 or equiv., see text)*
*$S_1$—S.p.s.t. toggle switch ("Capacitance In-Out," see text)*
*$S_2$—S.p.s.t. toggle switch ("Power On-Off")*
*$M_1$—0-1 ma. meter, 2" dia.*
*$T_1$—Power trans. 115 v. pri. to 150 v. sec. and 6.3 v. fil. winding (Merit P-3046 or equiv.)*
*$PL_1$—#40 or #47 pilot lamp $V_1$—6AN8 tube*
*1—7" wide, sloping panel utility box (Bud C-1605)*

quired in the placement of the various components in order to reduce stray capacitance to a minimum.

A 6AN8 tube is used in this circuit. The pentode section makes a good amplifier and the triode section serves very nicely as the cathode-follower. The output of the cathode-follower is rectified by the germanium diode ($CR_1$ in Fig. 1) and the resultant voltage is read directly on the output meter.

The "Resonance Meter" is entirely self-contained with a built-in power supply using a small plate and filament transformer to provide safe isolation from the line. It is built into a sloping-panel utility box (*Bud* C-1605) seven inches wide. The entire amplifier is assembled on an easily constructed aluminum chassis and this is mounted within the utility box.

The tube is mounted upside down in order to keep the leads to the coil terminals and the capacitor terminals as short as possible. Figs. 2 and 3 give some idea as to how this is managed.

It will be noted that the terminals for the signal-generator input and the terminals for the external coil and capacitor are the porcelain feedthrough type commonly used for high-voltage applications. The original model used standard binding posts made of some Bakelite compound. These proved to be unacceptable in this application, since they added so much capacitance and inductance to the circuit that a false frequency reading was obtained. Many different types of binding posts were tried, but it was impossible to find any entirely free from this effect. The use of the high-voltage feedthroughs minimized the added capacitance and inductance effects to the point where they were acceptable.

The toggle switch ($S_1$) that enables the calibrated capacitance to be inserted into the circuit also produced this problem and actually no real solution was found. There is evidently a need for a switch with very low capacitance and inductance in a size small enough for this application. If one could be found, it is recommended that it be used in place of the toggle switch the author employed in his model.

The chassis that contains most of the components of the "Resonance Meter" is made from a piece of aluminum stock approximately 2" wide, $5\frac{1}{2}$" long, and $\frac{1}{16}$" thick, bent into a sort of "L" shape. See Fig. 2. The 9-pin socket for the 6AN8 tube is mounted in the center of the top part of this chassis. The socket is mounted so that the pin terminals face up and the tube, when inserted in the socket, will be upside down. On the top side of the chassis, two tie-point strips are mounted along the edges next to the bottom side of the socket. These provide handy connecting points for the various capacitors and resistors used in the circuit.

The power transformer is mounted on a 2" x $2\frac{1}{2}$" strip of aluminum (Fig. 2) that has a $\frac{1}{2}$" lip on one end for mounting to the main chassis. This is mounted to the right side—looking at the chassis from the rear of unit.

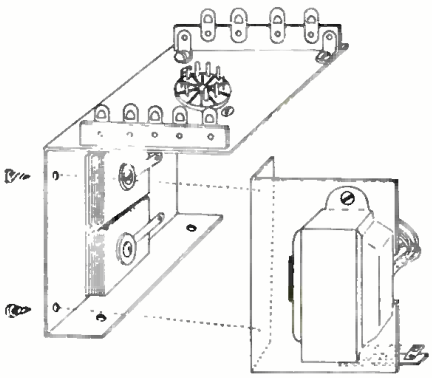


**Fig. 2. Layout for two chassis plates and main parts. Two selenium units may replace single silicon diode of Fig. 1.**

In the original model, the power rectifier consisted of two 60-ma. selenium rectifiers, connected in series, as shown in Fig. 2. Two were used because the r.m.s. voltage output of the power transformer is 150 volts whereas the maximum r.m.s. voltage rating of the selenium rectifiers is 130 volts each. From a safety standpoint, the use of two rectifiers in series was indicated to take care of the full voltage more than adequately without danger of breakdown. It would doubtless be more convenient and less costly to use one of the newer silicon rectifiers now available, as indicated in the parts list. These rectifiers take up very little space and have r.m.s. voltage-breakdown ratings in excess of 200 volts, which makes them a natural for this application.

The variable capacitor used for external tuning ($C_8$) is mounted on the sloping panel of the utility box. The one used was a *Hammarlund* type HF-100, which is designed to have a straight-line characteristic. The plates of this capacitor are so formed that there is a linear change of capacitance with a given amount of rotation of the rotor plates. It is, therefore, a relatively easy matter to draw a calibrated capacitance scale for this external adjustment. The minimum capacitance is 5 $\mu\mu$f. and the maximum is 100 $\mu\mu$f. The 180 degrees of rotation between the minimum and maximum is then divided into ten equal divisions and marked with the appropriate capacity values. This may not be an absolutely precise calibration but it is certainly close enough for all practical purposes. It would not vary much more than about 3 or 4 $\mu\mu$f. at the very most, and that tolerance is well within the anticipated needs of most users.

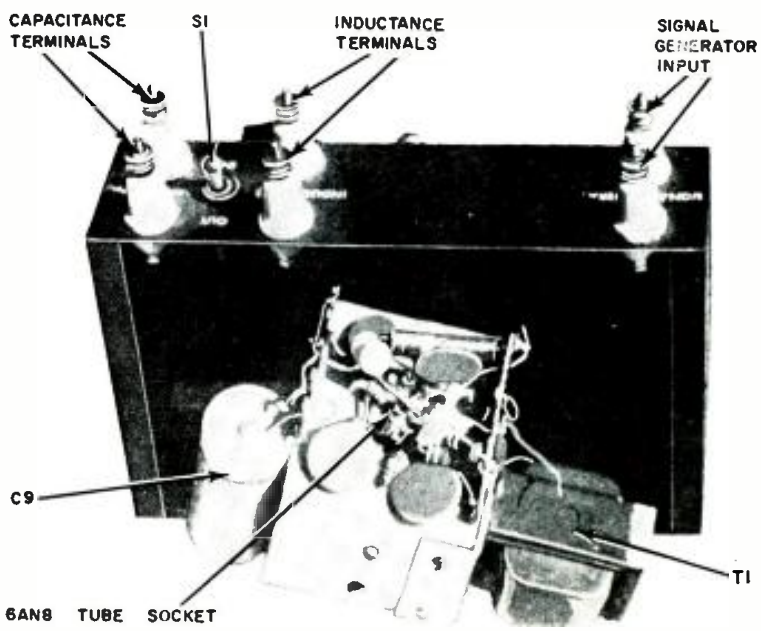
The meter, $M_1$, is also mounted on the sloping panel of the box. A 0-1 ma. meter provides ample sensitivity and, fortunately, units of this type are readily available at low cost.

The "Resonance Meter" performs many functions. The one that will probably find the greatest application is the determination of the resonant frequency of a coil when tuned either by circuit capacitance or by any size capacitor desired. Specifically, you may want to find out what frequency will be covered by a 20-turn coil of 1-inch diameter when tuned with a 50 $\mu\mu$f. capacitor. Or you may want to find out what frequency range will be covered by a slug-tuned coil of any given number of turns by running the slug up and down. These measurements are very simply made in the following manner.

A calibrated signal generator is connected to the input terminals of the "Resonance Meter." This connects the signal to the grid of the pentode section of the 6AN8 tube. The coil under measurement is connected to the inductance terminals. This puts the coil in the plate circuit of the pentode, which circuit is designed so that there is no d.c. present at these terminals—making it safe at all times. The fre-

(*Continued on page* 100)

**Fig. 3. Main chassis ready for mounting in case and location of terminals.**

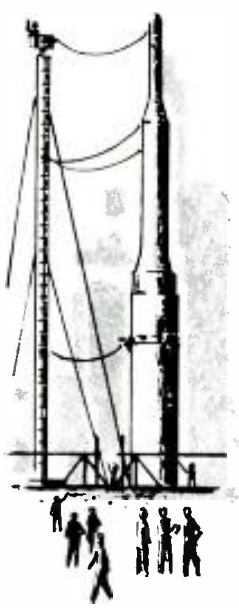


# Plain Facts about ELECTRONICS and CREI

## —*why you need advanced electronics education*

## —*how you can get it without quitting your present job*

NO DOUBT you know what is happening in electronics. You know that the electronics industry is growing with extraordinary rapidity. You know that regardless of the ups and downs of the business cycle, openings are always found for men with solid, advanced electronics education.



You know that every computer needs installation and maintenance. You know that every missile carries the end result of years of electronics planning and development. You know that every piece of radar equipment, every servomechanism, every astronautical device, requires not only electronics designers and builders but also electronics maintenance personnel as well. You know that our new awareness of outer space is founded on the inner workings of satellites. Rockets make them possible and electronics guides them and makes them intelligible.

And you know that the day of the mediocre electronics man is done. Added responsibilities and salary increases go to men with both theoretical and practical knowledge.

CREI home study courses make you eligible for positions which require advanced electronics education. You need not quit your present job. You can meet your family responsibilities while gaining knowledge of electronics engineering technology so essential for career advancement.

### CREI'S QUALIFICATIONS

We are now in our 34th year. 1958 marked the start of CREI Atomics, a division of CREI devised to meet the need for advanced home study education in nuclear engineering technology. 1958 also marked the opening of our European Division, bringing advanced professional electronic education to Western Europe.

Since 1927 we have directed the technical education of thousands—individuals and in groups—in electronics engineering technology. We developed the first civilian pilot course for radio mechanics for the Army Signal Corps in 1941, supplied 300,000 texts to the U. S. Navy in a special course for radio technicians in the South Pacific in 1943, trained hundreds of technicians during World War II for the Signal Corps. We cofounded the National Council of Technical Schools, which first established scholastic and business standards for the technical school field. We were among the first three technical institutes whose curricula were accredited by the Engineers' Council for Professional Development. In 1946 we instituted the group training programs now used by companies which represent the cream of the electronics

and aviation industries. In 1957 we initiated a plan which permits direct personal supervision for home study final exams.

What does this record of achievement mean to you as a CREI student? It means that industry and the Armed Services alike respect CREI men. It means that your CREI diploma is a door opener.

Significantly, Help Wanted ads often specify "CREI education or equivalent required." Our Placement Bureau, which helps graduates and advanced students find more desirable positions, is always available to CREI men. While no placement guarantees will be made by CREI or any other reputable institution, for many years the demand for CREI graduates and advanced students has far exceeded the supply.

Paul S. Lewis, Jr., a research assistant in an AEC-sponsored nuclear physics research program—and a CREI student — writes, "Like most large-scale physics projects, this machine (a proton accelerator) is largely electronics. The need for electronics technicians on basic scientific research projects will no doubt continue to grow."

Charles E. Lawson, another CREI student, brings out another point: "The fact that I am enrolled with CREI was met with enthusiasm on the part of my employer, Wright Airborne Electronics. A former student of CREI is now chief engineer for the company."

## CREI HOME STUDY ADVANTAGES

Technical education is accomplished on your own time, during hours chosen by you. You waste no time in travel. You have plenty of time to do your best. Your work is under the supervision of a regular staff instructor who guides your progress step by step. Courses are prepared by experts, presented in easy-to-understand form, kept up to date by periodic revision. Experience in more than three decades of home-study teaching, during which time we have corrected and commented on many hundreds of thousands of examinations, enables us to avoid difficult-to-understand text matter in our lessons.

## CREI STUDENTS

Our active home study roster today numbers more than 20,400 professional electronics engineers and technicians, all over the world and in every phase of electronics, about one-third military, the rest civilian. Their median age is 28. Last year they devoted approximately 1,572,465 hours to 104,831 lesson texts, answered (and were individually graded upon) 1,048,-310 searching questions and engineering problems. They studied electronics engineering technology — transistors, microwaves, forward scatter, computers, servomechanisms, radar, electronic navigational devices, and the entire field of modern electronics. New students enrolled during the year are on the missile ranges of Vandenburg AF Base and Cape Canaveral. They are at Alamagordo and China Lake, at SAC bases around the world. They are in the research laboratories and manufacturing plants where the latest electronic equipment is designed and produced. They maintain electronic equipment for United Air Lines and Trans-Canada Air Lines. They share in electronics at All-America Cables and Radio, Inc., and The Martin Co. They work for U.S.I.A. (Voice of America) and Columbia Broadcasting System, for Gates Radio and Federal Electric, to name but a few. All of the firms mentioned offer their personnel CREI technical education under company plans. CREI men are found by the hundreds among field engineers of major electronic manufacturers. They're across the world —and across the street. They are the men you must compete with to hold your place in the electronics profession. Wouldn't you like to be as well qualified?

## QUALIFICATIONS FOR CREI

College degree is not essential. If you have had basic electronic education, practical experience in electronics, and a high school education, you can probably qualify. A good way to find out: Use the postage-paid card. It will bring you the free book which has launched thousands on their advanced careers: "Insurance For Your Future in the New World of Electronics." Please fill out the card carefully, checking appropriate items and providing essential data. Tuition is reasonable and may be paid monthly. It takes just one $10-a-week raise to repay your investment in CREI education and leave you a substantial bonus the first year. Available to veterans under GI bill.

## LATEST CREI COURSE

Automation and Industrial Electronics Engineering Technology. Complete course, covering all electronic phases of automation. Special emphasis on theory, functioning and applications of servomechanisms and computers. Also noteworthy—lessons on machine control, instrumentation, data processing and telemetry.

## RESIDENCE SCHOOL

For those who can attend classes, CREI operates residence programs in Washington, D. C. Day and evening classes start at regular intervals. Qualified graduates earn AAS degree in 27 months. Electronics experience not required for admission.

**CAPITOL RADIO ENGINEERING INSTITUTE**
*Founded 1927*
*EOPD Accredited Technical Institute Curricula*
Dept. 1101-G1
3224 16th St., N.W.
Washington 10, D. C.

## The Resonance Meter

(*Continued from page* 95)

quency of the signal generator is then varied until a reading is obtained on the output meter. The frequency that produces the peak reading on the meter is the resonant frequency of the coil.

If it is desired to tune this coil with any given amount of capacitance, all that is necessary is for the capacitance switch to be thrown to the "in" position. This connects the 100 $\mu\mu$f. variable capacitor across the coil and any desired amount of capacitance can be inserted. The frequency of the signal generator that produces the peak reading of the output meter is the resonant frequency of the coil and capacitor combination. If more capacitance than the 100 $\mu\mu$f. built into the meter is desired, it is a simple matter to connect the required additional capacitor to the capacitor terminals on the meter. This automatically puts the added component in parallel with the 100 $\mu\mu$f. variable, and there is no limit to the amount of capacitance that can be inserted in this way.

The meter readings obtained are very sharp and clearly defined. Due to the sensitivity of this instrument, care must be taken to insure that a false reading is not obtained through inadvertent peaking on a harmonic of the signal generator. This is very easily checked out, however, by tuning the signal generator through the next higher frequency range and, if no peaking is obtained, then the highest frequency that did produce the peaking is the correct reading. In actual practice, the readings obtained from the fundamental frequencies are considerably higher than those obtained from the harmonic frequency due to the greater fundamental output from the signal generator. This fact will also help to avoid error.

### Operating Techniques

Some of the many special functions that this device will perform include the relative measurement of the "*Q*" of a coil or capacitor and a check of the bandpass characteristics of a tuned circuit. The methods involved will be discussed subsequently. However, to the author, one of the most gratifying uses has been the determination of the proper combination of coil and capacitor to provide a desired range of tuning. Specifically, this is of interest in arriving at suitable values for the right amount of bandspread in a ham receiver or a transmitter v.f.o.

It is quite simple to insert a coil of a given size in the meter experimentally and to determine how much capacitance is required to tune it to a desired frequency. Once the capacitance is determined, the latter may then be varied to see how much the resonant frequency changes with capacitance variations. By changing the value of the coil experimentally, it is then possible to arrive at the right combination of values of inductance and capacitance that will provide the exact amount of bandspread required.

While this determination usually constitutes a knotty problem, the suggested method not only provides a simple solution but an accurate one, as well. The amplifier used in the meter simulates closely, as a rule, the stray circuit and tube capacitances in those circuits of conventional receivers and similar equipment in which the coil-capacitor combination will be used. Thus there is very little change when the tested components are transferred to the circuit for which they have been selected.

It is also a very simple matter to measure the relative "*Q*" of a coil or capacitor. Since "*Q*" is a figure of merit, a coil having a high "*Q*" will give a higher meter reading than one having a lower "*Q*". The same is true of a capacitor. The relative "*Q*" of a capacitor can be quickly determined by substituting various capacitors of the same nominal value across the test coil. The capacitor that gives the highest meter reading has the highest "*Q*" of those being tested. This test will graphically illustrate how important it is to use high-quality components in tuned circuits, especially at the higher frequencies, if any reasonable efficiency is desired.

It is also possible to measure the bandpass characteristics of a given tuned circuit. Most bandpass characteristics are measured on the resonance curve at a point 6 db down from maximum. Using the coil and capacitor combination under test in the "Resonance Meter," the frequency of the signal generator is varied until a peak reading is obtained on the meter. This is the center frequency of this resonance curve. If there is an attenuator on the signal generator, vary the output until a convenient reading of, say, .8 ma. is obtained on the meter. The frequency of the signal generator is then shifted higher in frequency until the meter reads exactly one half of the center frequency reading; in this case, .4 ma. This frequency is noted. Then the frequency of the signal generator is changed again, this time to the low-frequency side of the center frequency, until the meter once again reads half of the maximum reading. These "half-maximum" readings are the "6 db points" down the slope of the resonance curve. The frequency spread between the high-frequency reading that gave the .4 ma. meter reading and the low-frequency reading that gave the same .4 ma. meter reading is the bandpass of that particular coil and capacitor combination at 6 db down.

The number of uses to which the "Resonance Meter" can be put seems to be unlimited. It has proven itself invaluable many times and has taken a well-deserved place right next to the author's overworked and uncomplaining v.t.v.m. Build it and see if you don't agree. —30—


# "best 35¢ I ever spent"...

*From every corner of the electronics world comes this unanimous report:*

***RADIO SHACK'S NEW "KING SIZE" CATALOG — A 312-PAGE "GUIDE TO ELECTRONIC BUYING" —*** *is the most comprehensive, most exciting publishing achievement in electronics history. Send for your copy today. It's a typical Radio Shack bargain!*

## look what you get:

**OVER 300 JUMBO 8½ x 11 PAGES**

**Thousands of electronic and hi-fi items. Detailed "specs" and illustrations. Fine rotogravure printing.**

**"Outstanding in the industry . . . "**, comments a Pennsylvania hi-fi enthusiast. "Tops! . . . ", says a Michigan radio amateur. A University Professor asks, " . . . is it available in quantities for our students as a supplement to our textbook?" A hi-fi manufacturer writes, " . . . congratulations . . . excels all others I have ever seen". A laboratory notes, " . . . and we were pleased with the fine illustrations and informative listings".

**84,000 copies of this valuable new Radio Shack Guide have already been sold** in the two short months since its publication! By phone, letter and wire, hundreds of unsolicited "testimonials" tell us that we've published not merely another "free catalog", but literally an electronics education worth many dollars. Everything new, everything you need to know — everything that represents *value* — in today's wide world of electronics is yours in its 312 rotogravure 8½ x 11 pages.

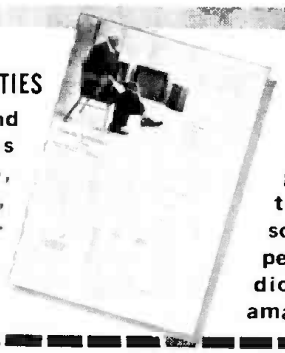
**Over 40,000 products are listed** — test equipment, laboratory supplies, stereo and high fidelity components and accessories, products for industry, public address, ham gear, optical goods, electronic textbooks, records, tape, tools — with lowest net prices, clearly written specifications, fine quality halftone illustrations. There's not only a complete Product Index, but a Manufacturer Index that amounts to practically a "Who's Who" of Electronics.

**You'll find stimulating articles and helpful engineering data, too.** On pages 8-9, for example, is an article entitled "Selecting Your Stereo System" written by an expert in the field. On pages 41-42 the internationally known authority G. A. Briggs explains his latest theories on "Room Acoustics". And beginning on page 301 you'll see Radio Shack's quick-reference "Handbook" of electronic specifications, symbols, schematic diagrams and formulas for students, experimenters, laboratories and engineers.

**Fill out the coupon right now.** You'll agree it's the best 35¢ YOU ever spent.

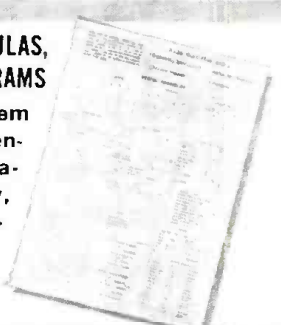
**ARTICLES BY LEADING AUTHORITIES**

**Expert opinion and latest theories about Stereo, Room Acoustics, Speaker Placement, Amplifiers, Cartridge Design – many more!**

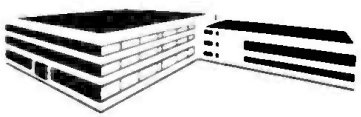


**USEFUL FORMULAS, SYMBOLS, DIAGRAMS**

**Hundreds of them – for students, engineers, laboratories, industry, schools, shops, experimenters, audiophiles, radio amateurs.**



**RADIO SHACK CORPORATION**



167 Washington St., Boston 8, Mass.
730 Commonwealth Ave., Boston 17, Mass.
230-234 Crown St., New Haven 10, Conn.

**MAIL THIS COUPON NOW!**

RADIO SHACK CORPORATION, Dept. 1F, 730 Commonwealth Avenue, Boston 17, Mass.

Please send **POSTPAID** the new 1960 Radio Shack Guide to Electronic Buying. I enclose 35¢

Name..... ☐ cash

Address..... ☐ check

City.....Zone....State..... ☐ money order

**New Guide also on sale in our 3 stores**

# newest knight-kits® . . . years-ahead

A PRODUCT OF ALLIED RADIO

## incomparable *knight-kit* stereo hi-fi saves you up to 50%

### DELUXE 40-WATT STEREO AMPLIFIER KIT

**Y-774D**

**$79.50**

*$5 Down*

Finest hi-fi stereo amplifier you can buy in money-saving kit form. Features special full-frequency range, extra center-channel output for 3-speaker systems. Dual built-in equalized preamps accommodate every existing sound source; exceptional control versatility, including single knob channel balance and separate dual concentric tone controls for each channel. Outputs for stereo tape recording. Exclusive printed circuit switches and plug-in units for easy assembly. Custom-styled in Cordovan gray vinyl plastic bonded to steel; Desert Beige and Sand Gold extruded solid aluminum escutcheon; 4⅛ x 15½ x 11¼". Shpg. wt. 24 lbs.

**Model Y-774D.** 40-Watt Stereo Amplifier Kit. **$5 DOWN**

### DELUXE STEREO FM-AM TUNER KIT

**Y-731D**

**$87.50**

*$5 Down*

Distinguished for quality and styling, years-ahead in features. Has completely independent FM and AM sections, each with moving-bar "magic eye" tuning indicator. Only tuner kit with Dynamic Sideband Regulation (DSR) on FM for purest, distortion-free reception. Sectionalized construction permits easy addition of "built-in" multiplex. Has 2½μv sensitivity. Double limiter-discriminator FM circuits—adjustable AFC. Separate cathode-follower outputs on FM and AM with level set controls. Precisely aligned RF and IF transformers in FM section. Printed circuit boards for fastest, easiest assembly. Styling matches the 40-watt amplifier; 4⅛ x 15½ x 12". Shpg. wt., 18 lbs.

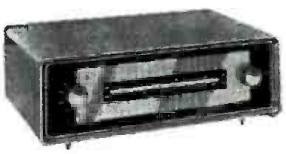
**Model Y-731D.** Stereo FM-AM Tuner Kit. **$5 DOWN**

## there is a money-saving *knight-kit* for every hi-fi need

**20-Watt Stereo Amplifier**

Truly a super-value. Built-in equalized preamps; single-knob selector switch for control convenience; dual concentric, clutch-type level control. 17 lbs.

**Y-773D.** *$2 Down.* Only **$44.50**



**FM-AM Hi-Fi Tuner Kit**

Amazing buy, featuring: Tuned RF stage; high sensitivity; AFC; flywheel tuning; pre-aligned IF and RF coils; cathode follower output. Truly great value. 14 lbs.

**Y-787D.** *$2 Down.* Only **$49.95**

**18-Watt Hi-Fi Amplifier Kit**

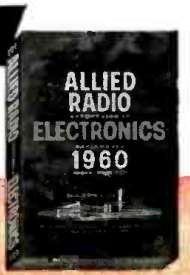
A brilliant performer at unbelievable savings. 18 watts at only 0.5% distortion; RCA 6973 audio output tubes; 8 inputs; 7 record equalization settings. 15 lbs.

**Y-797D.** *$2 Down.* Only **$39.95**

**SEE THEM ALL**

**See the impressive selection of Hi-Fi Knight-Kits (including speaker systems) in the money-saving 1960 ALLIED Catalog. If you haven't a copy, send for it today.**

**FREE**




**ONLY $5 DOWN (OR LESS)** on orders up to $200; up to 24 months to pay. Fast handling—no red tape—take advantage of these easiest-pay terms . . .

# for you who want to build the very best for less...


## all-new *knight-kit* citizens band transceivers...2-way radio everyone can afford

### CITIZENS BAND SUPERHET TRANSCEIVER KIT

**Y-712D**
**$79.95**
*$5 Down*

A high-sensitivity do-it-yourself transceiver for efficient, economical 2-way radiotelephone communication. Any citizen, 18 or older, can get a license—no exam required. For mobile or stationary use. Covers up to 20 miles, depending on antenna height and terrain. Works just like an intercom, with talk-listen operation. Receiver is sensitive superhet; tunes all channels continuously. 5-watt transmitter section. Built-in AC power supply. With transmitting crystal (available for any channel from 1 to 22—specify preference) and doublet antenna. Extras available: Y-723, 6-12 v. DC power supply, $10.95; Y-729 vertical antenna, $6.50; Y-714 mobile mounting bracket, $5.35. Distinctive high-impact styrene case; 5 x 12 x 12". Shpg. wt., 20 lbs. **$5 DOWN**

**Model Y-712D.** Superhet Transceiver Kit.

### CITIZENS BAND TRANSCEIVER KIT

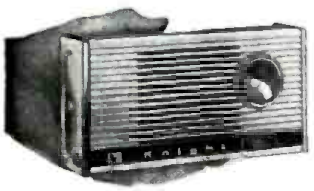
**Y-713D**
**$39.95**
*$2 Down*

Low-cost super-regenerative receiver and 5-watt transmitter kit. Readily fits car, boat or desk. Simple, one-switch operation permits talk or listen. Receiver tunes all 22 channels continuously. Built-in AC power supply. With mike, transmitting crystal—specify channel (1 to 22) if you have a preference—and doublet antenna. Handsomely styled case; 6 x 10 x 8". Designed for easy assembly and dependable operation. Available extras: Y-723, 6-12 v. DC power supply, $10.95; Y-729 vertical antenna, $6.50; Y-724 mobile mounting bracket, $5.35. Shpg. wt., 10 lbs. **$2 DOWN**

**Model Y-713D.** Transceiver Kit.

## dozens of exciting hobbyist kits available

**"Span Master" 4-Band Radio Kit**
Famous for world-wide short-wave and broadcast reception. True band-switching; continuous 4-band coverage from Broadcast to 30 mc. Sensitive regenerative circuit; 4" PM speaker. With cabinet. 8 lbs.
**Y-258D.** *$2 Down* Only..... **$25.95**

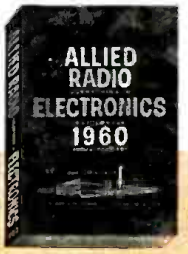


**5-Transistor Portable Radio Kit**
Popular, low-cost personal portable. Fun to build; superhet circuit; only 22 ounces; big 3½" speaker; built-in ferrite loopstick; phone jack. (Less battery, $1.30.) 2 lbs.
**Y-771D.** *$2 Down.* Only..... **$25.95**

**"Ranger" Clock-Radio Kit**
Easiest superhet of all to build—plug-in modules and printed circuit board eliminate small parts assembly. Excellent AM broadcast reception. Telechron clock has "sleep" switch. With appliance outlet. 6 lbs.
**Y-737D.** *$2 Down.* Only..... **$24.95**

**SEE THEM ALL: Knight-Kits offer the most exciting hobbyist kits available. See the complete selection in the 1960 ALLIED Catalog. Write for it now—use coupon on page following.**

**FREE**




*manufactured and sold exclusively by* **ALLIED RADIO** 100 N. WESTERN AVE., CHICAGO 80, ILL.

# newest knight-kits® ... years-ahead

A PRODUCT OF ALLIED RADIO

## knight-kits break through the professional instrument price barrier

### 5" LAB DC SCOPE KIT WITH IVA

**Y-611D**

**$285.00**

*(less preamps)*

For the first time in easy-to-build kit form—a triggered sweep DC precision quality lab scope with plug-in **interchangeable vertical amplifiers (IVA).** Brilliantly engineered with an impressive array of professional features, including: crystal-controlled timing markers; DC amplifiers in both horizontal and vertical channels; electronically regulated power supply; sweep timing adjustable to 1%; built-in voltage regulated peak-to-peak calibrator. Three interchangeable vertical preamplifiers are available: high-gain differential, $35.95; wide-band (to 10 mc), $24.95; dual-trace, $48.95. **There is no other instrument like this in kit form**—here is laboratory precision quality and reliability at far less than the cost of any comparable factory-built unit. Shpg. wt. 50 lbs.

**Model Y-611D.** Lab DC Scope Kit. **$10 DOWN**

*Available in March—reserve yours now*

### LAB AUTOMATIC AC VTVM KIT

**Y-608D**

**$99.50**

*$5 Down*

A major achievement in instrumentation! This all-new AC VTVM features **automatic range selection**—by means of an electronically-actuated self-seeking mechanism which **automatically** selects the proper range when you touch probes to the circuit under examination. Simultaneously, a front panel light indicates the range in use. Covers 11 ranges from 3 millivolts to 300 volts full scale; frequency response to 2.5 mc. Reads as low as 100 $\mu v$. Highly stable 3-stage amplifier has cathode follower output; ideal for use as preamp for other test equipment or for connection to scope for simultaneous wave form observation. Includes precise trigger circuits; regulated power supply; latest printed circuitry for easy assembly and quality performance. An exclusive Knight-Kit development—there is no other instrument like it on the market, in any form or at any cost. Shpg. wt. 13½ lbs.

**Model Y-608D.** AC VTVM Kit. **$5 DOWN**

## save on every instrument need with knight-kits... best by design

**Famous-Value VTVM Kit**

Measures DC voltage (11 meg. input) and resistance; AC voltage, rms and peak-to-peak. 4½" meter. Push-pull balanced bridge circuit. 7 lbs.

**Y-125D.** *$2 Down.* Only **$25.75**

**Deluxe Tube Checker Kit**

Checks over 700 receiving type tubes. 16 filament voltages. Tests cathode emission as well as shorts, open elements, etc. 15 lbs.

**Y-143D.** *$2 Down.* Only **$32.95**

**5" Wide-Band Scope Kit**

Top versatility. 5 mc bandwidth; DC coupled p-p output amplifiers; 25 mv/inch vertical amplifier sensitivity. Outstanding value. 29 lbs.

**Y-144D.** *$5 Down.* Only **$65.75**

### SEE THEM ALL

**You'll find dozens of other fine quality Knight-Kit instrument values fully described in the 1960 ALLIED Catalog. If you haven't a copy, write for it now—use coupon on opposite page.**

**FREE** send for the value-packed 1960 ALLIED CATALOG

# electronic achievements at half the factory-built cost

## years-ahead *knight-kit* amateur gear

### T-400 AMATEUR 400-WATT TRANSMITTER KIT

Y-716D
**$395.00**
*400-Watt CW Transmitter*

Truly the "dream" transmitter—has what it takes to punch out a QRM-busting SSB, AM, or CW signal. 600 watts P.E.P. input on SSB; 400 watts on AM and CW. Covers 80, 40, 20, 10, and 15 or 6 meter bands. Start with the basic CW kit— then add AM and SSB accessory units and other "add-ins" whenever you wish. Has heterodyne VFO to assure a signal which "stays put." Tremendous 14" dial is precision-calibrated for all bands, 80 through 6 meters. SSB features: front panel controls—VOX, anti-trip and adjustable speech compression. Smooth, chirpless screen-clamp keying, plus VFO keying for complete CW break-in. Has 7034/4X150A final—coasts along well within its CCS ratings; silicon rectifier power supply runs cool. Dozens of advanced features put this job in a class all its own. Shpg. wt. 140 lbs.

**$10 DOWN**

**Model Y-716D.** T-400 CW Transmitter Kit.

*Available in March—reserve yours now*

**"Add-In" Accessories:** SSB Generator Kit, $69.95 • AM Modulator Kit, $24.95 • Speech Amplifier Kit, $9.95 • Monitor Scope Kit, $37.95 • 6-Meter Conversion Kit, $7.50.



### R-100 AMATEUR RECEIVER KIT

Y-726D
**$104.50**
*$5 Down*

Incomparable receiver kit with all the features, selectivity and sensitivity of high-priced commercial units. Tunes 540 kc to 30 mc in 4 bands; calibrated bandspread on all Ham bands; 300 cps to 4.5 kc selectivity; exclusive printed-circuit bandswitch; built-in Q-multiplier; constant-running HFO—dozens of other professional features. Truly superior kit value. 30 lbs.

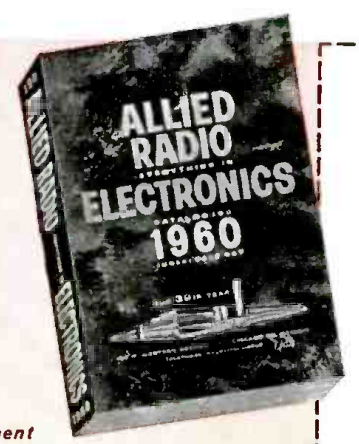
**$5 DOWN**

**Model Y-726D.** R-100 Receiver Kit.

**Y-727D.** S-Meter Kit for above, only..... $10.75
**Y-728D.** 4" Matching Speaker, only..... 7.50

**FREE** Send for the 1960
## ALLIED CATALOG

Describes the complete KNIGHT-KIT line in detail—the leading Buying Guide for everything in Electronics. Send for your FREE copy. Use coupon at right.




# ALLIED RADIO

*pioneers in quality electronic kit development*

OUR 39th YEAR

**ALLIED RADIO CORP., Dept. 131-A**
100 N. Western Ave., Chicago 80, Ill.

Ship me the following KNIGHT-KITS:

| Quantity | Description | Model No. | Price |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

$..... enclosed. (For parcel post include postage; express shipped collect.)

☐ **Send FREE 1960 ALLIED CATALOG**

Name_____

Address_____

City_____ Zone_____ State_____

## Thoughts on Amplifier Design

(*Continued from page 69*)

problems, application of this method is limited to 20-26 db of usable feedback, which represents a 10:1 to 20:1 reduction of distortion products.

Careful listening tests of amplifier performance prove that extremely stable amplifiers with high degrees of feedback provide a noticeable improvement in sound quality and a definite reduction in listening fatigue. This improvement can be attributed to lower harmonic and intermodulation distortion products, more linear phase characteristics, and improved transient response.

A "multiple loop" approach to increasing the degree of usable feedback is the most logical solution to the problem of providing lower distortion without sacrificing stability. Multiple loops become additive if their ratio is adjusted to the relative degree of distortion produced. Thus, if one stage has twice the distortion of another, it should have twice as much feedback around it. Experiment has shown that the equivalent of 32 db over-all feedback with unconditional stability is safely achieved with this technique.

### Extension of Response

Extensive listening experience has revealed an interesting fact. As mentioned earlier, the behavior of an amplifier several octaves above and below the normal range of hearing affects the sound quality of the amplifier. Amplifiers which offer a frequency response extending at usable power levels to below 5 cycles are found to have a tight and clearly defined low-frequency response. This is particularly noticeable in the 40-100 cps region. This characteristic improves the amplifier's ability to damp speakers, even those having a tendency to sound muddy; and this improvement of the low frequencies is distinctly audible.

A similar example is the performance at the high-frequency end of the spectrum. Amplifiers which limit their high-frequency range to slightly above the limit of human hearing have a tendency toward strident reproduction and poor differentiation of instruments in the higher overtones. Conversely, amplifiers which offer a frequency response beyond 100,000 cps without any evidence of ringing or instability with reactive loads will provide clean and transparent tone qualities in the higher frequencies with excellent separation of individual instruments.

To realize this extended frequency range, pulse amplifier techniques may be applied to the low-level stages of the amplifier. 12BY7 video power pentodes feeding into low-impedance loads provide a flat frequency and phase response beyond the capabilities of the output transformer. KT88's, in a distributed-load circuit, were selected for the output stage because of their ability to operate into a low-impedance

load, thus extending the usable frequency range of the output transformer.

To maintain the stability of an amplifier carrying a low-frequency cut-off of approximately 2 cycles, the power supplies must meet very special requirements in terms of regulation and low source impedance. These requirements may be met by using a silicon rectifier voltage-doubler circuit. This circuit takes advantage not only of the low internal impedance of the silicon rectifiers but also of the very low copper loss in the power transformer, thus providing the necessary regulation and low source impedance.

A special output transformer is required in order to take advantage of the broad-band circuitry. By minimizing the leakage inductance and distributed capacity of the primary halves, the resonant frequency of the transformer used has been raised to the 270,000 cps range. The massive design, utilizing the highest grade core materials, lowers the effect of core distortion, due to magnetizing current, to a region well below the limit of human hearing.

### Kit Design

It is far more difficult to design a kit than a manufactured product. On a production line, special facilities and skilled help are available to assemble the amplifiers and subject them to elaborate test procedures. The kit builder, however, cannot be expected to have any but the simplest tools and most elementary test equipment, if any. The kit, therefore, must be simple to assemble and its performance must be "built-in." This involves careful attention to the mechanical design and the layout of components.

The problem can thus be stated quite simply: How can professional results be achieved by people with considerably less-than-professional assembly skills? One solution to the problem was found in the use of military-type terminal boards and cable harnesses. As the development of our kits progressed, we found this type of construction yielding additional benefits to the builder. The kit construction resolved itself into different phases, each requiring a different form of activity. The completion of a loaded terminal board or a laced harness presents milestones in the construction of the instrument, providing within themselves a substantial measure of satisfaction both in terms of technical accomplishment and aesthetic value. Thus, the pleasure of kit building is considerably enhanced.

Much time was invested in critical listening to this amplifier. Program sources varying from 15 ips tape originals to 78 rpm records were used. The sound fully confirmed our concepts and expectations. Poor program material was considerably enhanced when played through the new amplifier while the better program sources exhibited a surprising improvement in listening quality. —30—

# Lafayette Superior Quality HI-FI KITS!

*The FINEST . . . through research . . . engineered by LAFAYETTE!*

**KT-250**

IN KIT FORM **64.50**

**LA-250 89.50**
COMPLETELY WIRED

## 50 WATT INTEGRATED STEREO AMPLIFIER

**• RESPONSE 17-21,000 CPS ± 1 DB (at normal listening level) • UNIQUE "BLEND" CONTROL • PREMIUM EL86 OUTPUT TUBES • 50 WATTS MONAURAL—25 WATTS EACH STEREO CHANNEL • CLUTCH-OPERATED VOLUME CONTROL • SEPARATE BASS & TREBLE CONTROLS**

A completely new stereo high fidelity amplifier with a high quality of reproduction, remarkable versatility and new distinctive styling. Full range of controls include a unique "blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phasing switches plus outputs for 4, 8 or 16 ohm speakers. Harmonic distortion less than 0.25%, IM distortion less than 1%. Hum and Noise 74 db below full output. Assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

**KT-250 WX** Stereo Amplifier Kt ..... 5.00 Down ..... Net 64.50

**LA-250 WX** Stereo Amplifier, wired & tested ..... 5.00 Down ..... Net 89.50

**KT-600**

IN KIT FORM **79.50**

**LA-600 134.50**
COMPLETELY WIRED

## PROFESSIONAL STEREO CONTROL CENTER

**• RESPONSE 5-40,000 CPS ± 1 DB • UNIQUE STEREO & MONAURAL CONTROL FEATURES • PRECISE "NULL" BALANCING SYSTEM • CONCENTRIC INPUT LEVEL CONTROLS**

A truly professional stereo preamplifier and master audio control center—solves every stereo monaural control problem. Features unique Bridge Conrol for variable cross-channel feed for elimination of exaggerated channel separation effects—plus controlled 3rd channel output. Has all-concentric controls—including clutch-operated Volume Balance control. Provides complete and advanced facilities for accepting, controlling and providing undistorted gain for any and all program sources. Sensitivity 2.2 mv for 1 volt out (low level inputs). Dual low impedance "plate follower" outputs 1500 ohms. Response 5-40,000 cps ± 1 db. Less than .03% IM distortion. Less than .1% harmonic distortion. Hum and noise 80 db below 2 volts (high level inputs). Uses 7 new 7025 low-noise dual triodes. Size: 14" x 4½" x 10⅜". Shpg. wt., 16 lbs. Complete with all parts, tubes, deluxe cabinet and detailed instruction manual.

**KT-600 WX** Stereo Preamplifier Kit ..... 5.00 Down ..... Net 79.50

**LA-600 WX** Stereo Preamplifier, wired and tested ..... 5.00 Down ..... Net 134.50

**KT-310**

IN KIT FORM **47.50**

**LA-310 72.50**
COMPLETELY WIRED

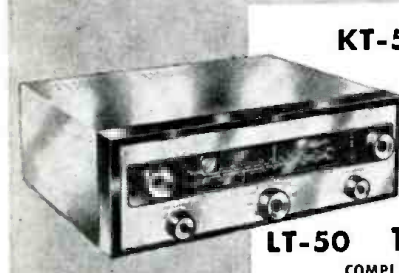
## STEREO/MONAURAL POWER AMPLIFIER KIT

**• 36 WATT STEREO AMPLIFIER—18 WATTS EACH CHANNEL • EMPLOYS 4 PREMIUM-TYPE 7189 TUBES • 2 PRINTED CIRCUIT BOARDS FOR SIMPLIFIED WIRING • RESPONSE BETTER THAN 35-30,000 CPS ± ½ DB AT 18 WATTS • LESS THAN 1% HARMONIC OR IM DISTORTION**

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monaural-Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6AN8, 4-7189, GZ-34 rectifier. Size 10-9/16" d x 5¼" h x 13¼" w. Complete kit with cage, all parts, tubes and detailed instruction manual. Shpg. wt., 22 lbs.

**KT-310 WX** Stereo Power Amplifier Kit ..... 2.00 Down ..... Net 47.50

**LA-310 WX** Stereo Power Amplifier, wired and tested ..... 5.00 Down ..... Net 72.50



**KT-500**

IN KIT FORM **74.50**

**LT-50 124.50**
COMPLETELY WIRED

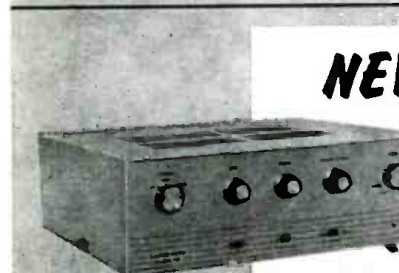
## FM-AM STEREO TUNER KIT

**• 11 Tubes (4 dual-purpose) + Tuning Eye + Selenium rectifier provide 17 tube performance • Multiplex Output for new Stereo FM • Armstrong Circuit with Dual Limiters and Foster-Seeley Discriminator • Extreme Sensitivity and Wide Frequency Response.**

A precision engineered, highly stable tuner—perfect for lifelike stereo FM-AM broadcast reception. FM reception and/or AM reception. Features separate tuning and volume controls for AM and FM. Magic eye on AM and FM, plus automatic frequency control on FM for accurate tuning—stations are "locked" in. Other deluxe features include cathode follower outputs and 5-position Function Selector. Efficient, broadband circuitry on AM with built-in antenna. FM section features include 2 microvolts sensitivity for 30 db quieting, frequency response 20-20,000 cps ± ½ db and full 200 KC bandwidth. Two printed circuit boards make wiring simple—even for such a complex unit. Complete kit includes all parts, deluxe cabinet and detailed instruction manual. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 22 lbs.

**KT-500 WX** FM-AM Stereo Tuner Kit ..... 5.00 Down ..... Net 74.50

**LT-50 WX** Same as above, wired & tested ..... 5.00 Down ..... Net 124.50



**NEW!**

IN KIT FORM

**KT-236 52.50**

## LAFAYETTE 36-WATT INTEGRATED STEREO AMPLIFIER KIT

**• 36-WATTS MONAURALLY—18 WATTS PER CHANNEL • FREQUENCY RESPONSE 15-30,000 CPS ± 1 DB • UNIQUE "BLEND" CONTROL • CONCENTRIC CLUTCH-OPERATED VOLUME CONTROL • DUAL CONCENTRIC BASS AND TREBLE CONTROLS • 4-EL84 TUBES IN PUSH PULL**

This exciting new amplifier kit combines dual preamplifiers and dual 18 watt power amplifiers on one compact chassis. Instant selection from monophonic to stereophonic is provided by the turn of a switch. An amazing new "Blend" control gives continuously variable channel separation from full monophonic to full stereo. The concentric clutch-operated volume control offers independent or simultaneous level adjustments of both channels. Dual concentric bass and treble controls furnish 4 independent tonal adjustments. Harmonic distortion less than 0.15% at normal listening level. I.M distortion is less than .3%. Hum and noise 70 db below rated output. Complete with cage, legs and detailed instructions. Shpg. Wt., 24 lbs.

**KT 236 WX** Stereo Amplifier Kit. ..... 5.00 Down ..... Net 52.50

# NEW! Lafayette 50 Watt Complete Stereo Phono System


**COMPONENTS**

| | |
|---|---|
| LAFAYETTE LA-250 50-WATT STEREO AMPLIFIER . . | 89.50 |
| GARRARD RC121/11 STEREO CHANGER . . . . . | 41.65 |
| NEW GE VR-22 (.7 MIL) DIAMOND STEREO CARTRIDGE . | 24.45 |
| LAFAYETTE PK-111 WOOD CHANGER BASE . . . . | 3.95 |
| 2-LAFAYETTE SK-58 FAMOUS FREE EDGE 12" COAXIAL SPEAKERS at 29.50 . . . . . | 59.00 |
| Regular Catalog Price | ~~218.55~~ |

## COMPLETE STEREO SYSTEM

# 174.50

## YOUR GUARANTEED BEST STEREO SYSTEM BUY!

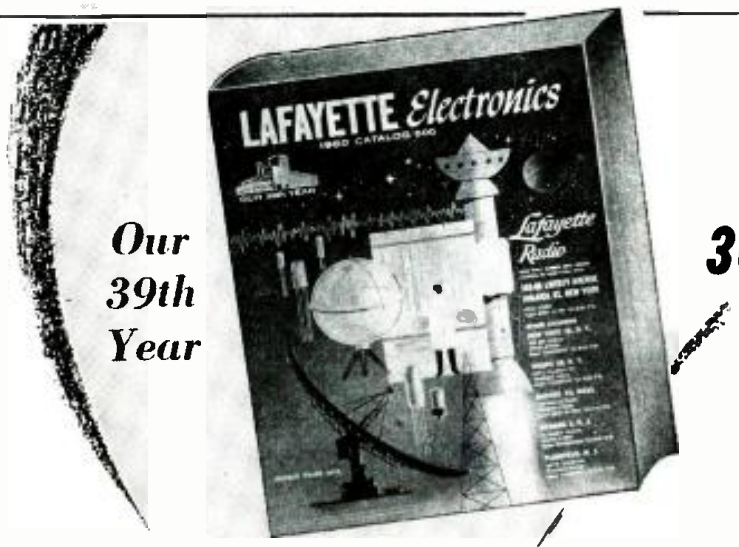
## YOU SAVE 44.05

This superb system will add a new dimension in living to your home with all the excitement and realism of a live concert. The new Lafayette LA-250, 50-watt stereo amplifier (25 watts each channel) forms the heart of this outstanding stereo hi-fi phonograph music system—the features, versatility and advanced circuitry of this unit are second to none. Also included is the famous Garrard RC121/11 intermix 4-speed automatic record changer with full manual or automatic operation supplied with your choice of stereo cartridges—the new GE VR-22 (.7 Mil) diamond stereo cartridge, Pickering 371-7D (.7 Mil) diamond stereo cartridge, Shure M7D (.7 Mil) diamond stereo cartridge or the new Electro-Voice 31 MD7 (.7 Mil) diamond stereo cartridge. Supplied with the Lafayette wood base cut for the RC121 in your choice of finishes. These outstanding components are coupled with the 2 famous free edge Lafayette SK-58 12" Coaxial speakers with built-in crossover network and brilliance level control. System supplied with plugs, cables and simple instructions. Shpg. wt., 67 lbs.

**HF-681WX** Hi-Fi STEREO PHONO SYSTEM with choice of cartridge and mahogany, walnut or blond changer base (please specify)
5.00 Down ..... **Net 174.50**

**HF-683WX** Same as HF-681, but with 2 Lafayette Eliptaflex Series Bookshelf Enclosures (please specify finish). Shpg. wt., 143 lbs.
10.00 Down ..... **Net 229.95**

**HF-682WX** Stereo AM-FM-Phono System. Same as HF-681 but including the Lafayette LT-50 stereo tuner. Shpg. wt., 85 lbs. 28.75 Down, 10.00 Down ..... **Net 287.50**




*Our 39th Year*

*Leaders in Hi-Fi*

The most complete selection and largest stocks of hi-fi components and systems—available for immediate delivery at the lowest possible prices. Save even more on Lafayette endorsed "best-buy" complete systems.

# FREE!

## 1960 CATALOG

## 308 GIANT SIZED PAGES

**The Complete Catalog Featuring "The Best Buys In The Business"**

FOR THE NEWEST AND FINEST IN STEREOPHONIC HI-FI EQUIPMENT AND SYSTEMS

- TAPE RECORDERS
- PUBLIC ADDRESS SYSTEMS
- AMATEUR EQUIPMENT
- INDUSTRIAL SUPPLIES
- MINIATURE COMPONENTS
- RADIO & TV TUBES AND PARTS
- EXCLUSIVE LAFAYETTE TRANSISTOR & HI-FI KITS

Send for Lafayette's FREE Catalog—the most complete, up to the minute electronic supply catalog crammed full of everything in electronics at our customary down-to-earth money-saving prices.

A "must" for the economy-minded hi-fi enthusiast, experimenter, hobbyist, engineer, technician, student, serviceman and dealer.

# Lafayette Radio

*"Everything in Electronics"*

**FREE** LAFAYETTE RADIO, Dept. RA-6
P.O. Box 222, Jamaica 31, N. Y.
308 GIANT SIZED PAGES — FREE

*Name* .....
*Address* .....
*City* ..... *State* .....

## Horizontal Deflection

(Continued from page 53)

condition of the switch $S_2$ in Fig. 3D.

The decaying magnetic fields allow the electron beam to return at normal scanning speed to center screen (scanning the left half of the screen) and allow currents $I_s$ and $I_d$ to flow. The damper current ($I_d$) charges the boost capacitor ($C_1$), and the cycle is complete. The circuit energy is now stored in the boost capacitor ($C_1$) to be used in the next scan cycle, which will start as soon as the grid saw-tooth voltage becomes positive.

It would appear from the foregoing description that all the energy circulated in the scanning circuit is restored to the boost capacitor after each completed cycle and is available to power the circuit again without additional power being drawn from the receiver "B+" supply. However, losses due to circuit resistance, imperfect dielectric, and the use of boosted "B+" supply by other parts of the receiver must be replaced. Thus a relatively small amount of power is drawn from the regular "B+" supply in the first part of each cycle.

A smooth transition from scanning of the left-hand part of the screen by the damper to scanning of the right-hand part by the output tube is essential for good raster linearity. This is achieved in two ways. In designing the circuit, the transformer tap to the damper tube is positioned to provide correct biasing for the conduction cycle of that tube, while control of the output tube's conduction period is achieved by grid sawtooth amplitude, variable in many receivers by way of the familiar drive control.

A high-voltage supply for the picture tube's second anode is provided by the horizontal-output circuit of all modern TV receivers. An over-winding on the transformer giving a high-voltage step-up ratio makes use of the strong, rapidly varying field during retrace time to produce an a.c. voltage that, after rectification, is fed to the picture tube. The high impedance of this supply does lead to poor voltage regulation, which may lead to considerable voltage variation with changes in picture-tube current. However, as the high voltage is "pulled down" causing an increase in raster size due to reduced scanning beam velocity, this added drain on the horizontal-output circuit causes a corresponding reduction in deflection current. The latter results in reduced width, which tends to compensate for the increased raster size. For the same reason, it is common practice to take the vertical scanning supply voltage from the boost capacitor, again providing compensation (in the form of changed vertical size) for high-voltage supply variations that affect raster size.

While the winding capacitance of the output transformer is useful in providing an *LC* circuit for high-speed re-

tracing, other similar *LC* circuits in the deflection coils and high-voltage over-wind tend to cause oscillations that are not desirable. These unwanted oscillations, or "ringing," may show on the screen as vertical bands of varying brightness and linearity if not damped out in the circuit design. A resistor-capacitor network across the deflection coils and the use of resistance wire in the high-voltage over-wind provide the necessary damping for these resonances.

### Service Hints

Servicing of the modern horizontal-output circuit, as with any other, depends on a good understanding of the circuit, but a brief review of some of the more common faults will not be amiss:

*Drive line* visible on the screen. In the modern receiver using the type of circuit described, the position of a drive line will be in the center of the screen, or even a little to the right of center, rather than towards the left as in earlier designs. In some receivers, a slight drive line under no-signal conditions is normal, so the symptom should be checked on an active channel. An abnormal line in this position (output tube taking over the scan at the wrong time) will likely be due to incorrect operation of the output stage. Specific possibilities include a defective tube, incorrect drive control setting, poor oscillator output amplitude, and incorrect screen voltage. In many receivers, the drive control and horizontal hold interact. If so, both should be adjusted for correct drive and frequency.

*Reduced width.* This again is likely to be caused in or around the output tube, but the possibility of an abnormally low "B+" supply should not be overlooked. If a capacitor is included in series with the yoke windings, it should be checked for a possible short.

*Loss of high voltage.* Perhaps the quickest procedure in this case is to remove the lead from the cap of the high-voltage rectifier tube and to check here for high voltage. If a normal arc can be obtained at this point, the output circuit is probably functioning correctly and the trouble lies in the rectifier tube or its associated circuit. If a good arc cannot be drawn, the fault must lie in or ahead of the horizontal-output circuit. Even the sync circuits should not be overlooked, as a defective phase-detector diode is a frequent cause of trouble that appears to originate in the output circuit.

*Keystone shaped raster.* This is the classic example provided in most service texts of a deflection yoke suffering from a shorted coil. The chances of seeing this condition are diminishing as deflection power increases—shorts of this kind become more and more likely to blow a fuse or burn out some other circuit component.

A final word of caution when servicing horizontal-output circuits: unless you are immune to shock, keep one hand in your pocket. —30—

# A New Antenna Rotator

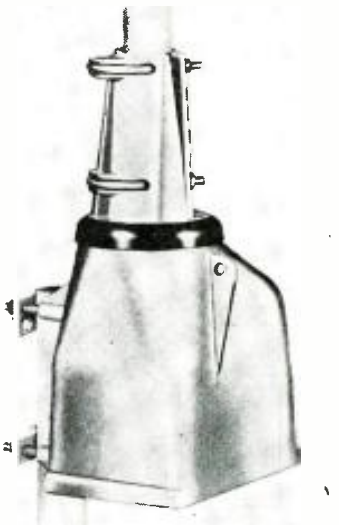


Fig. 1. Control unit (above) of the Tenn-A-Liner and motor housing (right).


By **HARRY GREENBERG**
Chief Electronics Engr., Channel Master Corp.


Better accuracy and reliability are objects of this automatic design approach.

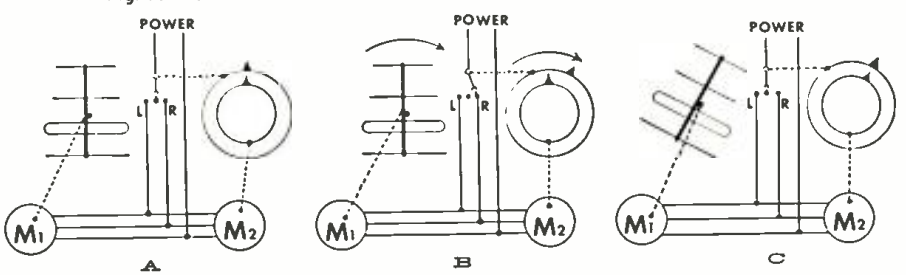
FOR THOSE many TV installations in which the rotator has become a necessary component, the most popular has been the automatic type since its introduction several years ago. The user simply sets the control dial to the best position for the particular channel he wishes to receive and then sits back as the rotator is moved to that position. However, dealers and consumers soon discovered that these automatic units had shortcomings.

Because they used solenoids, such rotators produced a noisy "clack-clack" during operation. They got out of step, requiring frequent service. They also produced electrical interference visible on the TV screen. Also, because they moved in step-by-step mechanical stops instead of continuous rotation, they could be set in position only in increments of, say, six or ten degrees. The latter limitation can be important in installations with reception problems using highly directional antennas to obtain maximum picture clarity, and more especially important with color TV. To meet the problems noted, *Channel Master* has introduced the Automatic Tenn-A-Liner (Fig. 1), using a dual-synchronous motor design without solenoids. It works without producing noise or interference, relieves the service problem, and permits orientation of antennas within one degree of desired direction.

In conventional automatic rotator systems, operation of the roof-top antenna depends on whether two independently rotating discs in the control box are lined up ("off" position) or not lined up ("running" position). When the discs are lined up (Fig. 2A) a switch is held in an open position, preventing operation of the motors ($M_1$ and $M_2$).

When the user moves his control dial, one of two discs (the manual disc) moves with the dial. This disturbs the alignment between the manual disc and the rotator-controlled disc (Fig. 2B) and applies power through the switch so that motion of the rotator begins in the desired direction. Just as the manual disc moves with the control knob, the rotator-controlled disc must move in unison with the rotor, until they reach the position set by the viewer. When this position is reached (Fig. 2C), the two discs are once more in alignment and the switch again opens, stopping all motion. The antenna,

Fig. 2. How an automatic rotator control moves an antenna into position.



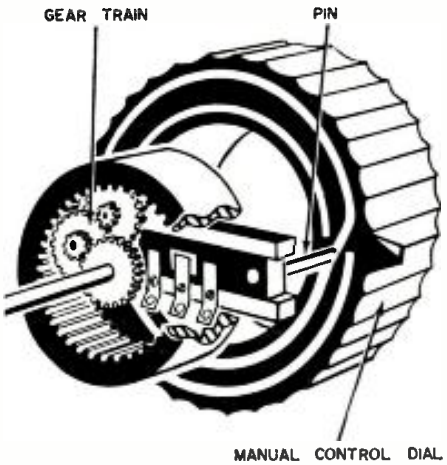



Fig. 3. This synchronizing system permits continuous movement rather than the stepped motion provided by an escapement.

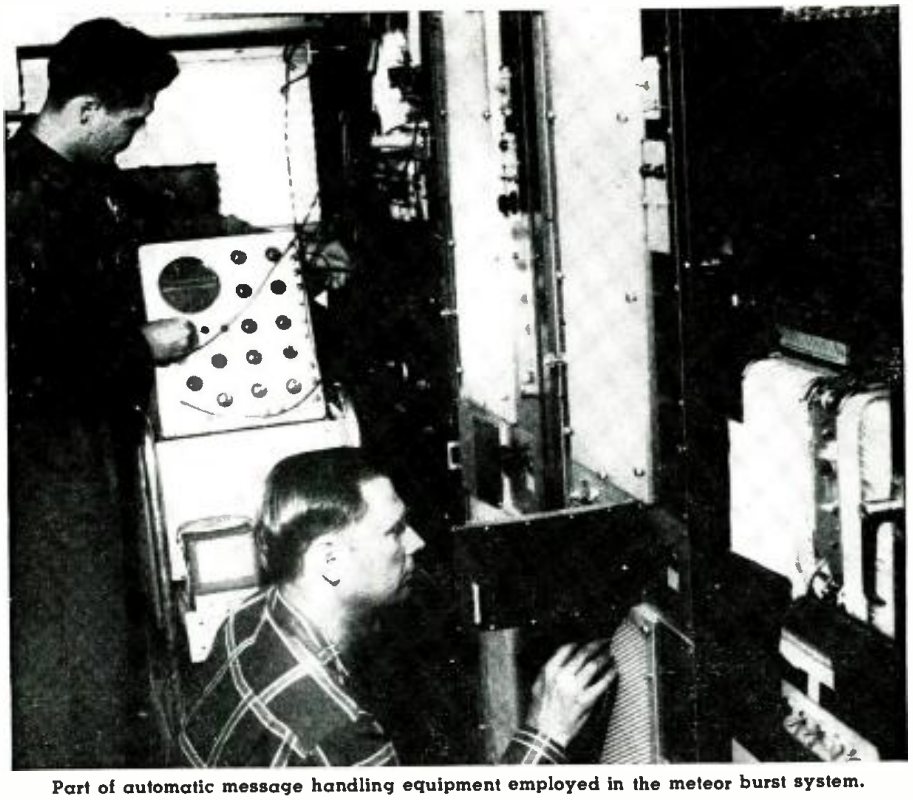
fixed to the rotor, is now properly oriented.

During this operation, the normally open switch in the rotator housing keeps closing momentarily, sending pulses of current to a solenoid in the control box. Through a mechanical linkage, the rotor-controlled disc slips through an escapement movement, like one used in a clock, permitting motion one step at a time. Thus each pulse permits motion of the rotor-controlled disc through a step of six or ten degrees at a time. Sometimes the linkage may jam, or a pulse may fail to move the disc, upsetting synchronism.

The system used for maintaining synchronization between the rotor and the rotor-controlled disc in the Tenn-A-Liner eliminates the need for the step-by-step intervals of movement, provided by the action of a solenoid and an escapement. Instead, the rotor-controlled disc is moved by the continuous action of a motor.

When the viewer sets his control dial, a pin (Fig. 3) is moved from its neutral position into a groove that rotates with the control dial. The movement of this pin closes a normally open circuit and simultaneously starts the rotation of two identical motors, one in the rotor and one in the control box. These two move the rotator and rotor-controlled disc in synchronism. The control-box motor moves the latter disc through a fine-meshed gear train. The pin moves in the groove of this disc until it can fall back into its neutral position, stopping the action. After the rotator and antenna have reached their pre-set position, more precise (one degree) adjustments may be made, if necessary.

Rotators are conventionally powered through a 29-volt stepdown transformer rather than directly from the a.c. line. However, before this voltage reaches the motor, it must generally pass through a potentiometer in the indicating device, through which about 6 volts is lost. Since there is no potentiometer in the new system, the full 29 volts is used to produce higher torque in the motor. —30—



Part of automatic message handling equipment employed in the meteor burst system.

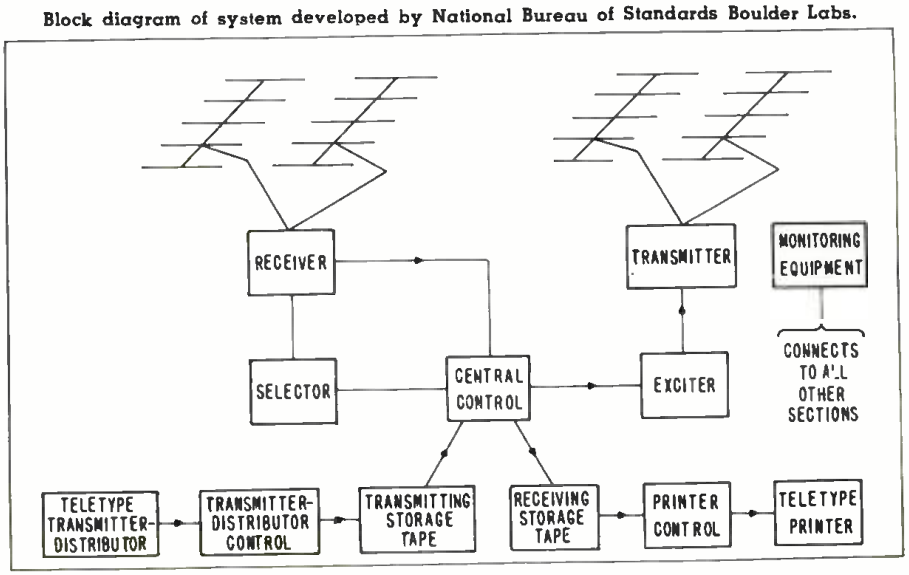
# Meteor Burst Communication System

## Two-way system using intermittent communication transmits messages at speeds up to 4800 wpm.

AN EXPERIMENTAL radio communication system that uses meteor trails for two-way message transmission has been developed by the National Bureau of Standards Boulder (Colo.) Laboratories under the sponsorship of the Air Force Cambridge Research Center. With this system, messages have been sent at speeds up to 4800 wpm—80 times the present speed of transmission by teletypewriter. The system resulted from a 3-year investigation to determine the feasibility of a long-distance v.h.f. communication system based on reflections from ionized meteor trails. Results of the study indicate that intermittent meteor burst communication can compete effectively with other long-distance systems, and that it is relatively free from ionospheric disturbances which affect long-distance communication in the h.f. range.

An 800-mile path from Kilbourne, Ill., to Erie, Colo. was used for most of the tests. Transmitters used are commercial units operating at a frequency of 49 mc. with a power output of 2 kilowatts. —30—

Block diagram of system developed by National Bureau of Standards Boulder Labs.



**DEALERS SERVICEMEN**
**TUBE TESTER ROUTE OPERATORS**
**EXPERIMENTERS**
**HAMS**


# with ZALYTRON QUALITY BRAND RADIO & TELEVISION RECEIVING TUBES

**BRAND NEW**
**INDIVIDUALLY BOXED**
In Famous Green & Black Carton

## GUARANTEED FOR ONE YEAR

We will replace all defective tubes within 12 months from date of purchase, excepting only burned out or broken tubes. Standard Customer Warranty 90 Days.

You "play ball" with "MAJOR LEAGUERS" when you buy ZALYTRON Tubes! "Tubes" are OUR MIDDLE NAME! We have been supplying tubes for many years to service dealers and Tube Tester Route Operators . . . and the ZALYTRON Brand name has achieved a reputation for quality and performance, second to none!

Yes, you "play it SAFE" with Zalytron because you get BRAND NEW Tubes:

**• NOT USED • NOT PULLED** from equipment **• NOT REJECTS**

but Zalytron's First Quality! And, important too: by selling DIRECT to the electronics trade, we pass the middleman's profit on to our customers . . . helping them to meet and beat competition in their areas.

**SEND IN A TRIAL ORDER TODAY!** You'll be delighted with our speedy service — and in due time you will join our host of customer friends who rank ZALYTRON as a First Class Source of Supply for Tubes. Your Trial Order will be shipped on our **FULL MONEY BACK GUARANTEE!** Try ZALYTRON Tubes at **OUR** Risk, and **JUDGE FOR YOURSELF!**

| TYPE | EACH | TYPE | EACH | TYPE | EACH | TYPE | EACH | TYPE | EACH |
|---|---|---|---|---|---|---|---|---|---|
| 0Z4 | $ .85 | 5CQ8 | 1.30 | 6BF5 | 1.35 | 6DQ6 | 1.10 | 12AV6 | .60 |
| 1AX2 | .70 | 5J6 | .75 | 6BF6 | .55 | 6DT6 | .60 | 12AV7 | .85 |
| 1B3 | .95 | 5T8 | .86 | 6BG6 | 2.25 | 6J5 | .70 | 12AX4 | .95 |
| 1S5 | .60 | 5U4G G8 | .75 | 6BH6 | .70 | 6J6 | .60 | 12AX7 | .65 |
| 1T4 | .55 | 5U8 | .75 | 6BH8 | .90 | 6K6 | .80 | 12B4 | .70 |
| 1U4 | .45 | 5V6 | .55 | 6BJ6 | .65 | 6L6 | 1.15 | 12BA6 | .60 |
| 1U5 | .55 | 5Y3GT | .55 | 6BK5 | 1.40 | 6S4 | .60 | 12BD6 | .60 |
| 1X2A/B | .95 | 6AB4 | .55 | 6BK7A B | .90 | 6SA7 | .80 | 12BE6 | .60 |
| 2AF4 | 1.00 | 6AC7M | .90 | 6BL7 | 1.55 | 6SC7 | .80 | 12BH7 | .80 |
| 3AF4 | 1.05 | 6AF4 | 1.05 | 6BN6 | .75 | 6SK7 | .75 | 12BQ6 | 1.10 |
| 3AL5 | .46 | 6AG5 | .65 | 6BQ5 | .70 | 6SL7 | .90 | 12BY7 | .80 |
| 3AU6 | .55 | 6AG7M | 1.25 | 6BQ6 | 1.10 | 6SN7 | .85 | 12C5 | .60 |
| 3AV6 | .45 | 6AH4 | 1.30 | 6BQ7A | 1.10 | 6SQ7 | .85 | 12CU5 | .60 |
| 3BN6 | .75 | 6AH6 | 1.35 | 6BR8 | .95 | 6T4 | 1.00 | 12CU6 | 1.10 |
| 3BU8 | .75 | 6AK5 | .85 | 6BU8 | .70 | 6T8 | .95 | 12DQ6 | 1.10 |
| 3BY6 | .60 | | | | | | | 12F8 | .65 |
| 3BZ6 | .60 | | | | | | | 12K5 | .70 |
| 3C86 | .60 | | | | | | | 12L6 | .65 |
| 3CF6 | .65 | | | | | | | 12SA7 | 1.00 |
| 3C56 | .60 | | | | | | | 12SK7 | .85 |
| 3DT6 | .55 | | | | | | | 12SN7 | .90 |
| 3Q4 | .65 | | | | | | | 12SQ7 | .90 |
| 3S4 | .65 | | | | | | | 12V6 | .55 |
| 3V4 | .70 | | | | | | | 12W6 | .75 |
| 4BC8 | 1.00 | | | | | | | 12X4 | .45 |
| 4BN6 | .75 | | | | | | | 19AU4 | .85 |
| 4BQ7A | 1.10 | | | | | | | 19T8 | 1.00 |
| 4BS8 | 1.00 | | | | | | | 25AX4 | 1.15 |
| 4BZ7 | 1.10 | | | | | | | 25BQ6 | 1.10 |
| 4CB6 | .60 | | | | | | | 25CD6 | 1.50 |
| 4DT6 | 1.00 | | | | | | | 25CU6 | 1.10 |
| 5AM8 | .80 | | | | | | | 25DQ6 | 1.10 |
| 5AN8 | .85 | | | | | | | 25L6 | .85 |
| 5AQ5 | .55 | | | | | | | 25W4 | 1.10 |
| 5AT8 | .85 | | | | | | | 35C5 | .65 |
| 5AU4 | .95 | | | | | | | 35L6 | 1.00 |
| 5BK7 | .90 | | | | | | | 35W4 | .50 |
| 5BQ7 | .98 | | | | | | | 35Z5 | .70 |
| 5CG8 | .85 | | | | | | | 50C5 | .70 |
| 5CL8 | .80 | | | | | | | 50L6 | .75 |

## WE PAY ALL SHIPPING CHARGES

on all orders accompanied by remittance in full.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6AL5 | .55 | 6BX7 | 1.65 | 6U8 | .85 | | |
| 6AM8 | .85 | 6BY6 | .60 | 6V6 | .80 | | |
| 6AN8 | .95 | 6BZ6 | .65 | 6W4 | .80 | | |
| 6AQ5 | .55 | 6BZ7 | 1.10 | 6W6 | .95 | | |
| 6AS5 | .90 | 6C4 | .50 | 6X4 | .45 | | |
| 6AT6 | .55 | 6CB6 | .70 | 6X5 | .65 | | |
| 6AT8 | .85 | 6CD6 | 1.70 | 6X8 | .85 | | |
| 6AU4 | 1.00 | 6CF6 | .70 | 6Y6 | .95 | | |
| 6AU5 | 1.75 | 6CG7 | .65 | 8AU8 | .90 | | |
| 6AU6 | .65 | 6CG8 | .80 | 8AW8 | .95 | | |
| 6AU8 | .90 | 6CL6 | 1.35 | 8CG7 | .65 | | |
| 6AV5 | 1.60 | 6CM7 | .70 | 10DE7 | 1.15 | | |
| 6AV6 | .55 | 6CN7 | .70 | 11CY7 | .75 | | |
| 6AW8 | .90 | 6CQ8 | 1.35 | 12AD6 | .55 | | |
| 6AX4 | .95 | 6CS6 | .70 | 12AF6 | .60 | | |
| 6BA6 | .65 | 6CS7 | 1.15 | 12AQ5 | .56 | | |
| 6BC5 | .60 | 6CU5 | 1.00 | 12AT6 | .60 | | |
| 6BC8 | 1.10 | 6CU6 | 1.10 | 12AT7 | .76 | | |
| 6B06 | .65 | 6CY7 | .75 | 12AU6 | .60 | | |
| 6BE6 | .55 | 6DE6 | .70 | 12AU7A | .70 | | |

## THIS MONTH'S SPECIAL

**GET THIS DELUXE SHELL 102 TEST-O-MATIC SELF-SERVICE**

# TUBE TESTER

(Nationally Advertised by the Factory at a Net Cost of $199.95)


102 SOCKETS

PLUS ZALYTRON "PACKAGE DEAL" OF
**150 RADIO & TV RECEIVING TUBES**

**COMPLETE FOR ONLY $245.00** F.O.B., NYC.

When you buy our "Package Deal" you are, in effect, getting with it a Stock of Tubes, worth $450 retail, FOR ONLY $45.00 — **which is actually 90% discount!**

| Quan. | Type | Quan. | Type | Quan. | Type | Quan. | Type |
|---|---|---|---|---|---|---|---|
| 1 | 0Z4 | 5 | 6AQ5 | 5 | 6CB6 | 2 | 12AT7 |
| 3 | 1B3 | 1 | 6AS5 | 1 | 6CD6 | 5 | 12AU7A |
| 1 | 1R5 | 1 | 6AT6 | 1 | 6CG7 | 1 | 12AV6 |
| 1 | 1S5 | 1 | 6AT8 | 1 | 6CM7 | 1 | 12AX7 |
| 1 | 1T4 | 5 | 6AU6 | 2 | 6CU6 | 1 | 12B4 |
| 1 | 1U4 | 1 | 6AU8 | 1 | 6DQ6 | 3 | 12BA6 |
| 1 | 1U5 | 1 | 6AV6 | 5 | 6J6 | 1 | 12BE6 |
| 3 | 1X2A/B | 1 | 6AW8 | 1 | 6K6 | 2 | 12BH7 |
| 1 | 3CB6 | 2 | 6AX4 | 1 | 6S4 | 1 | 12BQ6 |
| 1 | 3V4 | 3 | 6BA6 | 1 | 6SA7 | 1 | 12BY7 |
| 1 | 5AM8 | 1 | 6BC5 | 1 | 6SK7 | 1 | 12CU6 |
| 1 | 5AQ5 | 1 | 6BC8 | 5 | 6SN7 | 1 | 12SA7 |
| 1 | 5J6 | 2 | 6BE6 | 1 | 6SQ7 | 1 | 12SK7 |
| 3 | 5U4G | 1 | 6BG6 | 1 | 6T8 | 1 | 12SN7 |
| 1 | 5U8 | 1 | 6BH6 | 5 | 6U8 | 1 | 12SQ7 |
| 2 | 5Y3 | 1 | 6BJ6 | 2 | 6V6 | 1 | 25BQ6 |
| 1 | 6AC7M | 1 | 6BK7A | 2 | 6W4 | 1 | 25CU6 |
| 3 | 6AG5 | 1 | 6BN6 | 1 | 6W6 | 1 | 25L6 |
| 1 | 6AH6 | 2 | 6BQ6 | 1 | 6X4 | 2 | 35W4 |
| 1 | 6AK5 | 2 | 6BQ7A | 1 | 6X5 | 1 | 35Z5 |
| 5 | 6AL5 | 1 | 6BZ6 | 2 | 6X8 | 2 | 50C5 |
| 1 | 6AM8 | 2 | 6BZ7 | 1 | 7AU7 | 2 | 50L6 |
| 1 | 6AN8 | 1 | 6C4 | 1 | 12AT6 | | |

Above is only a partial listing of our huge tube stocks. Send today for FREE Complete up-to-date Tube Price List and Catalog. We Ship all Orders COMPLETE Same Day Received! C.O.D. ORDERS: 25% Deposit with order, balance C.O.D. plus all shipping charges. MINIMUM ORDER (Special for This Ad) $5.00.

**ZALYTRON TUBE CORPORATION**
**220 West 42nd Street New York 36, N. Y.**
Telephone: BRyant 9-2542 **DEPT. EW-1**

**FREE!**

Giant New Wholesale Catalog of Radio & TV Receiving Tubes, Electronic Components. **Free on Request.**

To ZALYTRON Tube Corp., DEPT. EW-1
220 West 42nd Street, New York 36, N. Y.
☐ Send FREE 1960 Catalog.

NAME_____

ADDRESS_____

CITY_____ ZONE___ STATE_____

# SOUND ON TAPE

By BERT WHYTE

THE 1959 High Fidelity Show is history now and, as far as the tape people are concerned, they fared quite well and the tape renaissance continues apace. Four-channel tape seems to have gotten over its earlier hurdles and now seems to be fairly well accepted, although it must be admitted there is quite a considerable corps of two-channel die-hards who stick by their guns that *their* baby is best.

I still feel that it is too early to give any hard and fast evaluation on this medium and that we must wait for the bugs to be ironed out. Because believe me, friends, there are bugs! Needless to say there was a plenitude of 4-channel tape playback equipment displayed, from very modest units to the most elaborate and expensive. It is obvious that any excuse that 4-channel tape equipment is hard to obtain at all price levels no longer has any validity.

And for those many thousands who own two-channel equipment, a large variety of 4-channel conversion kits now exists, many of them at extremely modest prices.

The cartridge machines were very much in evidence and many were operating with seemingly no difficulties. And it appears that several fairly prominent recording companies will soon issue cartridge productions. The big drawback at present with the cartridge concept is that the cartridges seem to be fairly expensive in the raw state—and that with all other cost factors added in, there seems to be some doubt as to whether cartridge music can be sold as cheaply as its advocates insist.

The other thing, of course, is the old chicken and egg story . . . in other words, recording companies might be encouraged to go into cartridges if a sizable proportion existed and, conversely, many people who would like the cartridge music won't buy machines because there isn't enough music in the new medium on the market. Ho hum, it seems to me I've gone through this deal before . . . stereo tape . . . stereo disc . . . I'm afraid it is always the same story and it is never resolved until someone comes along who has the courage to buck this obstacle and to go it alone for a while.

Now, getting back to the 4-channel bugs. You will probably have noticed that there has been a dearth of classical tapes reviewed here lately . . . and your old reporter pleads innocent. At the moment there are not too many companies producing four-channel classical tapes and, unfortunately, whether it is in the duplication equipment or

whatever, many of the tapes already announced have not appeared.

There are troubles . . . the nature of which cannot be pinpointed, but I have been waiting for some months now for certain classical 4-channel items and they have not reached me yet. There are some on the market which, unfortunately, I cannot review because of my affiliation with the company which produced them.

I hope some new material will be forthcoming or next month's column will return to that sad, bare look it had during the darkest days of the tape recession. Well, here goes the last of the 4-channel supply!

**THE MILLION SELLERS**
**Billy Vaughn and his orchestra. Bel Canto ST58. Price $9.95.**

As the name implies, this is a collection of songs which at one time were million-selling hits . . . such items as "In the Mood," "High Noon," "Tonight We Love," "Holiday for Strings," "Moonglow," etc. This record is liberally sprinkled with these and quite a few others of the same genre.

Billy Vaughn plays these hits well enough, in more or less stock arrangements. They are all very pleasant and innocuous and certainly will satisfy the needs of most people interested in background music.

The recording is very well done of its type, with excellent directivity, not overdone as is the case with so many pop stereo recordings, and a good acoustic perspective which is something still more rare in pops. The brasses and reeds are clean and well projected and there is good instrumental separation. In other words, a 4-channel stereo tape that meets all of the requirements of this medium—but on a minimal plane. As in two-channel stereo, the real acid test of the capabilities of the 4-channel stereo can only be assessed with some really good classical material.

**GEORGE WRIGHT'S GENIUS**
**HiFi Tape R713. Price $7.95.**

George Wright aided by some top engineering from this small West Coast company, has probably sold more pop organ records than all the rest of the field combined. He is, as the title insists, a genius in his chosen work and has an easy, ingratiating style and a sure, deft capacity for using just the right registration and arrangements.

Here he works his magic with such evergreens as "If I Had You," "Song of The Islands," "Tea For Two," "Strike Up the Band," and others of similar ilk. Through intelligent engineering *HiFi* obtains a stereo organ sound that deserves to be called stereo . . . far too often most stereo organ recordings degenerate into a big blur in which the attributes of directionality and depth are washed out. Here there is plenty of power and big pedal, but nonetheless all the various stops are clearly articulate and the melodic line is never lost. For pop organ aficianados, this is a winner. —30—

SUPERIOR'S NEW MODEL 77

# VACUUM TUBE VOLTMETER

## WITH NEW 6" FULL-VIEW METER

**Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price**

**Model 77 — VACUUM TUBE VOLTMETER ... Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!**

- ✓ Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- ✓ Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- ✓ Model 77 uses new improved SICO printed circuitry.
- ✓ Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.

**AS A DC VOLTMETER:** The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

**AS AN AC VOLTMETER:** Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

**AS AN ELECTRONIC OHMMETER:** Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

- ✓ Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- ✓ Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- ✓ Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

**SPECIFICATIONS**

• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)** — 0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER** — 0 to 1,000 ohms/10,000 ohms/100,000 ohms / 1 megohm / 10 megohms / 100 megohms/1,000 megohms • **DECIBELS** —10 db to + 18 db, + 10 db to + 38 db + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

*Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only .....*

**$42.50 NET**

---

SUPERIOR'S NEW MODEL 80

# 20,000 OHMS PER VOLT ALLMETER

## THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

**Model 80 — ALLMETER . . . Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!**

*NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.*

- ✓ **6 INCH FULL-VIEW METER** provides large easy-to-read calibrations. No squinting or guessing when you use Model 80.
- ✓ **MIRRORED SCALE** permits fine accurate measurements where fractional readings are important.
- ✓ **CAPACITY RANGES** permit you to accurately measure *all* condensers from .00025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.
- ✓ **HANDSOME SADDLE-STITCHED CARRYING CASE** included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

*SPECIFICATIONS:*

7 **D.C. VOLTAGE RANGES:**
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.

6 **A.C. VOLTAGE RANGES:**
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts.

3 **RESISTANCE RANGES:**
0 to 2,000/200,000 Ohms. 0-20 Meghoms.

2 **CAPACITY RANGES:**
.00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.

5 **D.C. CURRENT RANGES:**
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 **DECIBEL RANGES:**
— 6 db to + 18 db + 14 db to + 38 db
+ 34 db to + 58 db

*FEATURES:*

- A built-in Isolation Transformer automatically isolates the Model 80 from the power line when capacity service is in use.
- Selected, 1% zero temperature coefficient metalized resistors are used as multipliers to assure *unchanging* accurate readings on all ranges.

*Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only .....*

**$42.50 NET**

---

**SHIPPED ON APPROVAL**
***NO MONEY WITH ORDER — NO C.O.D.***

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

SEE PAGE 121 FOR COMPLETE DETAILS

**MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.**

SUPERIOR'S NEW MODEL TV-50A

# GENOMETER

## 7 Signal Generators in One!

- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

**Model TV-50A—Genometer**
**Total Price ..... $47.50**
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:
**A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV**

### *Specifications*

**R. F. SIGNAL GENERATOR:** The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

**CROSS HATCH GENERATOR:** The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

**VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

**DOT PATTERN GENERATOR (FOR COLOR TV)** Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

**BAR GENERATOR:** The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

**MARKER GENERATOR:** The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency).

**THE MODEL TV-50A comes absolutely complete with shielded leads and operating instructions.**

**$47.50 NET**

---

SUPERIOR'S NEW MODEL 79 **SUPER-METER** — WITH NEW 6" FULL-VIEW METER

## *A Combination* VOLT-OHM MILLIAMMETER.
## *Plus* CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS
## *Also Tests* SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES.

**Model 79—SUPER-METER . . . Total Price $38.50—Terms: $8.50 after 10 day trial, then $6.00 per month for 5 months if satisfactory. Otherwise return, no explanation necessary!**

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development.

In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

### *Specifications*

**D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500.
**A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000.
**D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
**RESISTANCE:** 0 to 1,000/100,000 Ohms. 0 to 10 Megohms.
**CAPACITY:** .001 to 1 Mfd. 1 to 50 Mfd.
**REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
**INDUCTANCE:** .15 to 7 Henries, 7 to 7,000 Henries.
**DECIBELS:** −6 to +18, +14 to +38, +34 to +58.

*The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.*

All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers. All Germanium Diodes.
All Silicon Rectifiers. All Silicon Diodes.

*Model 79 comes complete with operating instructions and test leads. Use it on the bench—use it on calls. A streamlined carrying case included at no extra charge accommodates the tester, instruction book and test leads. Only*

**$38.50 NET**

---

**SHIPPED ON APPROVAL**
**NO MONEY WITH ORDER—NO C.O.D.**

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

SEE PAGE 121 FOR COMPLETE DETAILS

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

## SUPERIOR'S NEW MODEL 82A

# Multi-Socket Type TUBE TESTER

## TEST ANY TUBE IN 10 SECONDS FLAT!

(1) Turn the filament selector switch to position specified.

(2) Insert tube into a numbered socket as designated on our chart (over 600 types included).

(3) Press down the quality button —

***THAT'S ALL!*** *Read emission quality direct on bad-good meter scale.*

**Model 82A — TUBE TESTER . . . Total Price $36.50 — Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.**

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Primarily, the difference between the conventional tube tester and the multi-socket type is that in the latter, the use of an added number of specific sockets (for example, in Model 82A the noval is duplicated eight times) permits elimination of element switches thus reducing testing time and possibility of incorrect switch readings.

To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch—THAT'S ALL! Read quality on meter. Inter-element leakage, if any, indicates automatically.

....*FEATURES*....

- Tests over 600 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings.
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence.
- Dual Scale meter permits testing of low current tubes.
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

*Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only.....*

**$36.50 NET**

## SUPERIOR'S NEW MODEL TW-11

## STANDARD PROFESSIONAL

# TUBE TESTER

**Model TW-11—TUBE TESTER . . . Total Price $47.50—Terms: $11.50 after 10 doy trial, then $6.00 per month for 6 months if satisfactory. Otherwise return, no explanation necessary!**

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lack-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Praximity fuse types, etc.

★ Uses the new self-cleaning Lever Actian Switches far individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Madel TW-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TW-11 does not use any cambination type sackets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong sacket.

★ Free-moving built-in roll chart provides complete data far all tubes. All tube listings printed in large easy-ta-read type.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

### EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, an emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

**The Model TW-11 operates on 105-130 Volt 60 Cycles. Comes housed in a handsome, portable Saddle Stitched Texan case. Only.....**

**$47.50 NET**

## SHIPPED ON APPROVAL

***NO MONEY WITH ORDER — NO C.O.D.***

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary.

SEE FOLLOWING PAGE FOR COMPLETE DETAILS

MOSS ELECTRONIC, INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

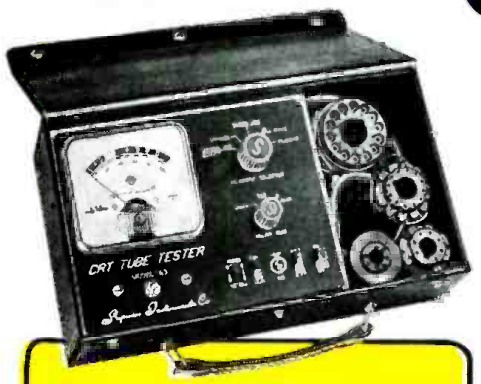
SUPERIOR'S
NEW MODEL 83

# C.R.T. TESTER

## Tests and Rejuvenates ALL PICTURE TUBES

**ALL BLACK AND WHITE TUBES** From 50 degree to 110 degree types—from 8" to 30" types.

**ALL COLOR TUBES** Test ALL picture tubes—in the carton—out of the carton—in the set!




**Model 83—C.R.T. TUBE TESTER . . . Total Price $38.50—Terms. $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!**

- ✓ Model 83 is *not* simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
- ✓ Model 83 provides *separate* filament operating voltages for the older 6.3 types and the newer 8.4 types.
- ✓ Model 83 employs a 4" air-damped meter with quality and calibrated scales.
- ✓ Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.
- ✓ Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
- ✓ Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a *selective* low voltage *uniformly* to assure increased life with no danger of cathode damage.

*Model 83 comes housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only . . . . .* **$38.50**

# RCA RADIATION COUNTER

***INDICATES RADIOACTIVITY IN 3 WAYS!***

*1—BY NEON*
*2—BY PHONE*
*2—BY METER*


RADIOACTIVE SPECIMEN

**RCA Radiation Counter**
**Total Price . . . . . $47.50**
**Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.**

***MADE TO SELL FOR $150.00—OFFERED FOR ONLY $47.50***
(Much less than cost of Manufacture.)

Endless experiments and discoveries in the new exciting field of nuclear energy are made possible when you acquire this finely built and engineered device. In the past, a rugged counter which was suitable for the prospecting of radioactive ores such as uranium, thorium and radium, was unsuitable for laboratory work due to the inability of combining accuracy with ruggedness. Conversely, a laboratory counter, while being extremely sensitive, could not withstand use in the field where it would be subjected to abuse and abnormally hard knocks. The Model WF-10AWB combines the laboratory and field counter in one rugged instrument. The use of phones and a visible lamp permits the operator greater freedom of operation as he no longer has to keep his eyes on a relatively small indicator.
In the laboratory where determinations of intensity (counts) of a reading are necessary, the WF-10AWB provides sensitivity far surpassing many laboratory counters.

- Employs the extra sensitive 1B85 Bismuth Type Geiger Counter tube. Sensitivity is .05 Roentgens per hour (1 MR/HR=2000 counts per minute).
- Three counting ranges: 0-100/1,000/10,000 counts per minute.
- Handy reset button.
- Ideal for survey work as the complete unit weighs only 5½ lbs.
- Sight and sound indications by neon flashes and headphone. Then when an indication is obtained you switch to meter reading for exact measurements.
- Decontamination easy with damp cloth applied to the weatherproofed aluminum case.
- A radioactive specimen is included for instrument checking and experiments.
- Included at no extra charge—U.S. Atomic Energy Commission booklet titled "Prospecting with a Counter."

**SPECIFICATIONS**

Three counting ranges are available—0-100 counts per minute—used in cosmic ray and extremely low activity determinations. 0-1,000 counts per minute—used for average activity and normal work. 0-10,000 counts per minute—used for tracer and high activity determinations. High accuracy is assured by the handy reset button, located on the front panel, which permits compensation for variations of battery voltages and background count. A rugged weather-proof aluminum case houses this light economical unit. The batteries will provide over 200 hours of intermittent operation from the two 67½ volt batteries and 50 hours from the three flash light batteries.

**Comes with complete set of batteries, carrying strap, headphone, radio-active specimen and A.E.C. booklet.....Only $47.50**

# SHIPPED ON APPROVAL
# NO MONEY WITH ORDER — NO C.O.D.

**MOSS ELECTRONIC, INC.**
**Dept. D-706 3849 Tenth Ave., New York 34, N. Y.**

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

Name .....

Address .....

City..... Zone..... State.....

All prices net, F.O.B., N.Y.C.

- ☐ Model 77 ..... Total Price $42.50
  $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 80 ..... Total Price $42.50
  $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model TV-50A ..... Total Price $47.50
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 79 ..... Total Price $38.50
  $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 82A ..... Total Price $36.50
  $6.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model TW-11 ..... Total Price $47.50
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 83 ..... Total Price $38.50
  $8.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ RCA Radiation Counter ..... Total Price $47.50
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.

By
**BERT WHYTE**

# CERTIFIED RECORD REVUE

WELL, friends, seems like the new year is upon us and in the world of audio 1960 may be remembered as the year of the Big Change. By this I mean that there are going to be some drastic changes in the record and high-fidelity equipment buying habits of the public. For one thing, the stereo disc has come along as a market entity at a much more rapid pace than anyone ever dreamed of. Dollar volume sales of stereo discs has now reached impressive proportions as compared to monophonic LP's and in 1960 there is every indication that the dollar volume of stereo discs may overshadow its mono cousin, at least in the classical field.

Mono appears to be holding its own percentage-wise in the pop field, but even here the die is cast and although the stereo encroachment may be slower than in the classical, it will be as inevitable.

In matters of equipment, stereo is being sold at an almost fantastic level. Even if much of this stereo equipment is of the packaged variety and of marginal quality, by the end of this year some eight or nine million stereo sets will be in use. As any record company sales manager can tell you, this alone makes a very large and attractive market. Yes, there is little doubt that America is "going stereo."

Of course, such a movement is bound to have a profound effect on both record and equipment manufacturers. Many companies who are equipped with stereo recording apparatus of rudimentary or sub-standard quality will have to make heavy investments in some of the newer and more sophisticated stereo recording equipment and, in addition, will have to use a combination of luck and sufficient monetary inducements to secure the services of really knowledgeable first-class stereo recording engineers. There are very few engineers who fall into this category and it wouldn't be too surprising if some lively "pirating" went on! Much the same can be said of the equipment manufacturers. As far as the component type manufacturer is concerned, he has the dual task of holding on to the high-fidelity market that has been created over the last ten years and of somehow making his admittedly more technical and formidable looking equipment more palatable to a potentially much larger market, this market being those members of the general public who, having become more sound-conscious through stereo and then ultimately more discriminating, decide to "graduate" into the higher quality, more refined equipment of the component type.

There is really a very funny situation building up. Some of the component manufacturers are beginning to espouse some of the ideas and gimmicks in both styling and merchandising that have been the province of the package manufacturers and, conversely, the package manufacturer is being forced to adopt a more sophisticated approach to his amplifier, preamplifier, tuner, and loudspeaker design because of the exigencies of stereo. It is not so much a matter that the package manufacturers feel compelled to furnish their mahogany monstrosities with components which are actually of any better quality, but with those which in this space age *look* more technical and therefore *must* be better. The situation becomes still more ludicrous when one realizes that there might be some sort of voluntary intermarriage between the component and the package manufacturers. In other words, it could conceivably be to the advantage of a component manufacturer to hire a stylist or engineer who has been with a package manufacturer and, obviously, the reverse might hold true for the package manufacturer who would feel that a stylist or engineer from a component manufacturer may furnish him with the sophistication he thinks his products need.

It is quite a "ring around the rosy" with some of the components people wanting what they think is the package manufacturers' approach to a mass market and the package manufacturers wanting what they think will be sufficiently impressive looking, from the component approach, in order to give their products "class."

I have said this before, but it bears repeating. The package manufacturer is an old "pro" when it comes to merchandising. He knows all the tricks, he knows all the angles, he has a high-powered sales staff, and mass distribution facilities. He also has a thing called "money" . . . and lots of it. For the average component manufacturer to engage these colossi in battle, especially at their own game, seems to me a very risky proposition. The component manufacturer has been a synonym for quality in an age when most manufactured articles are made to the standard of the lowest common denominator of quality. He has enjoyed a reputation for honesty and craftsmanship like that once enjoyed by the old Guilds. He has kept alive an individualistic approach to design and has steadfastly refused to be dictated to by the exigencies of mass taste. He has earned the respect and enjoyed the income derived from many thousands of people who saw in his product an escape from conformist mediocrity.

Yes, the grass always looks greener on the other side and despite all these sterling qualities, the component manufacturer is human. No one can blame him for wanting to turn an extra dollar. My own feeling is that a component manufacturer who tries to embrace mass market techniques without the formidable armamentarium of the package manufacturer is asking for a great deal of trouble.

I think 1960 is a year in which a lot of people can get badly burned by sticking their fingers in the wrong pie. This applies equally to package and component manufacturers. Actually, the component manufacturer, if he sticks by his guns and maintains his standards of quality, is in a better position to increase sales than ever before. I believe this is true because the package boys, with all their facilities of merchandising, advertising, etc. are doing a tremendous selling job on the American public. They are making the American public very aware of stereo and, in turn, stereo is educating many people in the greater delights of records and music. Inevitably, many of these people will become more discriminating and then, at that time, they become the prime target for the component manufacturer's product. It is up to the component people to make sure that their products reflect this higher quality and, through an industry coordinated advertising effort, that these people seeking higher quality will know where it can be purchased.

This preamble I thought necessary for reporting on the New York High Fidelity Show since the most evident thing about the Show was that here was the beginning of the Big Change. These changes were to be noted in the over-all dominance of stereo and the other changes, those insidious ones, between component and package manufacturers were everywhere in evidence. It seems that the whole nature of this show has been changing. It's a different type of crowd now than in the old days when it used to be called "The Audio Fair." There seems to be a higher proportion of the "man in the street" and less of the knowledgeable audiophile.

Even the musical tastes and manner of demonstration have changed. There were still remnants of the old block-buster sound spectacular type of demonstration, but for the most part the material was of a light or pop variety engendering little dynamic change and the levels at which the music was played were positively "polite."

In the larger-proportion-than-usual of couples, the attention of the wife was most often drawn to furniture and styling and what she saw and liked was rather heavily impressed on poor hubby. Thus in the logical order of events, more attention was paid to small speakers than large, packaged amplifiers rather than larger preamp and amplifier combinations, and, of course, the combination stereo tuner, preamp, amplifier, and gosh-knows-what-else all wrapped up most attractively in smaller and smaller packages, was looked upon favorably.

There were few really new items, however, most of the apparatus being ultra-refinements of tried and true components. And that brash upstart—four-channel tape—was much in evidence and tape in general was enjoying a renaissance. There were more companies displaying tape cartridge playback equipment, some of which was actual playing and, despite the discomfiture this will cause in certain tape circles, it was obvious that the cartridge concept was beyond the "gimmick" stage and nothing that could be flippantly dismissed.

Among the packages were some that were outright shams, which did very little of what they were purported to do. Certainly this type of equipment is an insult to the intelligence of even the greenest specimen of the average public. Fortunately, this group was in the minority and it is nice to report that many of the more conscientious manufacturers were displaying package units that were audibly improved. I guess in the package field it is more true than ever that "you gets what you pays for." So went the Show.

As I said, the seeds of the Change were sown at the 1959 Show and the Show in 1960 should be one of the most interesting in many years. For the decisions will have

been made, the battles will have been fought and won or lost, and in the aftermath and the sorting out process, the Change will have taken place and we will have entered a new era in audio.

*SESSIONS*
**BLACK MASKERS SUITE**
*McPHEE*
**TABUH-TABUHAN**
**Eastman Rochester Symphony Orchestra conducted by Howard Hanson. Mercury Stereo SR90103. Price $5.95.**

Both of these works have appeared previously in mono format and at the time of their issue created quite a stir with their exotic scoring and tremendous sound. The McPhee piece is programmatic in content and is derivative in the sense that it uses some elements of the gamelan orchestras of the East. The inspiration, in McPhee's own words, is South Seas, most likely Balinese in origin. It is an attractive little work with a wonderful rhythmic figure in the opening bars and this same sense of rhythm and vitality is maintained throughout the work. As noted, there are gamelan elements here, so there is some interesting use of high percussives.

The important work on this disc is the suite from the "Black Maskers." This is a very powerful, very stark work and, in spite of the fact that it is full of dissonance and atonality, it will have a strong appeal for many people who normally do not take to modern music. This is masterful writing with superb orchestration and constitutes a real virtuoso exercise for any orchestra.

Howard Hanson is completely at ease with this idiom and turns in a very vital, strong-lined performance and his fine orchestra follows his urgings with great spirit and wonderful accuracy.

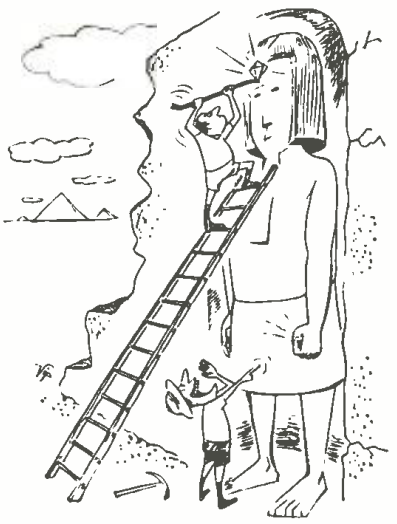
For lovers of the big sound, this is a must. There are some great resounding tympani and bass drum smashes, high percussives galore, ultra-brilliant and very forceful brass, and a pedal organ passage of very low frequency and great power that will truly be appreciated by owners of king-size speaker systems.

As an example of stereo recording, the "Black Maskers" ranks among the very best thus far. It has those qualities of directivity and instrument delineation which are usual in *Mercury's* three-channel, half-inch technique, but beyond this is a feeling of depth as well as a very strong sense of acoustic projection which is quite unusual and is one of the few stereo recordings that really display this phenomenon. The acoustics of the Eastman Rochester Theater are, of course, among the finest in the United States and probably it was a happy combination of these acoustics plus the type of scoring and the microphone pickup which has given us such a superlative recording.

A final note. These works were coupled differently in their mono format, but I think this is all to the good as they complement each other very well in this coupling.

*LISZT*
**PIANO CONCERTOS #1 & #2**
**Phillipe Entremont, pianist, with Philadelphia Orchestra conducted by Eugene Ormandy. Columbia Mono ML5389. Price $4.98.**

Some people may be a little confused by our young friend Entremont and the Liszt "Piano Concertos Nos. 1 and 2." You see this is a brand-new recording which has just been issued by *Columbia* in both mono and stereo and yet if you were to consult your *Schwann* catalogue you would find Entremont performing these same two concertos, but this time accompanied by Walter Goehr and the Zurich Radio Orchestra on a *Urania* label



"Forget that lousy ruby, Ed. Let's pry this Jensen cartridge loose."

and in mono and stereo to boot, by gad! Since it is the usual practice of recording companies to restrict an artist from recording the same work for some other company within a five-year period, either the *Urania* recording is very old or something's rotten in Denmark—or Switzerland in this case.

Since Entremont has been with *Columbia* about two years now, we could calculate that, if a five-year clause exists, the recording must have been made in 1954 or earlier. However, *Urania* was not recording in stereo in 1954, but further checking reveals that this was originally recorded for the *Concert Hall Society* and was issued as a stereo tape. Subsequently, this and other *Concert Hall* masters were sold to *Urania* and thus this crazy mix up.

In any case, Entremont has a very ingratiating way with these well-ridden war horses, and his bright, fresh readings, full of youthful exuberance, are a delight to the ear after so many ponderous statements on these concertos. A comparison between Entremont's old and his new recording reveals the progress of the artist . . . certainly his touch is more facile and he seems to have a much more assured and positive attitude in his approach to these works.

In terms of sound, even though my copy was mono, it sounded a great deal better than the poorly recorded stereo of *Concert Hall*. The piano is splendidly balanced against the orchestra and is particularly clean in its transient response. The favorable acoustics give a fine impression of spaciousness and the sympathetic accompaniment of Ormandy and his superlative Philadelphians add greatly to the attractiveness of these performances.

***BARTOK***
**CONCERTO FOR ORCHESTRA**
**TWO PORTRAITS**
**Royal Philharmonic Orchestra conducted by Rafael Kubelik. Capitol Stereo SG7186. Price $5.95.**

This is a magnificent recording, worthy of the attention of anyone who has a fondness for modern music. I heard Kubelik perform this wonderful music when he was with the Chicago Symphony and recall how impressed I was with the power and vitality of his reading. This, if anything, is an improvement over that memorable performance and most notable is Kubelik's superb handling of dynamics . . . one of the most important elements in this work. Couple this with judiciously chosen tempi, which neither drag nor rave, and a fine rhythmic proportion which is beautifully accurate yet buoyantly expressive . . . and you have a reading of rare excitement.

Sound-wise this is a fairly well balanced recording, except for the brasses which seem somehow subdued and not projected well enough forward. All elements are quite clean and Kubelik's dynamics are well realized. Stereo is good if you favor the M-S type of pickup, in other words, excellent middle somewhat at the expense of directionality. However, depth is well maintained through intelligent handling of the spacious acoustics.

Kubelik must have worked the Royal Philharmonic very hard for this virtuoso piece as they play with much more verve and accuracy than I've heard from them for some time. On strict comparison, the Dorati version still has the edge in over-all sound quality, even though it is mono. But the stereo version has its own particular merits in the smoothness and naturalness of its strings and the woodwind. Dorati's reading is also an exceptional job, although stressing rhythm more than most.

Summing up, kudos to Kubelik for this thrilling recording . . . he is a conductor whose talents are much more considerable than many critics would have you believe.

—30—

## Mobile P.A. Systems

(Continued from page 67)

we should be able to use the equipment as soon as it is turned on. The transistor, with no filament, requires no warm-up time. Then, because there are no separate elements in the same sense as those in a tube, the transistor can operate under conditions of extreme shock or vibration. To keep a tube amplifier from becoming or exhibiting microphonic tendencies would require shock-mounting, further increasing the size and weight of the equipment.

The circuit diagram of a modern mobile transistor amplifier that delivers 25 watts from a 12.6-volt battery is shown in Fig. 2. This is the circuit of the *Bogen* BT25 which can be driven to full output from a low-impedance microphone input, an auxiliary input, or a combination of both.

It is interesting to observe the output stage where both transistors of the push-pull pair are mounted directly to the aluminum chassis to provide maximum heat dissipation. In addition, the output is choke-coupled to the speaker (or speakers) from the emitters of these transistors. However, this is not an emitter-follower arrangement as might be imagined at first glance but the familiar grounded-emitter in an unconventional form. The drive to the transistors of this stage is accomplished between base and emitter through individual secondary windings of the driver transformer. The a.c. output is taken between collector and emitter, through the power supply.

The earlier stages are conventional; there is *RC* coupling between $V_1$ and $V_2$ — the second stage is direct-coupled to the driver, $V_3$. These early stages have good stability factors to give reliable operation within fairly large temperature excursions. This also makes the circuit non-critical as far as transistor replacement is concerned.

Over-all efficiency of this amplifier is about 62% at full output. This includes losses due to transformers and biasing and means that the battery is required to provide only 40 watts when the amplifier delivers 25 watts to the speaker load. When operated from a 6-volt battery source, 6 watts are available from this amplifier, making it suitable for most p.a. applications. More than 30 watts can be obtained from a 15-volt battery. Higher voltage operation is not recommended because of possible damage to the driver or output transistors.

The commercial version of this amplifier weighs 3 pounds, including its metal cage, and can fit into the glove compartment of most cars. In addition, it is priced below most comparable mobile tube amplifiers.

### REFERENCE

1. Millman, Jacob: "Vacuum Tube & Semiconductor Electronics" McGraw-Hill, New York.

—30—

## New Amplifier Standards

*(Continued from page 51)*

at the standard test frequency of 1000 cps.

### Distortion

The only distortion measurement specified in the new standard is that of *single-tone* distortion, which is basically a measurement of total harmonic distortion. A 1000-cps signal is applied, the amplifier is adjusted to full rated output, and an output voltage measurement is taken across the load. Then the fundamental component is removed from the output and the remaining harmonics and residual noise and hum are measured. The relation between these two voltages, expressed as a percentage, gives the per-cent distortion. In addition to rating amplifiers at rated output, it is standard to rate them at 3 and 20 db below rated output as well. This corresponds to half power (.7 voltage) and one-hundredth of the power (1/10 voltage) respectively. It is interesting to note that no standards were set up for IM distortion tests.

### Hum and Noise

Hum and noise factor is the ratio in db of the hum and noise voltages in the output with respect to the rated output at 1000 cps. Measurements are to be taken with the input terminals open circuited and short circuited. If gain or level controls are provided, these are then adjusted to reduce the output by 20 db, and then 40 db. The hum and noise factor is then expressed as the lowest numerical value in db determined by all the above tests. The standard also specifies that the measuring instrument be weighted to follow the 40 db (A) curve of ASA Standard Z 24.3-1944. It is interesting to note that this curve, usually employed in sound-level meters for low-level measurements, is down 27 db at 60 cps.

### Damping Factor

This term, designated by the symbol DF, is the ratio of the rated or nominal load impedance to the actual internal impedance of the amplifier. The measurement is taken with a 1000-cps signal applied and with the amplifier unloaded and producing a 1-volt output across the 8-ohm output terminals. Then an output load is applied, and is then adjusted until the output voltage falls to half the no-load value. Under these conditions the value of the load resistor is equal to the value of the amplifier's internal impedance. The ratio can now be set up and the damping factor calculated.

For additional details on the methods of measurements and standard conditions specified, we refer our readers to the complete publication "IHFM Standard Methods of Measurement for Amplifiers (IHFM-A-200)." This is available directly from the Institute, 125 East 23rd Street, N. Y., N. Y. at a cost of $1 each. —30—

# Service Industry News

IT HAS BEEN some time since the issue of licensing generated as much attention as it is currently receiving. The matter can never be considered dead, but it often goes into periods of relative inactivity. Spearheading the renewed interest is the adoption of a licensing ordinance in Kansas City, Mo. This community now joins such others as Detroit, St. Paul, and the State of Louisiana in using some legal instrument for passing on the qualifications of TV service technicians.

In communities where such regulatory legislation has been rejected recently, advocates of licensing have not taken such actions as defeats, but rather as steps toward the goal. For example, president Bob Larsen of the Empire State Federation of Electronic Technicians Associations has resigned his office to devote his concentrated energies to the fight for a licensing law in New York State. This follows the rejection by the legislature of a certification proposal by only a few months. Opposing the trend, one association is behind a move to test the legality of the Kansas City ordinance.

In many localities where licensing has been rejected, legislators have given as a reason the fact that existing laws should be sufficient to deal with unethical service businesses. Basing their strategy on this point, many associations are reporting questionable operators who may be violating sales tax laws, general businesses-licensing regulations, business zoning rules, and other local requirements.

Related to the matter of questionable operators, there is an increasing tendency to consider the role of the part-timers and to establish standards with respect to them. This includes an increased willingness to recognize that a part-time service technician is not necessarily the same as a "night crawler."

Also in the news: a growing wave of thefts from service shops, often giving the appearance of organized activity; the question of what is a fair price for service calls; and electron tube pricing.

### Tube Prices: Cincinnati

President Stan Shaffer of Cincinnati-TESA has something to say on proposals to reduce the mark-up on tubes to make these items less profitable for the drug stores to handle: "First of all the druggist, etc., couldn't care less if the list price of tubes is lowered because his total investment is approximately 4 square feet of floor area and, if he made nothing on tube sales, he is still creating store traffic he normally wouldn't have. Secondly the illegitimate part-timer can't be hurt because his income, after the cost of parts, is all profit and losing 50 cents or so per tube isn't going to slow him up at all. Thirdly, to get an idea just how this will 'help' you, mentally deduct half your tube profit from your net income last year."

### Louisiana Licensing

Harold J. Yuratich, director for the Louisiana State TV Service License system, reports that state officials, the public, and the service industry are all satisfied with the way in which the statute has been working out. Louisiana can claim a "first": as far as licensing on a state-wide basis is concerned, it is a pioneer.

### TEAM Fights License Law

The Electronic Association of Missouri, one of the most articulate of those established service associations that is opposed to licensing in principle, has elected to do something about the passage of such legislation in its home state. At the request of TEAM, two principals have filed suit against the mayor, the commissioner of revenue, the chief of police, and other officials of Kansas City. They question the validity of the recently passed law.

Says John V. Glass in "TEAM News," "Your business will be regulated by four of your competitors. There is not one word of protection for you from false accusation, personal animosity, and discrimination from a board dominated by politics. No provision is made for appeal from decisions of the Board or the Commissioner of Revenue."

### Tax Evasion, California

Television Service Dealers Association of San Mateo County, Calif., has been scrutinizing local ordinances carefully to turn up some interesting angles on do-it-yourself tube checkers located in non-service businesses. Most cities in the county require the licensing of vending machines and other such devices, but it has not been the practice of owners of these tube checkers to comply with the requirement. Also there is some question as to the evasion of property and other business taxes with respect to these testers. TSDA points out that, since established service businesses do indeed pay such taxes, they are at a competitive disadvantage.

### Texas Tax Law

Revisions in the state tax laws are being used by TEA of San Antonio and

other Texas groups as the basis for strategy in combating illegitimate service technicians and drug-store checkers. One provision of the law requires that a sales slip be written on each transaction giving the customer's name, items sold, and the tax collected. The TEA affiliate is prepared to report violators in the area of radio-TV service.

RTTG-TESA of Miami, following a plan similar to that being used in Texas, says, "Help put the illegitimate part-timer in business—report his activities to the license bureau, tax collector, and zoning board."

In some areas where there are effective laws to control weights, measures, and similar standards, another technique is being used on questionable tube testers. Service groups are asking that such devices be checked for their accuracy in providing measurements of tube quality and that they be controlled where it is found that they give misleading readings.

### Part-Timers

NATESA has been giving serious attention to defining the role of the part-timer. As reported by the "Newsletter" of the Television Service Association of Northeastern New York, the National Alliance recognizes two types of part-timers: the properly qualified one who has had sufficient background and experience, and the one "who may be your mailman, garbage collector, *et al*, who has never had training" but who "owns a tube caddy and a lot of nerve." NATESA is attempting to establish standards that will help in differentiating between these two groups.

In a related endeavor, members of the service industry have met in Indianapolis, Ind. to set up standards for recruitment, training, and testing at a regional apprenticeship conference.

In areas where TV service licensing does not exist, urges NATESA's Frank Moch, the local industry should adopt "self-licensing" either to force the part-timer out or put him legitimately in business: "Use every applicable tax, and other agencies, to force the part-timer to assume his proper business hurdens. This office will be more than happy to cooperate with you and make available to your group data gathered on both of these plans (licensing and self-licensing)."

### Bait Advertising, Pasadena

The *Independent Star-News* of Pasadena, Calif., will no longer accept television service advertising in which the price of a house call is mentioned in the copy. This newspaper joins a long list of other media that have adopted such a policy, usually as a result of the efforts of local service groups. Says the *Star-News*, "Decisions of this sort are based on public reaction and the desire of newspapers to maintain the highest standards of truth in advertising." Copies of the daily's notification went out to 22 service firms in the Pasadena area. —30—

## Wide-Band Millivoltmeter

(*Continued from page* 59)

5 of $V_4$ and the ground connection from pin 2 of $V_5$ are left open. All tubes are placed in their sockets except for rectifier $V_3$, and the slider on $R_{29}$ is set so that the entire resistance of 400 ohms is in the circuit. Connect a d.c. voltmeter between point $X$ and ground, plug the instrument into an a.c. source, and turn on power switch $S_2$. The reading will doubtless be below the 24 volts required for the heaters. Keep reducing the resistance of $R_{29}$ (with power off) until the desired 24 volts is read.

With power off, plug rectifier $V_3$ into its socket and set the slider on $R_{15}$ so that the full resistance of 2000 ohms is in the circuit. Connect an ammeter (0-100 milliampere scale) between pin 2 of $V_5$ and ground. Turn on the power and note the reading. $R_{15}$ should be adjusted for a reading of 35 milliamperes. Since this concludes power-supply adjustments, the amplifier "B+" lead may now be connected to pin 5 of $V_4$ and the ground connection made from pin 2 of $V_5$.

Turn meter switch $S_3$ off, turn on power switch $S_2$, and allow several minutes for the tubes to warm up. Check the heater, plate, and cathode voltages (shown in Fig. 3). If an oscilloscope is available, it may be plugged in at $J_2$ and the amplifier output checked for any spurious signals while switching the range switch through its various positions. If any signal is present at the output, the offending stage may be found by successively shorting each grid to ground. If a scope is not available, headphones may be used. It may be necessary to place the cover on the instrument when checking the 10-millivolt scale to prevent any external a.c. pickup.

If the output is clean, pull the scope plug, set the range switch to the 100-volt position, turn meter switch $S_3$ on, and rotate the range switch down through the lower scales. The meter should remain at zero on all scales. The instrument is now ready for calibration. Set the range switch to its 10-volt position and apply, through shielded test leads from an accurately known source, exactly 10 volts r.m.s. (preferably at 1000 cycles). $R_{11}$ is then adjusted so the meter reads full scale, and the instrument is completed and ready for operation.

### Other Facilities

The meter switch ($S_3$) and pin jacks ($J_3$, $J_4$) provide for use of the microammeter itself as a bench meter. The switch is also useful for taking the meter out of the circuit, when changing inputs, to prevent any damage.

The signal may be observed on an oscilloscope at the same time it is being metered by inserting a plug for the scope into $J_2$ just far enough to contact the closed-circuit jack. The instrument may also be used as a high-gain pre-amplifier by inserting a plug all the way in at $J_2$. This cuts out the meter circuit and its associated 15 db feedback, providing approximately 9.5 volts output with 10 millivolts on the grid of $V_1$, a voltage gain of almost 60 db.

It will be necessary to make up a shielded probe with a shielded lead for audio signal tracing. The instrument may also be used as an r.f. signal tracer by using a crystal-detector probe at the input, and the signal may be taken out at $J_2$ to headphones or an audio amplifier for aural tracing. The circuit for such an r.f. probe is shown in the lower right-hand corner of Fig. 3. —30—

## HANDY FILAMENT CHECKER

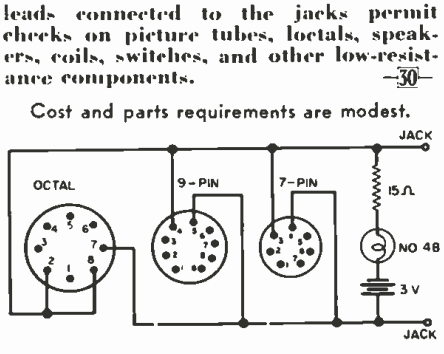
By NICHOLAS B. COOK

THE IDEA of series-string filaments has come a long way since their use in Christmas-tree lighting. Today, in addition to the common a.c.-d.c. radios, a large number of TV sets use such filament strings, with special lines of tubes designed for the purpose. However, when the lights go out, the old problem remains: "Which one is open?" Testing the heaters of individual tubes is still the most reliable way of getting the answer, but also the most time-consuming.

Compact, multi-socket filament checkers are probably the most convenient solution to the problem, but most available types have limitations. Dependence on an a.c. supply through a line cord limits mobility and introduces the hazard of a live circuit in a metal box. Battery-operated checkers have the disadvantage that the flashlight type of bulb ordinarily used limits battery life, especially if the light weight and compactness of the smaller cells are desired. Also such bulbs often limit the range of filament voltages that can be checked. However, these handicaps can be overcome by using No. 48 (or 49) panel lamps.

With either of these bulbs, a self-contained checker small enough to fit in the palm of the hand or pocket can be built for about a dollar, including two tiny penlight cells. The lamps are rated at only 60 ma. If wired as shown below, using only three sockets, the majority of currently popular types can be tested. The 15-ohm dropping resistor limits current to the rated value even on short circuits. It also helps make it safe to test even 1.5-volt tubes, with the pilot bulb giving a bright glow. The glow is still perceptible with such 50-volt tubes as the 50L6. The upper limit is a filament or other load of about 75 ohms. Test leads connected to the jacks permit checks on picture tubes, loctals, speakers, coils, switches, and other low-resistance components. —30—

Cost and parts requirements are modest.



## LORAN R-65/APN-9 RECEIVER & INDICATOR

Used in ships and aircraft. Determines position by radio signals from known transmitters. Accurate to within 1% of distance. Complete with tubes and crystal. Exc. used.
Value $1200.00. Our Price ..... **$79.50**
12 Volt Inverter Power Supply for above. BRAND NEW. **$32.50**
Circuit diagram and connecting plugs available.

## SCR-AR-283 Transmitter-Receiver

Consists of: RECEIVER, 201 to 398 Kc and 2500 to 7850 Kc. TRANSMITTER, 2500 to 7700 Kc. for unmodulated, tone-modulated, or voice. Here's what you get, at this fantastically low price: Receiver complete with 6 tubes; transmitter complete with 4 tubes, Dynamotor for 24 V DC operation, 5 coil sets 2 control boxes, antenna switching relay, operating manual. ALL BRAND NEW— and All Yours, for only..... **$16.95**

## NAVY AIRCRAFT RADIO RECEIVER

ARB/CRV 46151—190 to 9050 Kc in 4 bands. 6 Tube Superhet communications receiver, with local and remote tuning, band change. Sharp and broad tuning, AVC, CW. Illuminated dial. Complete with tubes and dynamotor, used..... **$17.95**
Like New..... **$26.50**

**BC-733 VHF 10-TUBE AIRCRAFT RECEIVER.** 6-channel xtal control. Freq. 108.3 to 110.3 Mc. Dual filter range. Easily converted for tracking Sputniks! **$7.95**
Exc. used. Complete with tubes.....
Brand New complete with tubes..... **$8.95**
**Dynamotor for above 12 or 24 V.—New $5.95**

## AN/APA-38 PANORAMIC ADAPTER

And Wave Analyzer. 30 Mc Center Frequency, 2 Mc Band Width. Total scan 10 Mc at one clip. Regular saw-tooth sweep. Variable sweep freq. control 1600 cycles. Use it as regular service scope! Including 11 tubes and 3" scope tube type 3DP1. LIKE NEW.. **$19.50**

## ASB-5 'SCOPE INDICATOR

**BRAND NEW,** including all tubes, together with 5BP1 'Scope Tube. Originally used in Navy Aircraft RADAR equipment. Easily converted for AC operation.
VALUE $250.00! OUR LOW PRICE **$15.95**

## SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.
**SCR-522 Transmitter-Receiver,** complete with all 18 tubes, top rack and metal case.
COMBINATION.....Special **$32.32**
Receiver only, with all tubes..... $19.50
Transmitter Only, with all tubes..... $17.50
Accessories for above available.

## LORAN APN-4 FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane. Indicator and receiver complete with all tubes and crystal.
INDICATOR ID-68/APN-4, and RECEIVER R-98/APN-4, complete with tubes. Exc. used **$49.50**
Receiver-Indicator as above. BRAND NEW.. **$69.50**
Inverter for above unit available from stock.

## LORAN APN/4 OSCILLOSCOPE

Easily converted for use on radio-TV service bench.

**Completely Assembled**

LIKE NEW! Supplied with 5" Scope, type 5CP1 only ..... **$14.95**
Brand New ..... $19.50

## BC-906 FREQ. METER—SPECIAL

Cavity type, 145 to 235 Mc. BRAND NEW, complete with antenna. Manual included.
OUR LOW PRICE..... **$9.88**

## STANDARD TUBES

Removed from Brand New Gov't Equipment

| RECEIVING | | | | | |
|---|---|---|---|---|---|
| 6AG5 | .35 | 6AC7 | .55 | 315 | 2.15 |
| 12AT7 | .45 | 6J6 | .32 | 837 | .85 |
| 6AK5 | .35 | | | 1625 | .29 |
| 6C4 | .25 | SPECIAL PURP. | | 1629 | .29 |
| 6AL5 | .33 | 3E29 | 4.25 | 2013 | .39 |
| 6J4 | .59 | 807 | .95 | 2014 | .39 |
| 6X5 | .35 | 813 | 6.95 | 4X-150 | 5.95 |
| | | 814 | 2.25 | 38P1 | 1.49 |

## REMOTE CONTROL RM-52

Direct remote control for radio equipment. Uses 4 flashlight batts. Provides bias for Microphone and sidetone to headset. Hi or Lo imp., Mike and Phone jacks. Makes good phone patch unit. BRAND NEW..... **$2.49**

**SCHEMATIC DIAGRAMS** For any equipment on this page, each.. **65c**

**SEND FOR FREE CATALOG, many more Wonderful Surplus Buys!**

## AN/ART-13 100-WATT XMTR

**11 CHANNELS**
**200-1500 Kc**
**2 to 18.1 Mc**
**$48.50 Complete with Tubes**

Famous Collins Automatic Aircraft Transmitter, AM, CW, MCW. Quick change to any of ten preset channels or manual tuning. Speech amplifier clipper uses carbon or magnetic mike. Highly stable, highly accurate VFO. Built in Xtal controlled calibrator. PP811s modulate 813 in final up to 90% c. class "B" A Real "HOT" Ham buy at our low price! Orig. cost $1800. Exc. Used ..... **$48.50**
**0-16 Low Freq. Osc. Coil for ART-13** ..... 7.95
**24V Dynamotor for ART-13** ..... 11.95
**Accessories available for xmtr. Inquiries invited.**

## THIS MONTH'S SPECIAL

### MARINE/MOBILE DYNAMOTOR

**DC INPUT:** 12V @ 16A and 24V @ 8A. **DC OUTPUT:** 300V @ .200A continuous, .400A intermittent. Change to other voltage by simple switching. BRAND NEW in original cases! Complete with filter base, shock mount, spare brushes. TERRIFIC PRICE SMASH! Reg. $24.50. THIS MONTH ONLY ..... **$16.50** Reg. $24.50

**DYNAMIC BOOM MIKE M-33/AIC.** Low Impedance. With mounting bracket for attachment to headsets. A REAL VALUE at ..... $3.95

**DYNAMIC HANDMIKE,** with "Press-to-talk" Switch on handle, cord and plug—BRAND NEW, only..... $2.95

**DYNAMIC HANDMIKE,** aircraft, made by Telephonics Corp. Press-to-talk switch on mike. BRAND NEW..... $4.95

**Hi-Fi DYNAMIC HEADSET with Cushions**
Freq. Range: 40-14000 CPS. No Distortion. **$7.85**
BRAND NEW .....

### MICROPHONES

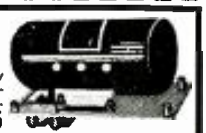
| Model | Description | Excellent Used | BRAND NEW |
|---|---|---|---|
| T-17 | Carbon Hand Mike | | $5.45 |
| T-30 | Carbon Throat Mike | $ .34 | .74 |
| T-45 | Army and Navy Lip Mike | | 1.25 |
| TS-9 | Handset | | 3.88 |
| TS-11 | Handset | | 3.95 |
| TS-13 | Handset | | 4.25 |
| RS-38 | Navy Type | | 4.75 |

### HEADPHONES

| Model | Description | Excellent Used | BRAND NEW |
|---|---|---|---|
| HS-23 | High Impedance | $2.19 | $4.65 |
| HS-33 | Low Impedance | 2.69 | 4.65 |
| HS-30 | Low Imp. (feather wt.) | .90 | 1.65 |
| H-16/U | High Imp. (2 units) | 3.75 | 7.95 |

**TELEPHONICS**—600 ohm Low Impedance HEADSETS, BRAND NEW, PER PAIR $3.25
CD-307A Cords, with PL55 plug and JK26 Jack ..... .99
Earphone Cushions for above—pair..... .50

## MOBILE-MARINE DYNAMOTOR



Input 12V DC. Output: 625 V DC @ 225 Ma. for press-to-talk intermittent operation. Shpg. wt. 14 lbs.
OUR LOW PRICE... **$6.45**

| OTHER DYNAMOTOR VALUES: Type | Input | Output | Excellent Used | BRAND NEW |
|---|---|---|---|---|
| DM-25 | 12V 2.2A | 250V .050A | | $4.50 |
| DA-1A | 28V 1.6A | 230V .100A | | 3.95 |
| DM-28 | 28V | 224V .07A | 2.75 | 4.75 |
| DM-32A | 28V 1.1A | 250V .05A | 2.45 | 4.45 |
| DM-33A | 28V 5A | 575V .16A | | |
| | 28V 7A | 540V .25A | 1.95 | 3.75 |
| DM-34D | 12V 2A | 220V .080A | 4.15 | 5.50 |
| DM-53A | 28V 1.4A | 220V .080A | 3.75 | 5.45 |
| DM-64A | 12V 5.1A | 275V .150A | | 7.95 |
| PE-73C | 28V 20A | 1000V .350A | 7.95 | 10.50 |
| PE-86 | 28V 1.25A | 250V .050A | 2.75 | 3.85 |

## TG-34A CODE KEYER

Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 5 to 25 WPM. **$16.88**

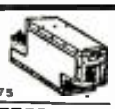
Please include 25% Deposit with order—Balance C.O.D. or Remittance in Full. 50¢ Handling Charges on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C. All Merchandise subject to Prior Sale and Price Change.

**G & G Radio Supply Co.**
**Telephone: CO 7-4605**
**51 Vesey St., New York 7, N. Y.**

## FM TRANSMITTER-RECEIVER

**APN-1.** 420 to 460 Mc Aircraft Radio altimeter equipment. Tubes: 4—955, 3—12SJ7, 4—12SH7, 2—12H6, 1—VR150. Complete with all tubes and mount. For 27 V DC. **$8.95**
**BRAND NEW**.....
Original operating manual for above ..... $1.00

## ARC-5/R28 RECEIVER



2-meter Superhet. 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. BRAND NEW **$24.45**
110V AC Power Sup. Kit for above $9.75

## ARC-5/T-23 TRANSMITTER

100-150 Mc Includes 2—832A, 2—1625 Tubes. BRAND NEW..... **$21.50**
**SPECIAL OFFER!** Limited quantity ARC-5/T23 xmitters. Excellent Used, less tubes..... $5.95
**MO-7 MODULATOR** for T-23, complete with 4 tubes. LIKE NEW..... **$9.95**

### ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes..... **$16.95**
Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**
**MODULATOR** for above, new with tubes..... $5.95

## 234-258 MC RECEIVER AN/ARR-2

BRAND NEW 11-tube UHF Tunable Receiver with schematic. Only a few at this low price! **$8.88**
Complete with tubes

## SCR-274 COMMAND EQUIPMENT

**ALL COMPLETE WITH TUBES**

| Type | Description | Used | Like NEW |
|---|---|---|---|
| BC-453 | Receiver 190-550 KC | $14.50 | $16.50 |
| BC-454 | Receiver 3-6 Mc | 9.45 | 12.45 |
| BC-455 | Receiver 6-9 Mc | 10.45 | 12.45 |
| BC-456 | 3-Receiver Control Box | 1.29 | 1.75 |

**110 Volt AC Power Supply Kit,** for all 274-N and ARC-5 Receivers. Complete with metal case, instructions ..... **$7.95**
Factory wired, tested, ready in oberals ... $11.50
**SPLINED TUNING KNOB** for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. Only ..... **49c**

**BC-457 TRANSMITTER**—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW... **$7.85**
**BC-458 TRANSMITTER**—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW..... **$9.75**
**BC-459 TRANSMITTER**—7-9.1 Mc. complete with all tubes and crystal. **$13.95**
**ARC-5/T-19 TRANSMITTER**—3 to 4 Mc. BRAND NEW complete with all tubes & crystal ..... **$8.85**
BC-456 Modulator ..... USED 3.45 NEW 5.95
BC-451 Transmitter Control Box.. 1.25 NEW 1.49
**ALL ACCESSORIES AVAILABLE FOR COMMAND EQUIPMENT.**

## BC-603 FM RECEIVER

20 TO 27.9 MC. **$12.95**
Used.....
Like New ..... $14.95
**BRAND NEW**..... $16.95
Convert to 20-50 Mc., and A.M.! (See CQ Sept. '58)
10 Channel, pushbutton tuning or continuous tuning. Complete with speaker. Tubes, squelch

12 or 24V Dynamotor for Above Exc. Used $4.25 ..... Brand New $5.50

**BC-683** same as above except 27 to 38.9 Mc Used ..... **$23.50**
Brand New ..... $27.50

**AC POWER SUPPLY FOR BC603, 683**
Interchangeable, replaces dynamotor. Has On-Off Switch. NO RECVR. CHANGE NEEDED. Provides 220 VDC @ 80 Ma. 24VAC @ 2 Amps..... $10.49
Complete 240-page Technical Manual for BC-603, 604 ..... $2.95

**BC-604 TRANSMITTER**—Companion unit for BC-603 Recvr above. With all tubes.
BRAND NEW..... **$10.95**

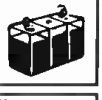
**BC-684 TRANSMITTER**—Companion unit for BC-683 Recvr above. Complete with all tubes.
Like NEW..... **$7.95**
BRAND NEW..... **$12.95**

**POWER SUPPLY** for BC-620, 659, available for 6, 12 or 24 Volts DC. Specify..... **$8.95**

## BC-659 TRANSMITTER & RECEIVER

27 to 38.9 Mc. F.M. Two preselected channels crystal controlled. 5 to 10 watts. Complete with speaker, tubes. Exc. Used..... **$11.95**

## WILLARD 6-VOLT MIDGET STORAGE BATTERY



3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte ..... Only **$2.95**

## 2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery, Model #20-2. 3" x 4" x 5½" high..... $2.79
1—2V. 7 prong Synchronous Plug-in Vibrator ..... 1.49
1—Quart Bottle Electrolyte (for 2 cells) ..... 1.45
**ALL BRAND NEW!!** Combination Price ..... **$5.45**

# Transistor Radio Circuits

*Part 3. The i.f. stage, a.g.c. control circuit, and the audio detector are discussed in this article.*

EDITOR'S NOTE: *This material on transistor circuits, appearing here and in subsequent issues, is being reproduced with the kind permission of the* Delco Radio Division *of* General Motors Corporation. *Although originally prepared and distributed to those servicing* Delco *auto radio receivers, much of the information is also applicable to other types of transistorized radios and we believe it worthwhile to present this material to our readers.*

## I.F. Stage

The i.f. amplifier is one of the most important stages in the receiver from the standpoint of good sensitivity. In vacuum-tube sets, the voltage gain of the i.f. amplifier is often as much as 100 times, but when transistors are used, it is difficult to obtain gain values of this magnitude at the r.f. and i.f. frequencies. Therefore, it is common practice to use two or three i.f. stages in high-gain receivers to obtain the required sensitivity.

Shown in Fig. 4 is a typical i.f. amplifier stage, employing a 2N149 *n-p-n* transistor in a common-emitter circuit. The i.f. signal output from the mixer stage is shown directly coupled to the transformer input in a conventional manner. The primary and secondary windings may be separated and mounted in individual cans in some cases and capacity coupled by $C_1$. Note that the base connection is at a tap on the secondary winding near the ground end or low-impedance part of the coil for proper matching. A capacitor gives the bottom end of the secondary a ground for a.c. signal voltages but not a d.c. ground because a positive base voltage is needed for forward bias on the input diode section of the transistor. The base voltage of about .7 volt is supplied by the voltage divider resistors at the bottom of the winding.

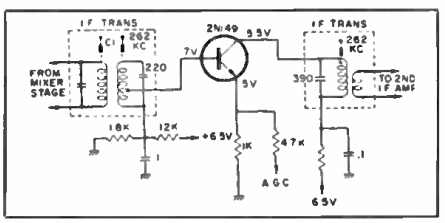



Fig. 4. The first i.f. stage of car radio.

Voltage drop across the 1000-ohm emitter resistor supplies positive emitter voltage and helps to control the static collector current which is on the order of .5 ma. This voltage is supplemented by a.g.c. voltage which drives the emitter more positive on strong signals and reduces forward bias toward the point of cut-off. This tends to keep receiver sensitivity fairly level since it reduces stage gain while tuned to strong signals and allows it to return to normal on weak signals.

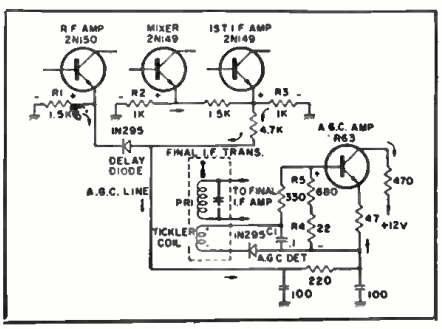
The collector circuit is tuned to resonance by a 262 kc. transformer primary, slug-tuned to the i.f. frequency. The amplified signal voltage induced in this winding is coupled to the next stage by an untuned secondary tickler winding with enough turns for proper matching to the next stage. This method of coupling can be used whenever there are a sufficient number of other tuned circuits in the receiver to attain the desired amount of selectivity. This would be especially true in receivers employing more than two intermediate-frequency stages.

## A.G.C. Control Circuit

To keep the receiver output fairly constant for various strength signals and to prevent signal overloading of the amplifier stages, a.g.c. is employed. The a.g.c. voltage is commonly taken from the last i.f. transformer primary or secondary circuit and in the circuit of Fig. 5 the primary signal voltage is used. It is coupled into the a.g.c. detector circuit by the tickler winding. When the signal voltage here is in the direction shown, the 1N295 crystal detector conducts through detector load resistors $R_1$ and $R_2$ producing a voltage drop across the load at the polarity indicated.

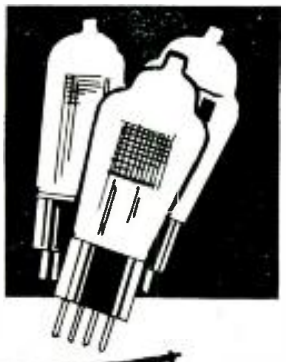
The i.f. signal pulsations are removed from the detector load by capacitor $C_1$ and the resulting output is direct-coupled to the base of the a.g.c. amplifier transistor. This causes the base of the transistor to go positive, driving it into conduction and sending electron current through the path indicated by the arrows. Further examination of the emitter current path for the a.g.c. amplifier will reveal that resistors $R_1$, $R_2$, and $R_3$ all provide ground returns for the R63 emitter and the current drawn by the a.g.c. amplifier will therefore produce a voltage drop across these resistors. Since each of these three resistors also functions as the emitter resistor for the r.f., mixer, and i.f. stage respectively, the additional voltage drop produced by a.g.c. amplifier current causes the emitter of each stage to go more positive. This reduces the for-

Fig. 5. A.g.c. control of amplifier stages.



*your best buy . . .*

# TRU-VAC®



## REMARKABLE TUBE VALUES AT 1950 PRICES

**ALL TUBES INDIVIDUALLY BOXED, CODE DATED AND BRANDED "TRU-VAC®"**

Typical TRU-VAC® Bargains!

**THIS IS A PARTIAL LIST** — Thousands More Always In Stock

6SN7GT . . **ALWAYS 30c**

6W4GT . . . **ALWAYS 30c**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| OY4 | 3AU6 | 6A6 | 6B8 | 6CH8 | 6S7 | 7B4 | 12AT6 | 12SA7 | 36 |
| OZ4 | 3BC5 | 6AB4 | 6BA6 | 6CL6 | 6SBGT | 7B5 | 12AT7 | 12SJ7 | 38 |
| 1A7GT | 3BN6 | 6AC7 | 6BC5 | 6CM6 | 6SA7 | 7B6 | 12AU6 | 12SK7 | 39/44 |
| 1B3GT | 3BZ6 | 6AF4 | 6BC8 | 6CM7 | 6SD7GT | 7B7 | 12AU7 | 12SN7GT | 41 |
| 1C6 | 3CB6 | 6AG5 | 6BD6 | 6CN7 | 6SF5 | 7B8 | 12AV6 | 12SQ7 | 42 |
| 1C7 | 3Q4 | 6AH4GT | 6BE6 | 6CQ8 | 6SF7 | 7C4 | 12AV7 | 12V6GT | 43 |
| 1F4 | 3S4 | 6AH6 | 6BF5 | 6CR6 | 6SG7 | 7C5 | 12AX4GT | 12W6GT | 45 |
| 1F5 | 3V4 | 6AK5 | 6BG6G | 6CS6 | 6SH7 | 7C6 | 12AX7 | 12X4 | 50A5 |
| 1G4 | 4BQ7A | 6AL5 | 6BH6 | 6CU5 | 6SJ7 | 7C7 | 12AZ7 | 14A7/12B7 | 50B5 |
| 1H5GT | 4B58 | 6AM8 | 6BJ6 | 6CU6 | 6SK7 | 7E5 | 12B4 | 14B6 | 50C5 |
| 1L4 | 4BZ7 | 6AN8 | 6BK5 | 6D6 | 6SL7 | 7E6 | 12BA6 | 14Q7 | 50L6 |
| 1L6 | 4CB6 | 6AQ5 | 6BK7 | 6DE6 | 6SQ7 | 7E7 | 12BA7 | 19 | 56 |
| 1N5GT | 5AM8 | 6AQ6 | 6BL7GT | 6DG6GT | 6SR7 | 7F7 | 12BD6 | 19AU4GT | 57 |
| 1R5 | 5AN8 | 6AQ7 | 6BN6 | 6DQ6 | 6T4 | 7F8 | 12BE6 | 19BG6G | 58 |
| 1S5 | 5AT8 | 6AR5 | 6BQ6GT | 6F5 | 6U8 | 7G7 | 12BF6 | 19J6 | 71A |
| 1T4 | 5AV8 | 6AS5 | 6BQ7 | 6F6 | 6V6GT | 7H7 | 12BH7 | 19T8 | 75 |
| 1U4 | 5AZ4 | 6AT6 | 6BR8 | 6H6 | 6W6GT | 7N7 | 12BQ6 | 24A | 76 |
| 1U5 | 5BR8 | 6AU4GT | 6BS8 | 6J4 | 6X4 | 7Q7 | 12BR7 | 25Z6GT | 77 |
| 1V2 | 5J6 | 6AU5GT | 6BY5G | 6J5 | 6X5GT | 7S7 | 12BY7 | 26 | 78 |
| 1X2 | 5R4 | 6AU6 | 6BZ6 | 6J6 | 6X8 | 7X6 | 12CA5 | 27 | 80 |
| 2AF4 | 5U4 | 6AU8 | 6BZ7 | 6J7 | 6Y6G | 7X7 | 12CN5 | 35 | 84/6Z4 |
| 2BN4 | 5U8 | 6AV5GT | 6C4 | 6K6GT | 7A4/XXL | 7Y4 | 12D4 | 35A5 | 11723 |
| 2CY5 | 5V4G | 6AV6 | 6CB6 | 6K7 | 7A5 | 7Z4 | 12F5 | 35B5 | |
| 3A4 | 5V6GT | 6AW8 | 6CD6G | 6N7 | 7A6 | 12A8 | 12K7 | 35C5 | |
| 3A5 | 5X8 | 6AX4GT | 6CF6 | 6Q7 | 7A7 | 12A8S | 12L6 | 35W4 | |
| 3AL5 | 5Y3 | 6AX5GT | 6CG7 | 6S4 | 7A8 | 12AQ5 | 12Q7 | 35Z5 | |

## 35¢ ea.

## $33 PER HUNDRED

## For any used or factory second tube!

### 1 YEAR GUARANTEED PICTURE TUBES

Brand New* — Allied A-1 Tubes — Brand New

Below Listed prices do not include dud. Add Additional $5.00 Deposit on tube sizes to 20"; on 21" and 24" tubes - $7.50. Deposit refunded immediately when dud is returned prepaid. Aluminized tubes - $4.00 extra.

Picture tubes shipped only to continental USA and Canada — All tubes F.O.B. Harrison, N. J.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10BP4 | 7 99 | 16HP4 | 12 19 | 17CP4 | 16 99 | 19AP4 | 18 39 | 21A1P4 | 18 79 | 21FP4 | 18 39 | 21YP4 | 18 39 | | |
| 12LP4 | 10 49 | 16KP4 | 11 99 | 17GP4 | 17 89 | 20CP4 | 15 89 | 21AMP4 | 17 99 | 21KP4 | 18 39 | 21ZP4 | 17 49 | | |
| 14B/CP4 | 11 99 | 16LP4 | 12 19 | 17HP4 | 16 99 | 20DP4 | 15 89 | 21AU4 | 18 79 | 21MP4 | 22 39 | 24AP4 | 39 49 | | |
| 16AD4 | 16 09 | 16RP4 | 11 99 | 17JP4 | 16 99 | 20HP4 | 17 89 | 21AVP4 | 18 79 | 21YP4 | 18 39 | 24CP4 | 27 79 | | |
| 16DP4 | 12 19 | 17AVP4 | 15 49 | 17QP4 | 13 89 | 21AP4 | 21 49 | 21AWP4 | 17 49 | 21WP4 | 17 49 | 24DP4 | 29 79 | | |
| 16GP4 | 16 09 | 17BP4 | 13 49 | 17TP4 | 16 99 | 21ALP4 | 18 79 | 21EP4 | 17 29 | 21XP4 | 17 49 | | | | |

**ATTENTION!**

Get More For Your Money . . . Get Quality And Bigger Selection . . . Get Truly Remarkable Tube Values When You Buy At TRU-VAC

**FREE FUSE CLIP !**

Sent With Any Order Of $5 Or More

**GUARANTEE**

Only TRU-VAC guarantees to replace free any tube which becomes defective in use within one year of date of purchase.

**USED TV CONSOLES**

GUARANTEED To Work When You Receive Them

| | |
|---|---|
| 10" & 12" | $29 |
| 14" & 16" | $37 |
| 17" | $45 |
| 19" | $59 |
| 20" & 21" | $70 |

All sets shipped in two cartons to avoid breakage. Sets shipped express to continental U.S.A. and Canada only. F.O.B. Harrison, New Jersey.

**FREE BONUS—RABBIT EARS**

$7.95 Value

FREE with each set purchased

**ATTENTION QUANTITY USERS!**

Big Discounts Are Yours . . . Call or Write For Our 1000 Tube "Private Label" Special! Attention Branding Dept. MGR.

**MONEY CHEERFULLY REFUNDED WITHIN FIVE (5) DAYS, IF NOT COMPLETELY SATISFIED!**

**TRU-VAC® PAYS YOUR POSTAGE**

On orders of $5 or more in U.S.A. and Territories. Send approximate postage on Canadian and foreign orders. Any order less than $5 requires 25c handling charge. Send 25% on C.O.D.'s. All orders subject to prior sale.

Complying with Federal regulations, the following statement appears in all Tru-Vac advertising: Tubes appearing in this ad may be FACTORY SECONDS or USED tubes and are clearly marked.

Write Dept. L For FREE LIST Of Other Tube Types and Products Sold By TRU-VAC®

# TRU-VAC® Electric Company

**Harrison Avenue Box 107 Harrison, New Jersey**
**HUmboldt 4-9770**

Visit Our Huge Testing Dept. In The Heart Of Harrison, N. J.'s Electronics Industry

ward bias on these stages, driving the transistors toward cut-off and reducing their gain.

Stronger signals produce more i.f. voltage at the tickler winding which, in turn, produces more a.g.c. detector output and a more positive a.g.c. amplifier base voltage. This drives the a.g.c. amplifier into stronger conduction causing an increase in current through $R_1$, $R_2$, and $R_3$, producing a greater voltage drop across these resistors, and more positive emitters in the r.f., mixer, and first i.f. stages. This further reduces the receiver gain, which is necessary to keep the volume level at the speaker relatively constant for various signal strengths.

Note that a 1N295 crystal diode is inserted in series with the a.g.c. connection to the r.f. amplifier emitter. This delays the application of a.g.c. voltage to the r.f. stage because the crystal diode offers a high resistance to current flow until the a.g.c. line becomes more positive than the r.f. amplifier side of the diode. At this time, the diode resistance drops and a.g.c. current begins to flow through $R_1$ and the diode, producing a.g.c. voltage at the r.f. amplifier emitter. The delay is desired to keep the r.f. stage operating efficiently over a wider range of signals than the other two stages, which keeps selectivity, image rejection, and signal-to-noise ratio at a high level.

## Audio Detector

After sufficient amplification of the signal is obtained in the i.f. stages, the audio intelligence must be removed or detected from the signal carrier. This is a function of the audio detector stage, such as the one shown in Fig. 6.

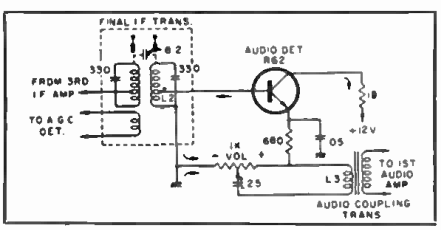



Fig. 6. Simplified audio detector diagram.

The i.f. signal is taken from the last i.f. transformer and applied to the base of the R62 audio detector transistor. Note that there is no forward-biasing network in this circuit and the transistor remains cut off until signal is applied. As signal voltage is developed across secondary winding $L_2$, it is applied to the base of the audio detector. During the half cycle that the base voltage swings positive due to applied signal, the transistor input is driven in the forward direction, causing electron current to flow as indicated by the arrows in Fig. 6.

Since the ground return for the emitter is at the left end of the volume control, both the collector current and base current must flow through the control, producing a voltage at the control as shown. During the half cycle when the i.f. signal reverses polarity at secondary winding $L_2$, the transistor

current cuts off and the voltage drop across the volume control disappears. Thus rectification has taken place but the i.f. component must be removed before undistorted audio detection is completed. This is accomplished by the .05-$\mu$f. emitter capacitor which is connected across the detector load resistance, consisting of the 680-ohm emitter resistor and the volume control. This capacitor is large enough to filter the i.f. pulsation across these resistors but allows the audio signal fluctuations to remain. This audio signal voltage at the volume control is coupled through the 25-$\mu$f. capacitor to winding $L_3$ of the interstage audio coupling transformer, for transfer to an audio-amplifier stage.

This detector circuit offers minimum "loading" of the last i.f. transformer since the transistor input impedance is high when operated with no d.c. forward bias. Further isolation between the i.f. transformer and the detector transistor is sometimes obtained by adding a crystal diode in series with the base lead of the transistor. This added isolation may be necessary in signal-seeking auto radios where any signal dampening at this point may interfere with normal triggering action.

*(To be continued)*

| Sun | Mon | Tue | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|
| | | | | | 4 | 5 |
| | | | | | | 12 |
| | | | | | | 19 |
| | | | | | | 26 |

# CALENDAR of EVENTS

**JANUARY 6-9**

*1960 High Fidelity Music Show.* Sponsored by Institute of High Fidelity Manufacturers. Shrine Exposition Hall, Los Angeles, Calif. Open to public.

**JANUARY 11-13**

*Sixth National Symposium on Reliability and Quality Control.* Sponsored by IRE, AIEE, EIA, and ASQC. Statler-Hilton Hotel, Washington, D. C. Program information available from C. M. Ryerson, RCA, Camden, N. J.

**JANUARY 22-25**

*1960 High Fidelity Music Show.* Sponsored by Institute of High Fidelity Manufacturers. Brooks Hall, Civic Center, San Francisco, Calif. Open to public.

**FEBRUARY 1-4**

*Instrument-Automation Conference and Exhibit.* Sponsored by the Instrument Society of America. Rice Hotel and Sam Houston Coliseum, Houston, Tex. Full details available from ISA at 313 Sixth Ave., Pittsburgh 22, Pa.

**FEBRUARY 3-5**

*1960 Winter Convention on Military Electronics.* Sponsored by IREPGME and Los Angeles Section of IRE. Biltmore Hotel, Los Angeles, Calif. Exhibits, field trips, and papers.

# SHIPPED ON APPROVAL

NEW

## CRT TESTER-REACTIVATOR Model CRT-2


Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD*

**Model CRT-2 $57.50 Net**

TERMS: $13.50 within 10 days. Balance $11 monthly for 4 months.

***NOW*** . . . a TESTER-REACTIVATOR really designed to test, repair and reactivate EVERY PICTURE TUBE MADE — whether black and white or color . . . with exclusive features never before found in picture tube testers.

1. THE MULTI-HEAD (patent pending) . . . A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD — A tremendous advance over the maize of cable and adapters generally found with other testers. Enables you to test, repair and reactivate every type of picture tube with greater convenience than ever before . . . 50 degree to 110 degree types from 8" to 30", whether 12 pin base, 8 pin base, 14 pin base . . . even the very latest 7 pin base. A special color switch on the MULTI-HEAD enables you to test, repair and reactivate each of the red, green and blue color guns separately.
2. WATCH IT REACTIVATE THE PICTURE TUBE — You actually see and control the reactivation directly on the meter as it takes place, allowing you for the first time to properly control the reactivation voltage. This eliminates the danger of stripping the cathode of the oxide coating. It enables you to see the speed of reactivation and whether the build-up is lasting. You will see if the cathode contamination is too great and if the picture tube is too far gone to be reactivated.
3. CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION — Stronger than any found in other testers . . . high enough to really do the job — yet controlled to avoid damage to the picture tube.
4. UNIQUE HIGH VOLTAGE PULSE CIRCUIT — Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.
5. VISUAL LIFE TEST — Enables both you and your customer to see the life-expectancy of any picture tube right on the meter. The fact that your customer can see the results of your tests as you make them virtually eliminates resistance to picture tube replacement when necessary.
6. TESTS, REPAIRS AND REACTIVATES SPECIAL LOW SCREEN VOLTAGE TUBES — Many new type picture tubes use special low voltage of approximately 50 volts. The CRT-2 will test, repair and reactivate these types with the same thoroughness as the regular types with complete safety.
7. SEPARATE FILAMENT VOLTAGES — Including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.
8. TESTS, REPAIRS AND REACTIVATES 'SF' PICTURE TUBES — found in the newest Sylvania and Philco TV sets. These picture tubes have different base pin connections than standard picture tubes and there is always an element of risk that the tube may be burned out when tested with ordinary picture tube testers. The CRT-2 is designed to accommodate this new base pin arrangement and will test the tube with no danger of damage.

The CRT-2 steps in and solves the limitations and shortcomings of present day CRT Testers. Unlike ordinary CRT testers that keep entering the field with a limited range of operation, the CRT-2 employs a new brilliantly engineered circuit designed to test, repair and reactivate every black and white or color picture tube made. The CRT-2 eliminates the guesswork and risk that until now, has always been present when a picture tube is reactivated. It accomplishes this by providing perfect control of either the 'Boost' or 'Shot' method of reactivation.

### THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

**TEST**
- for quality of every black and white and color picture tube
- for all inter-element shorts and leakage up to one megohm
- for life expectancy

**REPAIR**
- Will clear inter-element shorts and leakage
- Will weld opens between any two elements in the tube gun

**REACTIVATE**
- The unique controlled 'SHOT' (high voltage pulse) method of reactivation provided by the CRT-2 will restore picture tubes to new life in instances where it was not possible before. Furthermore the high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- The 'BOOST' method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will improve definition, contrast and focus greatly and add longer life to the picture tube.

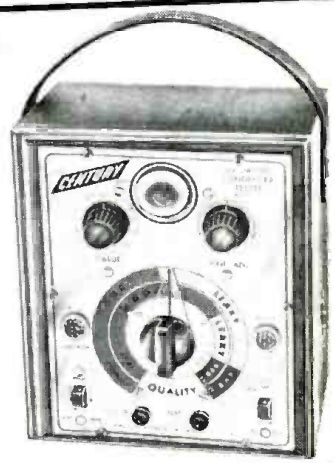
### ADDITIONAL FEATURES

• Employs the time proven dynamic cathode emission test principle • Large 4½" meter with heavily damped movement for smooth action, accuracy and long life • Provides separate shorts test for each element in the picture tube • Filament continuity is shown on a separate glow indicator • An easy to read instruction manual contains all the latest testing information on old and new type picture tubes • Housed in handsome hand-rubbed oak carrying case with special compartment for MULTI-HEAD and line cord.

* patent pending

## IN-CIRCUIT CONDENSER TESTER Model CT-1

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condenser fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.




### *in-circuit checks:*
- Quality of condensers even with circuit shunt resistance . . . (This includes leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

### *out-of-circuit checks:*
- Quality of condensers . . . (This includes leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

### OUTSTANDING FEATURES
- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for every greater accuracy
- Isolated power line
- Housed in sturdy hammertone finish steel case . . . comes complete with test leads

**Model CT-1 $34.50 Net**

TERMS: $9.50 within 10 days. Balance $5 monthly for 5 months.

**EASY TO BUY IF SATISFIED** — *see order form on facing page*

# FOR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

## *NOW* a Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

### WITH LARGE EASY-TO-READ 6" METER —

### *featuring the sensational new MULTI-PROBE* * *Patent Pending*

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

**❶ DC Probe ❷ AC-Ohms Probe ❸ Lo-Cap Probe ❹ RF Probe**

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maize of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

Housed in hammertone steel-case — complete with MULTI-PROBE

### FUNCTIONS

**DC VOLTMETER** . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

**AC VOLTMETER** . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

**ELECTRONIC OHMETER** . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

**RF and LO-CAP MEASUREMENTS** . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

### OUTSTANDING FEATURES

• Completely portable — self powered with long life batteries — permits use everywhere • New advanced pentode amplifier circuit assures amazingly low battery drain • Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s • Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC • Simplified multi-color easy-to-read 4-scale meter • No heat operation assures rigid stability and accuracy • Immune to power line fluctuations • Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments • Meter completely isolated — practically burn-out proof • Hand-crafted circuitry eliminates the service headaches of printed circuitry • 1% resistors used for permanent accuracy • Separate RF ground return for low-loss RF measurement • Microphone type co-axial connector • Matching cover protects instrument face — snaps on and off instantly.

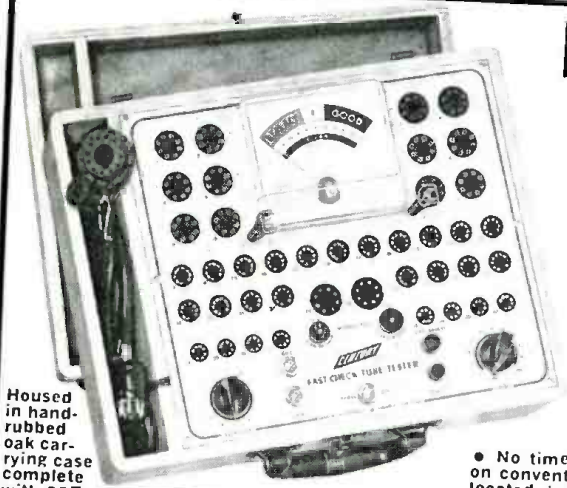
### SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
- AC Volts (RMS and Peak-to-Peak) — 0 to 3/12/60/300/1200 volts
- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- RF — Peak reading demodulator supplied for use on all DC ranges
- Zero Center — available on all DC volt ranges with zero at mid-scale
- Decibels — from —10 Db to +10, 22, 36, 50, 62 based on the Dbm unit: 0Db-1MW in 600 ohms
- Impedance — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- Input Capacity — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

**Model VT-1 $58.50 Net**

TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

## FAST-CHECK TUBE TESTER Model FC-2



Housed in hand-rubbed oak carrying case complete with CRT adapter

**Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!**

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

### PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

### RANGE OF OPERATION

- ✓ Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. 0Z4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✓ Checks for inter-element shorts and leakage.
- ✓ Checks for gas content.
- ✓ Checks for life-expectancy.

### SPECIFICATIONS

• No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers • No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement • Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale • 41 phosphor bronze beryllium tube sockets never need replacement • 7-pin and 9-pin straighteners mounted on panel • Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out • Special scale on meter for low current tubes • Compensation for line voltage variation • 12 filament positions • Separate gas and short jewel indicators • Line isolated — no shock hazards • Long lasting etched aluminum panel.

***NOTE:*** The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

**Model FC-2 $69.50 Net**

TERMS: $14.50 within 10 days. Balance $11 monthly for 5 months.

## CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

**ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR**

**The extremely low prices are made possible because you are buying direct from the manufacturer.**

## CENTURY ELECTRONICS CO., INC.

### *CHECK INSTRUMENTS DESIRED*

- ☐ Model CRT-2 CRT TESTER REACTIVATOR ..... $57.50
  $13.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model CT-1 In-Circuit Condenser Tester ..... $34.50
  $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter ..... $58.50
  $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester ..... $69.50
  $14.50 within 10 days. Balance $11 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

111 Roosevelt Avenue, Dept. 201, Mineola, New York

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name .....

Please print clearly

Address .....

City ..... State .....

## What Set Owners Think

*(Continued from page 49)*

has obviously been influenced by the fact that the industry has traditionally underestimated its own worth. What other guide does he have for determining a fair price? A rather high number of set owners (17 per-cent) admit they do not know what a fair price is. Also, they seem to be getting suspicious of the lower prices (Table 7) characteristic of "bait" advertising. Firmness on the part of the service shop may work better than indecision: a "compromise" fee ($2.50, $3.50, $4.50, etc.) does not seem to re-assure the customer as much as a flat figure that is fifty cents higher! Whatever the price may be, few set owners (11.3 per-cent in Table 3) are likely to gripe about it. In fact, a few think charges are not high enough. There is very little reason for any professional to delude himself with the thought that he can add much volume by pricing himself out of business.

The gloomy specter of the "drug-store" checker is not a mere fancy, according to Tables 8 and 9. Most people have never bothered with them, but the minority that has (35.8 per-cent) is quite substantial. Fortunately, this figure seems to be somewhat higher than the national average. *Tung-Sol's* merchandising manager, Robert M. Andrews, estimates that 12 per-cent of tube sales are through vending machines nationwide. Some comfort is provided by the fact that more than one-third of the people who had used such testers were not satisfied with the results. This means that, of all persons interviewed whether they had used such testers or not, only about 23 per-cent were satisfied. The principal reason given for dissatisfaction was "not accurate." Thus, although the drug-store tester has made serious inroads on tube sales by service shops, the practice is vulnerable. It is noteworthy that many consumers indicated they used the non-professional outlets only when regular service shops were closed, as on weekends or holidays.

Another point on these testers: not all who are "satisfied" involve lost business to shops. Where the checkers indicate that no tubes are defective, the set owner may turn to other channels while still feeling he has received a fair deal. Although complacency is a mistake, there is a clear limit to how much checkers can do and how much business they can take away.

The first general conclusion we may draw is that the independent service industry has one great Achilles' heel: a great deal of the business on which it must rely is being siphoned off in other directions. On the other hand, there is far less consumer resistance to its practices and prices than it realizes. In addition to continuing to render honest and competent service, it must be more confident and aggressive than in the past in insisting on realistic charges, in promoting its own stature in the eyes of the public, and in articulating the point that it should be the first resort, rather than the last, when sets need service. In short, act like a professional if you want to be treated like one. —30—

**10** Sets under Warranty

| RESPONSE | PER-CENT |
|---|---|
| Yes | 15.5 |
| No | 70.8 |
| Don't know | 13.7 |

**11** Ownership of TV Insurance

| RESPONSE | PER-CENT |
|---|---|
| Yes | 10.7 |
| No | 80.8 |
| No answer | 8.5 |

**12** Multiple Ownership of Sets in Family

| NUMBER OF SETS | PER-CENT |
|---|---|
| 1 | 75.8 |
| 2 | 23.7 |
| 3 | .5 |

**13** Types of Sets in Use

| MODEL | PER-CENT |
|---|---|
| Console | 56.2 |
| Table model | 25.4 |
| Portable | 9.3 |
| Combination | 9.1 |

## 20-Watt Amplifier

(Continued from page 60)

for 15 watts; and 2.7% for 20 watts. These figures are high compared to the 1% figures that we were able to obtain from many of the individual high-power amplifiers during the pre-stereo days. The results in this case, however, are not a true indication of the IM distortion alone as other factors are actually included in such a measurement.

IM distortion measurements are a deep concern to the industry at present. The new Institute of High Fidelity Manufacturers standards for testing amplifiers have excluded IM distortion tests for the time being. Their hope is to provide time for further analysis before additional standards are determined. (See page 51.)

Basically, the 60- and 6000-cps frequencies are the customary ones to use, but any combination of any two frequencies in the audio range could be applied. IM distortion figures would vary considerably depending on the combination used, and the 60-cps signal provides an extremely severe test, particularly for integrated amplifiers of today. For amplifiers having a flat frequency response from 30 to 15,000 cps at maximum power output, the 60-cps characteristic is not severe. However, for the more economical integrated packages, saturation of the iron of the output transformers does occur at the frequencies below 100 cps (depending on the design) resulting in loss of power output at the low end. The IM distortion figures in such cases now become a characteristic that combines erroneously the IM distortion with the characteristic of loss of power output at low frequencies. Suffice it to say that this is a problem at the moment and we will reserve decision until later as to whether we will continue taking IM distortion measurements.

The kit is not difficult to assemble if one follows closely the detailed construction manual. We actually assembled the kit in 13½ hours. This may seem like a ridiculously low figure to many. However, things seemed to click off rather rapidly so that we did not run into any lost motion.

We know of another case where this kit was built in 18 hours and this may be a more realistic average figure. We did run into one unusual problem. The multi-deck selector switch, as it turned out, had one of its decks rotated 180 degrees. This was a mis-assembly on the part of the supplier of the control switch. We feel sure that this is an unusual situation and the chances are one in a thousand of its recurring. We had no other problems with the unit. In our opinion this integrated amplifier will provide true high-fidelity performance.

The kit is available for $79.95 and a factory pre-wired version is available at a price of $129.95. —30—

"Rush Suppressor"
(*Continued from page* 41)

rush-level which was used as a reference point in setting the operating point of the relay. The d.c. across the relay is now at its maximum, causing it to energize. The speaker is now on and operating.

Once the relay receives enough voltage for operation, the long time-constant of the circuit created by $C$ holds the relay in during entire words and short pauses. During extended pauses, the speaker is silent. Resistor $R$ was added to increase the amount of available voltage for relay control and, with the resistance shown, does not seriously affect the amount or quality of audio on the speaker. It also serves as a load for the voice-coil winding when the speaker is off.

A single-pole, single-throw switch was added to disable the voice-control circuit. This is not absolutely necessary, but it does free the volume control for normal use once communication has been established.

The particular relay used is a surplus item with a d.c. resistance of 2200 ohms and, in actual operation, would energize with 1 ma. and release with .75 ma. Any sensitive relay with similar characteristics will work satisfactorily.

Location and mounting of components is not at all critical and may be accomplished wherever there is room. The top view photograph shows the location of the additional circuit components. The only reason for mounting the relay as shown was to provide access to receiver and transmitter tuning adjustments. Much smaller relays are readily available and they could be mounted directly on the chassis. It can be seen from the front-panel view that the squelch disable switch is a rotary canopy type mounted between the two neon lamps, thus retaining the symmetry of the front-panel layout.

This circuit has been in use eighteen hours a day for some time with the transceivers operating over a four-mile air path with excellent results. The circuit is not critical to adjust and can be applied to most superregenerative receivers with a minimum of chassis and front-panel disfiguration. At last, a quiet superregen! —30—

# TRANSISTOR ALARM GENERATOR

By DAVE STONE

HERE is a useful and interesting circuit which produces pulses of audio tones at intervals of less than one-per-second to about eight-per-second. When it is connected to an audio amplifier the resulting output sounds like a series of "beeps" much like the busy signal on the telephone, or "whoops" similar to the emergency call which summons crews to combat stations aboard a battleship.

The self-quenched superregenerator is an old standby in the radio-frequency range. Feedback for regeneration is obtained from the split primary winding of the audio output transformer (*Triad* A-65J) and the circuit produces a normal audio tone at a frequency determined by $C_2$'s capacity and the primary inductance of $T_1$. It is approximately 600 cps with the values indicated on the schematic.

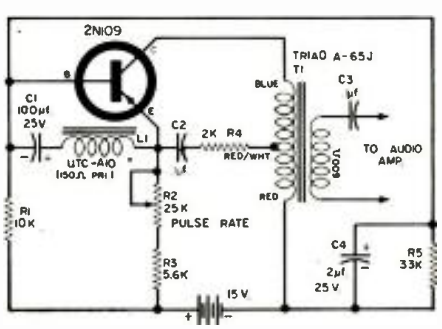
$C_1$ is connected so as to provide cut-off bias to the base-emitter circuit when it has sufficient charge. During oscillation it charges high enough to "quench" the oscillator and when no oscillator current is flowing, discharges until the cut-off bias is reduced and the circuit begins to oscillate again. The "tone-on," "tone-off" action is repeated at a rate determined by the values of $C_1$ and $L_1$. The "Pulse Rate" control, $R_2$, changes the bias and charging conditions which, in turn, affect the repetition rate.

The values of $C_1$ or $L_1$ can be altered to obtain faster cycling—up to a rate of about fifteen-per-second, if desired. The optimum values for $L_1$ were found to lie between 500 to 700 millihenrys. The 50-200 ohm windings of a low-to-high-impedance transformer—such as the mike-to-grid or line types—will fill the bill. Several transformers of this type were measured and the low-impedance windings were within the desired inductance range. The *UTC* A-10 audio transformer provides several low-impedance combinations.

The tone of the audio frequency can be varied by changing the value of $C_2$—the larger the capacitor, the lower the tone while a smaller capacitor will produce a higher frequency output. $C_3$ and the 600-ohm secondary of the A-65J transformer will work well into a moderate- to high-impedance p.a. system input.

Use this stage to generate an alarm or warning signal with the higher pulsing rates. A burglar alarm relay can be connected to apply power to the alarm generator when it is activated. The resulting noise is guaranteed to command attention. Use it as an audible "count-down" signal over the p.a. system, by adjusting the pulses to exactly one-per-second. —30—

Complete schematic of alarm generator. All parts are standard, intervals are adjustable.



# What's New in Radio

### PRIVATE PLANE RADIO

*King Radio Corp.*, 9700 W. 75th St., Merriam, Kansas has developed a new 10-watt transmitter-receiver which is

designed to provide light, medium, and executive planes with airline communications power.

Available with either 14-volt or 28-volt power supply, this 90-channel unit is compact and lightweight. Designed for easy custom panel installation, simply by the removal of faceplate, the KY-90 is only 3" high, 6½" wide, and 8" deep. The complete unit, including power supply, weighs only 8 pounds.

The power supply/modulator is completely transistorized with line filter to minimize radio interference. Both side tone and mike gains are adjustable from the front panel.

### NEW SSB RECEIVER

*Hammarlund Manufacturing Company, Inc.*, 460 W. 34th St., New York 1, N. Y. has announced the development of a new communications receiver which offers SSB tuning plus full dial coverage from 550 kc. to 30 mc.

The HQ-180 is entirely self-contained, with its own power supply and

requires only the addition of an external speaker or earphones. The circuit is an 18-tube superhet with automatic noise limiter. It is triple conversion from 7.85 to 30 mc. and dual conversion from 540 kc. to 7.85 mc. It offers the operator a choice, or combination, of slot filter, selectable sideband, tuned i.f., bandspread and separate linear detector in tuning the desired sideband signal.

A new high-frequency crystal filter is used at 3035 kc. to improve selectivity and shape factor of the first i.f. amplifier. The slot filter is adjustable ±5 kc. over the passband for up to 60 db attenuation.

The new receiver is designed for amateur, commercial, or military SSB operation. It is available in either cabinet or rack-mounted versions.

### POCKET V.O.M. KIT

*Allied Radio Corporation*, 100 N. Western Ave., Chicago 80, Ill. has just released a low-cost, pocket-sized v.o.m. which is hardly larger than a package of cigarettes.

The new unit reads in 13 ranges at 1000-ohms-per-volt d.c. sensitivity. The ranges are d.c. volts 0-5-15-50-150-500; a.c. volts 0-15-50-150-500; d.c. milliamps. 0-1-10-100; and ohms, 0-30,000 (1200 ohms mid-scale).

The instrument has a front-panel zero-adjust, 2½" meter with two-color scale, and 5% shunts and multipliers. Only 2⅜" x 3¾" x 1½" when assembled, the kit comes complete with battery and test leads. It is catalogued as Stock No. 83 Y 708.

### TRANSISTORIZED POWER SUPPLY

*Barker & Williamson, Inc.*, Bristol, Pa. is now offering a new standard line of transistorized d.c. converters and an inverter.

The converters include 25-, 60-, and 120-watt models. The 25-watt inverter delivers 115 or 26 volts at 400 cycles. All operate on 12- to 14-volt d.c. input.

Small in size and lightweight, the new units are designed to withstand severe environmental conditions. Current drain is small and the absence of moving parts eliminates wear.

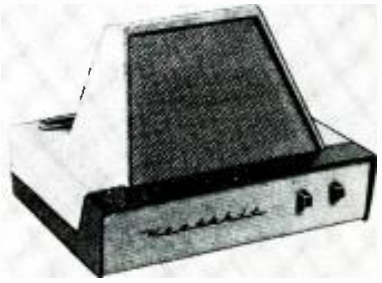
Applications for the converters include mobile communications, Citizens Band radios, marine radiotelephones, and aircraft radios. The inverter can be used for synchro position indicators, gyro instruments, remote indicating compasses, and other aircraft and marine instruments.

### TRANSISTORIZED INTERCOM

*Heath Company*, Benton Harbor, Mich. is now offering an all-new transistor intercom system which is available as master and remote stations separately.

The master unit (XI-1) can call any one remote station, any combination, or up to five if desired. Any remote station (XIR-1) can turn the system on and initiate a call to the master; once the master replies to a call, control of the system is taken over by the master and the remote unit need not be touched.

The circuit is completely transistor-



ized for instant operation and low battery drain. The intercom is powered by eight inexpensive "C" flashlight batteries that provide up to 300 hours of normal "on" time. The 4½", 45-ohm PM speakers serve as both microphone and speaker on all stations.

For complete details and prices on these new kits, write the company direct.

### ANTENNA MIXING NETWORKS

*Jerrold Electronics Corporation*, 15th and Lehigh Ave., Philadelphia 32, Pa. has developed a new series of antenna mixing networks which will permit multi-channel, all-direction reception simultaneously.

According to the company, the new low-loss, high-isolation TX models eliminate the need for rotors and switches normally required to bring in TV signals. With the TX series, multi-set homes are no longer limited to receiving only the channel or channels whose reception hinges on the direction the rotor faces.

One of the new units, the TX-FM, permits the connection of a TV set and an FM receiver to a single antenna without loss of signal to either set. The Model TX can be used individually or in any combination to mix cut-to-channel antennas with a single broadband antenna; separate individual channels from broadband antenna; mix or separate v.h.f. TV and FM signals; act as a splitter to feed v.h.f. TV signals to TV receivers; and FM signals to FM receivers from a single broadband antenna.

The components are housed in unbreakable plastic cases and use universal mountings.

### NEW EMC V.O.M.

*Electronic Measurements Corp.*, 625 Broadway, New York 12, New York is now offering a new model v.o.m. which is available in both kit and wired forms.

The Model 109 incorporates a 40 μa., 4½" meter and features an a.c. voltage sensitivity of 10,000 ohms-per-volt. There are five d.c. voltage ranges (up to 3000 volts) at a sensitivity of 20,000

ohms-per-volt; five a.c. voltage ranges to 3000 volts; three a.c. and d.c. current ranges; and three resistance ranges to 20 megohms.

The circuit is housed in a high impact molded Bakelite case. Write the manufacturer for prices on either or both versions.

### FM TEST OSCILLATOR

*Heath Company*, Benton Harbor, Mich. has just introduced a test oscillator kit which has been especially designed for FM servicing.

The Model FMO-1 covers all frequencies for r.f., i.f., and FM detectors; features 100 kc. bandwidth markers; a 10.7 mc. crystal marker; 10 mc. calibrating crystal; and incorporates a variable-width sweep oscillator.

The circuit is housed in a single compact, easy-to-use case and comes with

test leads. All test frequencies (except the sweep circuit) are fixed, assuring frequency accuracy dependent only on the actual accuracy of the coils and their initial alignment.

### SILICON POWER RECTIFIER

*Westinghouse Electric Corporation*, P.O. Box 2088, Pittsburgh 30, Pa., is now offering a new silicon power rectifier for high-current, high-voltage applications.

The Type 439 can provide up to 240 amperes of forward current per cell with maximum peak inverse voltage ratings up to 600 volts. Maximum reverse leakage current is 50 ma. at the rated peak inverse voltage.

The unit may be operated at up to 190 degrees C at the junction. It features a solid copper base for ruggedness and small size (maximum cell length 3" and over-all weight 8 oz.).

A hermetically sealed cell, this power rectifier is nickel-plated to maintain low contact resistance and to prevent corrosion. Ceramic insulation between the anode and cathode provide a greater creepage distance than previously available on this type of silicon rectifier. Details on request. —30—

## Within the Industry

*(Continued from page 26)*

ratio for such system is given by systems using suppressed carrier amplitude modulation. This applies to some six system proposals. However, it does not apply to one other proposal which does not suppress the carrier but would result in an appreciably simpler stereo receiver. The evaluation of relative receiver complexity for these systems would be made by the receiver panel of the NSRC.

Bruce T. Bogert, *Bell Labs*, and Norman Parker, *Motorola*, head a separate study group to evaluate, on a theoretical basis, the relative merit of FM or AM subcarrier for FM stereo broadcasting.

B. F. Tyson, *Sylvania Electric Products Inc.*, was asked to bring his classification of AM systems up-to-date so that they can be evaluated in the near future. It was further decided that the value of an *EMI* proposal should be determined by comparison listening with other systems.

* * *

**RAY LANE** has been appointed to the post of director of research and engineering for *Pyramid Electric Company*.

Mr. Lane was previously associated with *F & B Manufacturing Company* and *Ajax Condenser Corporation*. He has also served with *Solar Manufacturing Co., Western Electric Co., Westinghouse E & M Co., Fada Radio Co.*, and *Micamold Radio Corp.*

In his new position, Mr. Lane will be responsible mainly for the development of new capacitors for the avionic and consumer products markets.

* * *

**RADIO KITS, INC.** has changed its name to **ARKAY INTERNATIONAL, INC.** The officers and directors remain the same . . . **INTERNATIONAL RESISTANCE COMPANY** and **CHICAGO TELEPHONE SUPPLY CORPORATION** have reached an agreement whereby the former firm becomes sales representative for the latter company's industrial and military variable resistor products in five major marketing areas . . . **ARTLOOM INDUSTRIES, INC.** has acquired **EASTERN PRECISION RESISTOR CORPORATION.** Present management will be retained with Martin Green as president of the electronics manufacturing company . . . **THOMPSON RAMO WOOLDRIDGE INC.** has acquired **BEL CANTO STEREOPHONIC RECORDINGS, INC.** Russ Molloy, formerly executive director of the recording company, will serve as president of the new subsidiary . . . **G-C ELECTRONICS COMPANY** has purchased **ELECTROCRAFT, INC.** The company will be moved to Rockford, Illinois and will be operated as a division of the parent concern. —30—

# Product Report

ELECTRONICS WORLD LAB TESTED

## VOCALINE CB TRANSCEIVER

A HIGHLY sophisticated Citizens Band transceiver incorporating a double-conversion receiver section, conservatively rated transmitter, and an unusual squelch circuit is being offered by the *Vocaline Company of America, Inc.* Trade-named the "Commaire Model ED-27," this new unit is designed for optimum single-channel operation. Current production models are being shipped with the transmitter and receiver preset for channel-12 operation.

Tuning up the "Commaire" is a simple, positive operation. The loading indicator for the pi-network is a small dial lamp in series with the antenna. Although positioned in the rear of the cabinet, a Lucite rod directs the light to a bull's-eye on the front panel. Using a *Vocaline*-recommended antenna, the whole tune-up operation can be performed in just about 30 seconds.

On the air, the "Commaire" is distinguished by a healthy sounding signal with clean, full modulation. However, it is on "receive" that the "Commaire" really shines. The double-conversion superhet offers extremely good selectivity, a highly desirable characteristic in areas where a large number of stations are on the air. In our tests, a mobile unit operating on an adjacent channel could not be heard although it was only 100 yards away. Sensitivity is in keeping with the best design qualifications and seems to work hand-in-glove with the "Vocatron" squelch circuit, giving the feeling that the background noise level floats and that the weakest readable signal will easily open the squelch. This operation contrasts with many squelch circuits that operate on the block-busting principle. The delicacy and effectiveness of the squelch in the "Commaire" has to be used to be appreciated.

In normal operation—fixed station with ground-plane antenna to mobile unit—in and around metropolitan New York City, the full-reliability range was between 5 and 7 miles. Receiving range for the fixed station (as opposed to the mobile unit with inherent ignition and road static problems) was a surprising 15 miles.

The receiver section uses a 6BJ6 slug-tuned r.f. stage followed by a 6U8 mixer and 31.0-mc. oscillator. The frequency of this oscillator is crystal-controlled and is not changed when the "Commaire" must be set up on a new channel. The output from the 6U8 mixer (for channel 12 it would be 3895 kc.) is then fed to a 6BE6 second mixer,

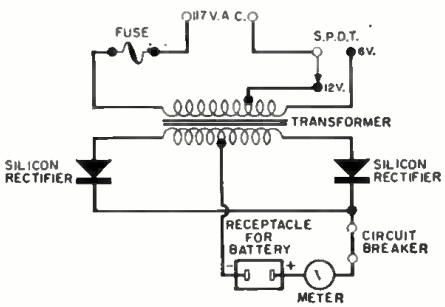
affording double conversion down to 455 kc. The elimination of the receiver crystal interchange is accomplished by slug-tuning the input to the 6BE6 mixer. By varying this "fine tuning" adjustment the receiver section easily covers the entire Citizens Band with only one receiving crystal. The second mixer is followed by a conventional 455-kc. i.f. stage, 6AL5 detector and noise limiter, two stages of audio (6AQ6 and 6AQ5) and the patented "Vocatron" squelch circuit.

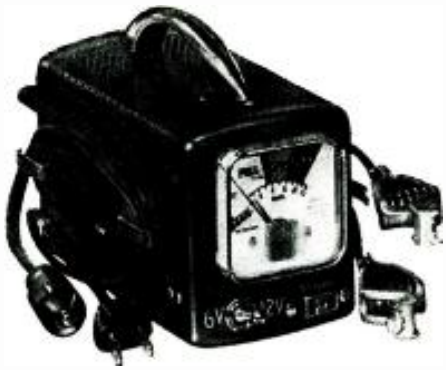
The transmitter utilizes a 6AQ5 crystal oscillator driving a conservatively rated 5763 power amplifier. The triode section of a 6AQ6 and a 6AQ5 pentode Heising-modulate the power amplifier. Silicon rectifiers and power transistors are used in the combination (117-volt a.c. and 12-volt d.c.) power supply. On a.c. the power supply is a voltage-doubler and on battery input the plate voltages are generated by a transistorized push-pull oscillator. —30—

## "SUPER CHARGER"

ONE of the most compact and effective battery chargers that has recently been called to our attention is *Terado Company's* Model 50181 "Super Charger." This is the deluxe version of the manufacturer's line of storage-battery chargers.

It is only 3 x 5 x 6 inches in size and incorporates a meter that shows charging current along with a scale showing the approximate condition of the battery. The unit has a maximum charging current of 10 amperes and it can





be used to charge 6- or 12-volt batteries. Two miniature silicon rectifiers are used in a full-wave circuit and the unit is equipped with an automatic overload circuit breaker.

The charger is sufficiently small in size and light in weight to make it ideal for use on small boats. An additional cable is supplied so that it can be plugged into the cigarette lighter receptacle of a boat or automobile, eliminating the necessity of making connections across the battery.

The unit lists at $39.95 and is available at automotive distributors throughout the United States. —30—

## AM TUNER KIT

FM radio, with its excellent frequency response and static-free reception, is usually considered to be the true broadcasting medium for high-fidelity sound reproduction in the home. However, there are many areas not covered by FM and there are many individuals who still prefer AM broadcasting for special newscasts or specific programs. This type of transmission, of course, has its limitations. The high-frequency response available from many stations does not exceed 5 to 7.5 kc. There are exceptions of course, as some stations do provide better high end performance than this indicates. Also, static disturbances and other noises are sometimes a problem. Not much can be done about either of these except to produce a receiver which will provide the best reproduction under these limitations.

With this thought in mind *Electronic Instrument Co., Inc.* (*EICO*) has recently placed on the market a high-fidelity AM tuner, the Model HFT-94. In addition to its generally high-quality performance, it features a choice of either wide or narrow bandpass. The latter is useful for the reception of low-power or distant stations.

The performance results obtained from one of the kits we assembled were as follows:

*Tuning range:* 545 to 1650 kc.

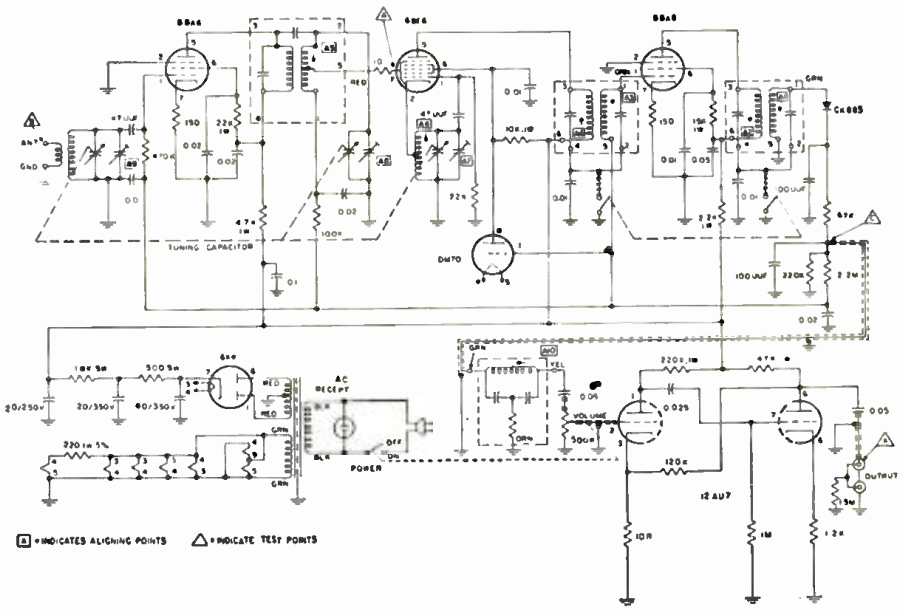
*Frequency calibration:* 20 kc. low at 1600 kc., and 5 kc. low at 550 kc.

*Over-all selectivity (−6 db):* for wide bandpass, ±7.35 kc., and for narrow bandpass, ±4.2 kc.

*Frequency response (assuming −3 db at extremes):* for wide bandpass, 15 cps to 9 kc., and for narrow bandpass, 15 cps to 5 kc. Note that for wide bandpass operation the highest modulation is 9 kc. This is just short of the 10-kc. AM channel separation. This tuner incorporates a whistle filter which eliminates (by a 20 db gain reduction) any between-station beat note.

*Usable sensitivity (assuming 20 db of quieting):* for wide bandpass, 7 μv., and for narrow bandpass, 3 μv.

This AM tuner is completely a.c. operated, employing 6 tubes and a special DM70 type tuning eye. Output is a plate-follower type, having an impedance of 8000 ohms.



*Sensitivity for 1 v. output:* for wide bandpass, 4 μv., and for narrow bandpass, .3 μv.

The construction of the unit is extremely simple. The r.f. and i.f. coils are supplied pre-aligned and the antenna, r.f., and oscillator trimmers are all pre-set. This does, in a way, eliminate the need for test instruments to align the receiver for satisfactory operation. Needless to say, due to variations of lead placements by one building a kit, a final alignment, with proper test equipment, will provide the final touch to obtain perfection in performance.

With negligible hum level and distortion, this new tuner is one of the best available for its price. It is offered in both kit and assembled versions at $39.95 and $65.95, respectively. —30—

## MARS SCHEDULES FOR JANUARY

THE First Army MARS SSB Technical Net, which operates on 4030 kc. upper sideband, Wednesdays at 9 p.m. (EST), has announced the following speakers for January.

Jan. 6—"The Atomichron" by Philip Heath, manager, field service engineering department, National Company, Inc.

Jan. 13—"Antenna Multi-Couplers" by Carl G. Southeimer, executive vice-president, CGS Laboratories.

Jan. 20—"Television and the Amateur Operator" by G. G. Lentzakis, chief instructor, TV course, radio division, USASCS, Fort Monmouth.

Jan. 27—"Basics and Applications of Re-Enforced Plastics in Communications Products" by Walter H. Greenberg, director of research, and J. Harvey McCoy, staff engineer, Riverside Plastics Corporation.

Director of the net is S. Edwin Piller, A2KPQ. Contact him at 157-32 20th Ave., Whitestone 57, N. Y. for any further information required.

The 100-millionth packaged electronics circuit, a development which helped open the way to miniaturization of electronic equipment for space rockets, is presented to David R. Hull of Washington (left), president of the EIA, by William S. Parsons of Milwaukee, president of Centralab, a division of Globe Union, Inc. The tiny circuit, less than two inches long is mounted at the center of the plaque shown.

# Manufacturers' Literature

### 1960 HEATHKIT CATALOGUE

*Heath Company,* Benton Harbor, Michigan, is now mailing copies of its 1960 catalogue of kits. Copies are available without charge upon request. Write to the company at the above-mentioned address.

A full-color, hard gloss cover brochure, it contains over 66 pages of electronic equipment in kit form, including high-fidelity components, test instruments, amateur radio gear, marine equipment, and hobby kits.

Spotlighting the high-fidelity section are three new stereo amplifiers and the new acoustic suspension speaker system, licensed in kit form exclusively by *Acoustic Research, Inc.* to the Michigan firm.

New in the ham radio line this year are a complete mobile rig, a kilowatt linear amplifier and power supply, and 6-and 2-meter conversion kits.

The test instruments section features an r.f. signal generator, an FM oscillator, and a new 5" d.c. oscilloscope.

A complete line of marine equipment is featured, including transistor radio direction finders and a host of accessories for safety and convenience afloat.

In the special interest category are a new educational electronic analogue computer and a new, improved electronic ignition analyzer, available in pre-assembled, ready-to-use form or as a kit.

### NEW TECHNICAL JOURNAL

*Tung-Sol Electric Inc.,* semiconductor division, has announced publication of the first issue of a new semiconductor technical journal entitled, "The Lattice."

Complimentary subscriptions may be obtained by design engineers writing on their company letterhead to Department A, 1 Sumner Ave., Newark, N. J.

Published principally for use by design engineers interested in solid-state devices, "The Lattice" will be devoted entirely to the theory and practice of the semiconductor art.

### CLOSED-CIRCUIT TV

*General Electric Company's* communication products department has published a new bulletin (GEA-6842 & ECL-74) describing the use of closed-circuit television for instantly transmitting high-resolution pictures of opaque or transparent weather charts, maps, and drawings from a central weather office to a number of remote receiving locations.

The bulletin explains how the equipment may be used at weather stations, air bases, and by the military. Performance data, dimensions, transmission system, remote receiving positions, and other specifications are given.

Write to the company, Closed-Circuit Television, Electronics Park, Syracuse, N. Y., for a copy.

### SEMICONDUCTOR DIRECTORY

*Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N. Y., is offering a new semiconductor directory, free of charge.

This listing is designed to give the engineer and scientist a comprehensive, easy-to-use listing of the latest in germanium transistors, silicon transistors, diodes, and rectifiers. All major manufacturers and types are numerically listed, complete with descriptions and applications.

The directory is suitable for loose-leaf insertion.

### COLOR TV

*International Correspondence Schools,* Scranton, Penna., has issued a new correspondence course entitled, "Trouble Shooting Color Television Receivers."

Written by Donald C. Freeman, assistant to the national electronics service manager, *Admiral Corporation,* the course includes a simplified circuit description plus troubleshooting procedures for each stage in color television receivers.

The 150-page book contains 68 illustrations. Write the school for details.

### SEMICONDUCTOR DIODES

*Sylvania Electric Products Inc.* has released a new characteristics and replacement guide for semiconductor diodes. Copies of the booklet may be obtained direct from the company, 1100 Main Street, Buffalo 9, N. Y.

The 13-page brochure contains complete data on the ratings and electrical characteristics of all of the firm's types as well as a replacement guide to virtually all Electronic Industries Association registered diodes.

The new booklet also features a section on the company's latest diode manufacturing equipment.

### NATIONAL BULLETIN

*National Radio Co.,* Malden, Mass., has announced the availability of a new catalogue covering sockets, caps, and terminals. The new bulletin, No. 59-4, is available to purchasing agents and engineers by writing direct to the company.

The new catalogue, which is four pages, two-colors, describes and gives specifications for the various components and assemblies available for radio and electronic applications. —30—

## Direct Mail Promotion

(Continued from page 57)

Less than five per-cent of the people who pass your shop pay any attention to the kind of business it is. Tell them about your shop and your equipment. Invite your customers in to see the facilities you have for keeping their TV sets and other electronic products in top operating condition.

2. Early spring special. With the budding of the leaves, people start to think about picnics, hours outdoors in parks and on the beach. Tell them they need their portables checked to be sure they are in peak condition when they are needed. (You should start to work on your spring business-promotion pieces and plans in January.)

3. Late summer, early fall. At this season, people start staying indoors more. Ahead of them are long hours before the TV set: a succession of interesting events climaxed by special programs during the Christmas season. This is the time to urge them to have their TV and radio sets checked for top performance. (Start to plan your fall programs in June.)

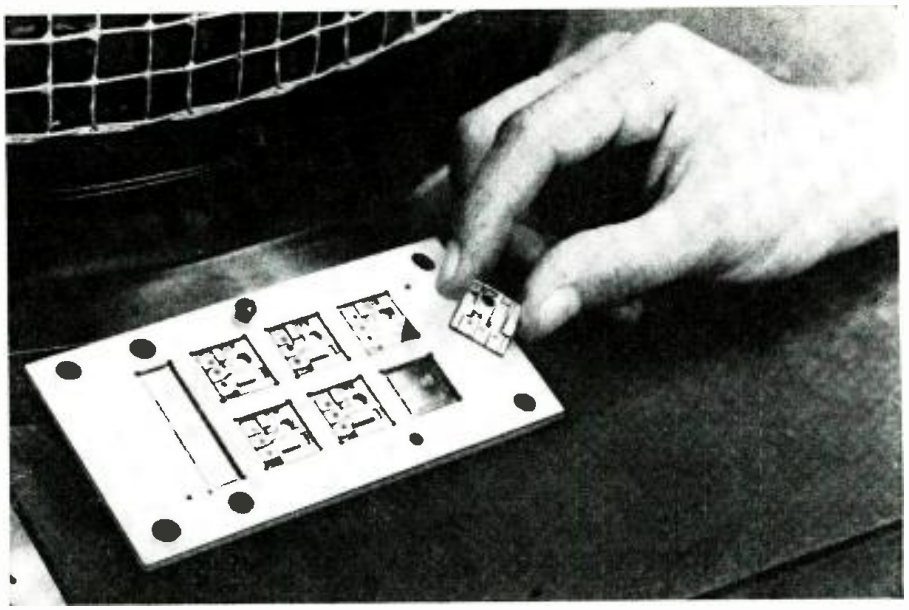
4. Have you ever seen anyone who was 100 per-cent satisfied with his TV reception? Occasionally take a shot in the dark. Suggest that your facilities will enable you to brighten his TV picture, remove annoying flicker, etc. It is amazing how many people put off a maintenance check-up, which they know a set can use, until they need total service. Often a simple promotion piece will trigger an owner's unexpressed desire to have his TV set serviced before it goes out completely. And don't forget the bonanza that is gradually building up in FM.

5. Community events offer the service dealer a golden opportunity to solicit business while identifying himself as an active participant in community affairs. They help to make people aware of the fact that you are a solid citizen, their neighbor, and a worker in the community.

Here are the major points to bear in mind when planning a long-range, business-building campaign by direct mail:

1. Set up your program to run for at least twelve months. 2. Arrange to handle the mechanics of the mailings so the program will move smoothly. 3. Plan to use a new mailing piece every two months. If you are unable to prepare copy for your own individual business, get one of the complete mailing campaigns that are available from the tube manufacturers. 4. In addition to your own customer mailing list, try to get a residential directory so you can focus your mailings in your normal or economical working area. 5. Set up the mechanics of your system to mail approximately fifty pieces per day. (This is based upon the business needs of a one-man shop.) 6. Carry out your program with dogged determination.

—30—



Partly completed "micro-Circuits" are shown in holding fixture used in manufacturing.

# Micro-Circuits for Miniaturization

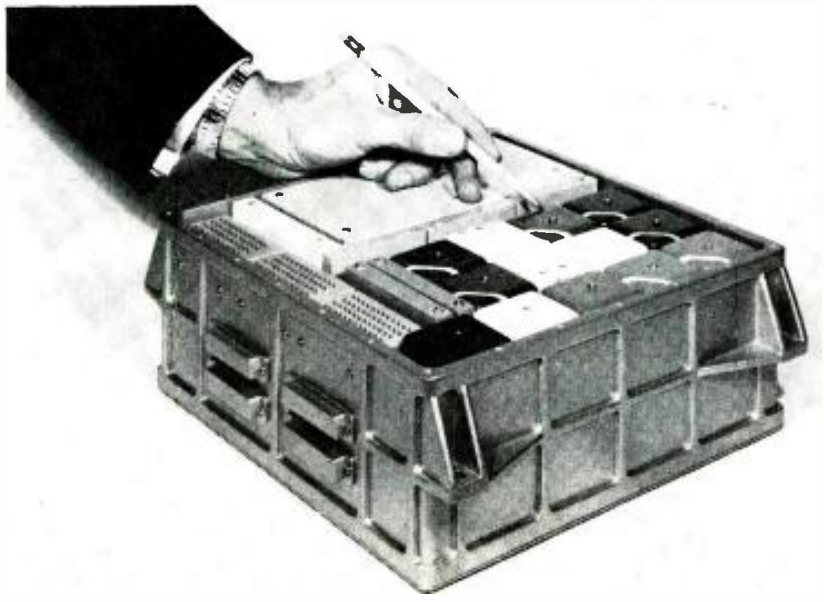
## New circuits used in missile-borne computers employ thin films of component material deposited on glass.

ELECTRONIC miniaturization, the goal of ever-smaller component parts for electronic assemblies, has taken a step forward with the perfection and practical use of "micro-Circuit" by *International Resistance Co.* Although "micro-Circuit" was specifically designed to fill an urgent need in *ARMA's* missile-borne computer program, it will find many other important applications.

The secret of the "micro-Circuit" is the deposition of exceedingly thin films of component material on a tiny substrate of glass, smaller than a postage stamp. Glass was chosen as the base material, in preference to ceramics or plastics, because of its structural strength and exceedingly smooth surface. This smoothness assures greater accuracy of component values, and adherence to more rigid quality specifications generally. Resistive, capacitive, and inductive components are now being made using the new technique having value tolerances of plus-or-minus 5 per-cent. Even at the present state of the art these tolerances could be closer if required.

Such "micro-Circuits" are not in the laboratory, but are fully integrated into presently operating equipment. One example of such equipment is shown in the photo below. —30—

New circuits have been designed for use in new compact military digital computers.



## Mac's Service Shop

(*Continued from page 68*)

and the set played. 'Aha, a bad selenium rectifier,' I told myself. After I finally found the rectifier tucked away on top of the tuning capacitor, I replaced it with a silicon unit and the proper additional surge resistance. Then I reduced the line voltage to 95 volts and plugged the set in. It played but, as I began increasing the line voltage, distortion started. At the same time, I noticed the filaments seemed to be burning brighter than they should. A check with the voltmeter revealed two volts across each one where there should have been 1.5 volts.

"At this point I happened to pick up the back of the set and glance at the very small printing on the label—no wonder most Japanese wear glasses!—and saw that the receiver was rated at 100 volts! I replaced the original selenium rectifier, set the line voltage at 100 volts, and checked the voltage across the filaments. It was a little below 1.5 volts, but the set would not play. I called some of the boys at the local radar station who were formerly in Japan, and they confirmed that 100 volts is a common nominal line voltage in Japan. In fact, less than 100 volts was usually present.

"What had happened was all too plain: when the lady plugged the set into her 120-volt line, it played for a short while; but the excess current soon paralyzed the tubes and prematurely aged the selenium rectifier, and the set quit. When I put in a new rectifier, this pushed the filament voltage still higher, and the set started to play; but it would not have done so for long because those poor filaments would have given up the ghost.

"When I tried to check the tubes, I found they were not listed for my tester. I called the local distributor about my problem, and not a one of the new tube checkers in the store listed the tubes. Neither could I find them on my tube list in the shop or in any of the brand-new electronic catalogues. The worst blow of all came when I could not find them in the cross-reference lists showing foreign tubes and American equivalents."

"What are you going to tell the little old lady?"

"All I can do is suggest she write to the manufacturer in Japan and ask him to list American tube equivalents for the tubes in the set. If he cannot do this, perhaps he can tell her where she can obtain the tubes in this country, or he can send them to her direct. With new tubes in the set, she can operate it on batteries without damage. If she wishes, we can get her a step-down transformer that will permit her to use it on a.c. I prefer doing this to inserting a heat-radiating, voltage-dropping resistor inside the set or trying to locate and install a suitable resistor-type line cord." (*Continued on page 152*)

"I've got a question, Doctor," Barney announced with a shrewd look. "While ago you said the tubes were supposed to have 1.5 volts on the filaments. Since you had no diagram and were unfamiliar with the tubes, how did you know this?"

"I've been waiting for that," Mac said with a chuckle; "and I'd have been disappointed if you'd let it pass. Really it's quite simple: the set used a single flashlight cell for an A battery in portable operation. Okay?"

"Okay," Barney grunted.

"But the main point," Mac said seriously, "is that I was guilty of doing exactly what I've told you not to do: I was ignoring the simple, logical possibility that a foreign set might be designed for a line voltage different from our standard 117 volts. If I had just glanced at that label right in the beginning, look at the time and trouble I could have saved myself. So-o-o-o. I can't very well fire you for being as dumb as I am, now can I?"

"No. I guess you can't," Barney said with a broad grin spreading across his pleasant, Irish face; "and you know something? I don't mind being chewed out nearly so much when the chewer-outer admits he makes mistakes himself!" —30—

## Air Traffic Control

(*Continued from page 40*)

the information is punched out on a rectangular strip containing flight-plan information for each airplane. Under the old system the data was calculated by the controllers and recorded by hand.

### Radar Beacons

While the computer is doing the bookkeeping, a radar beacon system recently installed at Newark, La Guardia, and Idlewild airports as well as in the New York Traffic Control Center, is aiding the traffic controller to identify aircraft on radar screens.

A refinement of radar, the radar beacon system (see Fig. 2) permits the positive identification of aircraft. When a controller has two or more aircraft on his radar screen, identification of each aircraft is vital to their safe passage through the area. Frequently an aircraft which is not identified will appear on the screen. Prior to the installation of the radar beacon system, the controller would request the aircraft to execute a 180-degree turn. This took some time—only minutes, of course—but in handling fast-moving aircraft, minutes are precious.

With the radar beacon, no turns are needed. The radar blip of a plane can be identified electronicly. A controller asks a pilot to identify his plane. The pilot then pushes a button and the blip on the controller's radar screen blooms and expands into an oval shape.

The radar beacon system is the outgrowth of the World War II military identification ("friend or foe") problems. Since 1953 *Airborne Instruments*

*Laboratory* has been a consultant to FAA and its predecessor, the CAA, in the over-all analysis of the use of the beacon system in high-density terminal areas.

### Scan Converters

The most recent electronic aid to air traffic control is the radar-to-television converter. It is best known as the scan converter (see Fig. 3) and was recently commissioned at the New York Air Traffic Control Center. Although on order from *Intercontinental Electronics Corporation* since 1958, production and installation delayed the commissioning of the scan converters until a few months ago.

The basis of the scan conversion system is a cathode-ray tube that converts radar information to television signals. These signals can be seen in full daylight on horizontal monitors upon which are placed video maps.

Since being placed in use, air traffic controllers have commented that the scan conversion system has been less fatiguing. They add that working under normal light conditions is easier on the eyes, and is therefore an aid in promoting safety.

### The Future

This is but the start of many new uses of electronics in the field of air traffic control. The FAA Bureau of Air Traffic Management says that a computer is being developed that "will keep track of flights in progress and reject proposed paths that would conflict with those of aircraft already enroute."

Although this may appear to be automation in a sense, the final decision on the disposition of aircraft will always rest with the air traffic controller, aided by the accurate information provided him by the various electronic devices at his disposal. —30—

Shown below is one of the horizontal consoles of the radar-to-television scan converters that have been installed in the enroute Air Route Traffic Control Center at New York's International (Idlewild) Airport. The system provides bright display of radar information that can be viewed in normal room light. Each plane has "tail" of light, allowing controller to determine speed, direction of turn.

## How a Pool Telecast Works

*(Continued from page 56)*

truck of the city's Bureau of Electricity—normally used for servicing street lights. Camera cable for this unit was run overhead, tying off on a streetlight pole and a boom on the truck. It was equipped with a Zoomar lens and adapter and had a clear field of vision extending a mile north and south on Michigan Avenue. This camera produced the best closeup views of the Queen seen during the parade, as her car passed directly under its position.

The camera mounted in WNBQ's *Cadillac* used a 6:1 Zoomar and successfully provided clear pictures of the Queen's car during the parade when other cameras were unable to cover it. The riding announcer had the unique advantage of being able to describe the proceedings from a participant's viewpoint. This unit was actually the leading vehicle of the motorcade, about five to ten car lengths directly in front of the Queen's automobile with a security vehicle intervening, an unfortunate position from a video standpoint. The only possible shot was head-on. When maximum focal length was employed for closeup attempts, the slightest road irregularities were quite apparent. Much better pictures would have resulted had the unit been free to move to right or left of the axis of the procession.

### Results and Costs

The pool telecast had a total duration of a little over an hour and was considered excellent by observers and participants. Complete and coherent coverage of a highly important and exciting civic event was provided as a public service and in a manner which no station acting alone could have realized in its wildest dreams. Some forty-five engineers and technicians, six announcers, and five directors were immediately involved in delivering the pool feed to the outputs of the central control room, and uncounted others participated as individual stations mixed local studio originations with the pool feed to suit their individual needs. Chicago's only other pool telecast—of General MacArthur's parade through the city in 1951—employed more people and equipment, but was produced in palmier days.

Cooperation was generally the keynote of the endeavor, with interchanges of equipment and continuous consultation taking place on problems and details. All was not sweetness and light, however. Understandably irked at being deprived of a leading role in the proceedings by the turn of a coin, WBKB imported a 65-inch lens from San Francisco and went on the air fifteen minutes ahead of the pool from the top of their State Street studio building, a mile and a half from Buckingham Plaza, with a preview of the Queen's landing. This "scoop" had been preceded, the evening before, by a one-hour attention-getting summary of the events leading up to and surrounding the royal visit.

A factor which somewhat dimmed the afterglow of the successful pool was a verbal hassle which developed when one station managed to slip onto the air some live shots of the Mayor's banquet for the Queen which they were televising on a closed-circuit basis at the City's behest, for benefit of the press overflow. According to other stations, it had been jointly decided to bypass this event.

Exact costs of the pool telecast are hard to come by and will probably never be compiled, but educated guesses put the total out-of-pocket figure under $10,000, about $3000 of this going for line charges. All four stations will share the out-of-pocket tab. Regularly scheduled engineering crews were used, and careful planning held overtime to a minimum. Economy was effected in choice, where feasible, of camera locations which did not require augmentation of power and terminal facilities. —30—

Sencore sales manager Ed Flaxman and Mark Markman, Sencore's California rep, are shown conducting a Time-Saving Clinic with the Van Nuys (Calif.) Society of Radio and TV Technicians. Demonstrations showed time-saving advantages in troubleshooting with proper equipment. The highlight of the evening was a 45-minute film entitled, "The Sencore Time Saver Story." These time-saving clinics are available free of charge to service technician groups throughout the United States. Arrangements can be made through your local parts distributors.


*coming in February ELECTRONICS WORLD:*

# your complete guide to buying a CITIZENS BAND RADIO

More people every day are finding a Citizens Band Radio useful to own, fun to operate! If you've been thinking of investing in one, be sure to read this ELECTRONICS WORLD feature FIRST. It tells you all you need to know before buying a Citizens Band Radio: what's available, what to look for, how to buy. In addition, this valuable directory tells you the rules and regulations, the privileges and limitations governing the field of Citizens Band Service. Complete with photographs and technical data, you'll find this feature an indispensable guide to the purchase of your Citizens Band Radio!

**You'll also enjoy these features in February ELECTRONICS WORLD:**

- **ROOM ACOUSTICS FOR STEREO:** Reverberation and Room Treatment Part Two of this four-part series covers optimum reverberation... tells you how to control room resonances with acoustic material. Important material here for all stereo enthusiasts!

- **BUILD A TWO-METER TRANSISTOR TRANSMITTER** Here's an important project for radio amateurs—a 20-milliwatt, battery-operated transmitter that uses two transistors. Complete with diagrams and instructions.

- **KNOW YOUR ELECTRONIC CHEMICALS** An authoritative discussion of cleaners, lubricants, cements, sprays, and other chemicals that play significant roles in electronic service and repair. Their various functions and applications are explained in this informative feature.

All these features are coming your way in February ELECTRONICS WORLD—typical of the varied coverage you'll enjoy month after month in the world's most authoritative electronics magazine. That's why it's such a good idea to make sure that ELECTRONICS WORLD is delivered to your doorstep regularly. Why not become an ELECTRONICS WORLD subscriber today?

**REGULAR SUBSCRIPTION RATES**

**one year, $5 two years, $9 three years, $12**

ELECTRONICS WORLD, 434 South Wabash Avenue, Chicago 5, Illinois

## Extended Stereo System

*(Continued from page 50)*

At the same time, −R information is being supplied to the element of the balance control that feeds the other section of the 12AZ7. Also being applied to this same element of the balance control is the L signal from the other section of the 12AZ7. Hence a composite signal, L−R, is impressed on the grid of the lower section of the mixer stage. This signal is also phase inverted by the tube so that it now becomes an (R−L) signal.

The (R−L) information is channelled into two paths. Part of this information is fed through the .022-μf. capacitor to the stereo control, which is basically a gain control for the (R−L) difference channel. Also part of the information is fed through the 120,000-ohm resistor and the .047-μf. capacitor and mixes with the 2L signal from the left preamp. At this point the (R−L) signal combines with the 2L signal to

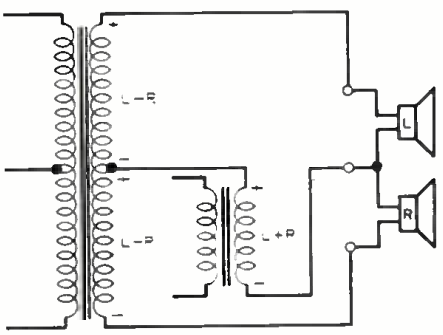



Fig. 3. Basic matrixing circuit used.

produce an (R+L) sum signal that is fed to the sum amplifier.

### Stereo Control & Matrixing

For monophonic operation, the stereo control is at its minimum setting. Under this condition no difference signal is applied to the difference channel. All information that passes through the system is (L+R) which is subsequently channelled to both speaker systems.

For standard stereo operation, the stereo control is advanced until the sum amplifier and difference amplifier receive equal amplitude signals. Under these conditions, (L+R) and (L−R) information is supplied to the matrix and only the L information is applied to the left speaker and only the R information is applied to the right speaker. This is normal stereo operation.

For "extended stereo" operation, the stereo control is advanced further so that the (L−R) or difference-channel signal is greater than the signal applied to the sum (L+R) channel. This difference in relative level is maintained at different loudness settings since the loudness control for both sum and difference amplifiers are ganged and the gains of both channels are controlled simultaneously.

Output matrixing, or mixing of the

sum and difference signals in order to get the desired outputs for the speakers, is accomplished by the output transformers (Fig. 3). The secondary winding of the difference-channel (L−R) transformer is center-tapped. To this center-tapped secondary is connected the untapped secondary winding of the sum-channel (L+R) transformer. We now have two windings that are connected in series-aiding (the sum winding and the top half of the difference winding) or in series-opposing (the sum winding and the bottom half of the difference winding). There are three possible conditions of operation as follows:

1. For monophonic operation, there is no difference signal so that both speakers will receive the sum signal.

2. For standard or normal stereo operation, the output of the difference channel is equal to the output of the sum channel. Under these conditions the upper speaker has applied to it (L+R) + (L−R), or 2L. Note that this is the left information only. The lower speaker has applied to it (L+R) − (L−R), or 2R. This is the right information only.

3. For "extended stereo" operation, the output of the difference channel is greater than the sum channel. Assuming there is twice the signal in the difference channel, or 2(L−R), the signal applied to the upper speaker is (L+R) + 2(L−R), or 3L−R. The signal applied to the lower speaker is (L+R) − 2(L−R), or 3R−L. Notice that the left speaker system receives an out-of-phase component of right information along with the left information, and the right speaker system receives an out-of-phase component of left information along with the right information. The magnitude of the out-of-phase components is what determines the apparent spread of the "extended stereo" system. —30—

## CHRISTMAS TVI

By J. T. SWANSON

THE OFTEN strange nature of interference was dramatized again last Christmas. The second set of the house, working on its built-in antenna in the living room, began to show intermittent vertical sync and horizontal flashes a few days before the holiday. Just about any movement in the room would bring on the symptoms. Moving the set to another room eliminated the trouble. Decorations on the Christmas tree were prime suspects, but the symptoms persisted when the bulbs were unplugged.

The tree was also decorated with such metallic material as tinsel and "icicles." Shaking a bunch of "icicles" brought the symptoms in severe form. Experimentally, one icicle was held in each hand and they were moved about to make intermittent contact. This induced the flashes and vertical slipping! Evidently these strips, with their invisible oxide coatings, acted as semiconductors when they made intermittent contact. They were probably detecting some strong, local signals and yielding a cross-modulation product that interfered with sync pulses. —30—


"ELECTRONICS REFERENCE DATA" compiled by Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 118 pages. Price $2.50. Soft cover. Vol. 2.

This is a second volume in an interesting publishing venture dedicated to making available in semi-permanent form outstanding articles in the electronics field.

This volume is an anthology of worthwhile articles which have appeared in various issues of "The *Aerovox* Research Worker" and covers TV circuits and applications, u.h.f., audio, radar, meters and measurement, and specialized applications and development.

Extensive use of schematics and line drawings makes this text a reference work well worth keeping in a permanent electronics library.

* * *

"THE ELECTRONIC EXPERIMENTER'S MANUAL" by David A. Findlay. Published by *Ziff-Davis Publishing Company*, New York. 169 pages. Price $4.95.

If our experience is any criterion, a very high percentage of the population is interested in some phase of electronics. From six to ninety-six, the miracle of the vacuum tube and its counterparts exerts an almost hypnotic pull on the average citizen.

For those with no background in electronics but endowed with a well-developed bump of curiosity, this volume should provide the answer to the problem of starting from scratch. The assumption is made that the reader is totally unfamiliar with the tools and techniques involved in electronic construction, hence the first three chapters cover, in detail, this basic material. The tools required, soldering, wire and wiring techniques, hardware, electronic parts and how to identify them, planning and making a chassis, etc. are all discussed and the subject amplified by a lavish use of photographs, line drawings, and symbols.

The remaining six chapters deal with the actual wiring and troubleshooting of circuits, making printed circuits, building a workshop to meet individual needs, special tools the experimenter can build, basic test equipment which can be constructed, with the final chapter covering eight interesting electronic projects (receivers, tuner, amplifier, an intercom, and a photoflash). Both tube and transistor circuits are represented by the suggested projects, giving the reader experience with both types of construction. Much of the material used in the preparation of the text originally appeared in the pages of POPULAR ELECTRONICS.

The treatment is progressive so that as the experimenter works through the text he accumulates both knowledge and experience. The text is written at an elementary level, making it especially valuable as a manual for the beginner working on his own or for group instruction in the basics of electronics.

* * *

"TWO-WAY RADIO" by Allan Lytel. Published by *McGraw-Hill Book Company*, New York. 281 pages. Price $9.50.

Since there are more than a million and a half two-way radio systems in operation in the U. S., this field offers an interesting and profitable line of endeavor for the qualified technician.

The text material constitutes a complete guide to two-way radio and includes everything from a description of the type of systems to technical details on the equipment, installation methods, troubleshooting, and repair.

Included in the coverage are AM and FM transmitters and receivers, antennas, selective-calling methods, power supplies, installation, and servicing. The author has also delved into such subjects as digital pulse codes, power sources, transmitter tuning, use of the crystal calibrator, phase-shift modulators, split-channel operation, dial codes, oscillator circuits, and other pertinent topics.

The author also lists and describes the various test equipment and measuring devices required for work in this field, including AM and FM signal generators, r.f. signal generators, wavemeters, grid-dip meters, heterodyne and interpolating frequency meters, and modulation meters.

Technicians interested in increasing their incomes by broadening their areas of competence will find this book helpful as a reference work and practical servicing manual.

* * *

"PRESERVATION AND STORAGE OF SOUND RECORDINGS" by A. G. Pickett & M. M. Lemcoe. Published by Library of Congress. Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 74 pages. Price 45 cents.

This is a report of a comprehensive study made under the auspices of the Library of Congress, supported by a grant from the Rockefeller Foundation. The report covers an investigation which was made regarding the deterioration of sound recordings in storage in order to establish optimum storage environments and techniques.

Since the archival storage of phonograph discs and magnetic tapes is of fairly recent origin, information on the best means for preserving them was lacking. This study covers the effects of heat, light, fungus, grit, moisture, and other atmospheric and chemical conditions as they relate to the preservation of acetate, shellac, and vinyl discs and of acetate and polyester-based magnetic tapes.

Although prepared primarily for libraries, since the tests and procedures

are described, along with observed results and conclusions, the material could also be of value to the audiophile with an extensive record or tape collection.

* * *

**"SHORTWAVE PROPAGATION"** by Stanley Leinwoll. Published by *John F. Rider Publisher, Inc.*, New York. 147 pages plus a "Global Time Conversion Simplifier" insert. Price $3.90. Soft cover.

This compact, information-crammed book will be of interest to both communications engineers and radio amateurs since it covers the basic principles of short-wave radio propagation and deals with all of the important theoretical as well as practical aspects of the subject.

The text material is divided into twelve chapters and covers the ionosphere, radio waves, the sky wave, measuring the ionosphere, ionospheric variations, circuit analysis, achievements of the radio amateur, the amateur bands around the cycle, forecasting, and the future.

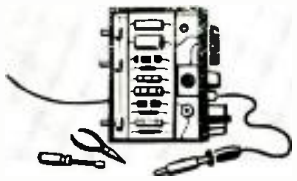
The "Global Time Conversion Simplifier" which is included as a fold-out, wall-size chart is a "plus" feature which should prove exceedingly valuable to the SWL and the ham. —30—

**Answer to Puzzle Appearing on page 30**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | R | O | S | S | O | V | E | R | | | | D | | B |
| | | B | I | T | | O | | E | R | A | S | E | | A |
| P | H | O | N | O | | I | | C | | C | | C | | S |
| R | | E | | P | I | C | C | O | L | O | | I | P | S |
| E | | | D | | | E | | R | | U | | B | | |
| A | U | D | I | O | | | | D | | S | L | E | E | P |
| M | | | S | | W | O | W | | | T | | L | | L |
| P | A | R | T | | | | O | | | I | | | | A |
| | | | O | | B | O | O | M | | G | | N | E | T |
| T | | | R | | | | F | | | S | | E | | T |
| R | E | S | T | | M | | E | | C | | T | O | N | E |
| E | | | I | | I | | R | E | E | D | | N | | R |
| B | A | S | O | O | N | | | | L | | | | B | |
| L | | | N | | I | | | | L | | | | A | |
| E | N | D | | A | M | | | C | O | N | C | E | R | T |


**PHOTO CREDITS**

| Page | Credit |
|---|---|
| 38 (top & center), 39 (bottom right), 40 (top) | Federal Aviation Agency |
| 38 (bottom) | Remington Rand |
| 39 (left) | Airborne Instruments Laboratory |
| 42 (top) | Aluminum Co. of America |
| 42 (center) | Westinghouse Electric Corp. |
| 42 (bottom) | Chance Vought Aircraft, Inc. |
| 43 (top) | Philco Corp. |
| 43 (center left) | General Precision Lab., Inc. |
| 43 (center right) | Raytheon Co. |
| 43 (bottom) | Radio Corp. of America |
| 55 (top), 56 (top) | Station WGN |
| 55 (bottom) | Russ Ogg |
| 56 (center) | NBC |
| 60, 61 | PACO Electronics Co., Inc. |
| 66 | Bogen-Presto Co. |
| 69 | Harman-Kardon, Inc. |
| 70 (top center) | New York City Transit Authority |
| 84 (top) | General Electric Co. |
| 84 (center) | Allen B. DuMont Labs. |
| 112, 113 | Channel Master Corp. |
| 114 | National Bureau of Standards |
| 145 (top) | Vocaline Co. of America |
| 146 (top) | Terado Company |
| 146 (bottom) | EICO |
| 147 (bottom) | Centralab |
| 150 | International Resistance Co. |
| 153 | Intercontinental Electronics Corp. |
| 154 | Sencore |



# ELECTRONICS MARKET PLACE

RATE: 60¢ per word. Minimum 10 words. March issue closes January 11th. Send order and remittance to ELECTRONICS WORLD. One Park Ave.. N. Y. C. 16. N. Y.

## FOR SALE

SAMS Photofacts 1 tp 352, ¾ in book form, $525.00. Box 3. West Redding, Conn.

ELECTRONICS Surplus—Wholesale and retail monthly. 12 issues, $1. Box 784, Wash. 4, D.C.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1. Conn.

RADIO & TV Tubes at manufacturers prices. Guaranteed—Send for free price list. Edison Electronic Tube Co.. Menlo Park, N. J.

PROFESSIONAL Electronic Projects—Organs, Timers, Counters, Intercoms, etc.—$1. each. List Free. Parks, Box 1665, Lake City, Seattle 55, Wash.

TELEVISION Sets $9.95, plus shipping. Jones TV, Sanatoga, Pa.

RADIO & TV Tubes at Manufacturers Prices! 100% Guaranteed! Brand New! No re-brands or pulls! United Radio, Box 1000, Newark, N. J.

TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality, Top Name Brands Only. Write For Free Catalog or Call WAlker 5-7000. Barry Electronics Corp.. 512 Broadway, New York 12N, N. Y.

TELEVISION & Radio Tubes. Parts and Supplies Guaranteed. Hi-Quality Tube Co., Inc., 284 Lafayette St., Rahway, New Jersey.

GOVERNMENT SELLS: Surplus Electronics: Test Equipment: Oscilloscopes; Transceivers; Jeeps; Boats; Aircrafts; Misc.—Send for U. S. Depot Directory & Procedure $1.00—"Government Surplus Sales," Box 425—RT, Nanuet, N. Y.

AUTO Radio Distributor Selling Servicing Becker Blaupunkt, FM-AM, other European, American Sets. Save 30% + Square Electronics, 150-60 Northern Blvd., Flushing, N. Y.

SURPLUS, Unused Shielded Hook-up wire, stranded, tinned copper, poly-vinyle chloride insulation, glass-braid, tinned copper shield, 1 conductor, AWG. 14. Recent manufacture—50 ft. 88¢. 100 ft.—$1.68—1.000 ft.—$15.00. Shock mounts, Lord, flat, 1" O.D, ¼" I.D., 4 mounting holes. 1 lb. and 2 lb. 12¢ ea. Switch, rotary, 4 sections, 5 positions, 4 pole, 4 moving contacts. Ceramic 49¢. Relay Leach 9031-SS. 3 PDT, 24 28 VDC, Rating 10 Amps. Hermetically sealed—$1.35. Relay, non-pileup, 1 PDT, 20 VDC, 5,000 Ohm 69¢. Storage Battery, BB-52, 36 V at .08 Amp. Hr., Pin type terminals 49¢. Relay, Leach, 2069, 3 PDT, 28 VDC, rating 12.5 Amps (removed from unused equipment) 79¢. No C.O.D. Less than $2.00 add 25¢ handling charge. E. K. O'Connor, Box 71, Round Lake, N. Y.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Malden 48, Mass.

TRANSISTOR and FM Radios. Lowest Prices, Free catalog. Myers Imports, 623 Gay, Knoxville, Tennessee.

TUBES—Radio and Television, Below manufacturers cost—Send for free price list—Orders shipped same day received. Standard Tube Distributors, 6810 Post Road, North Kingstown, Rhode Island.

MAKE Gizmos & Such, Still River, Mass. your headquarters for short wave radios, 25 varieties carried in stock, prices from $50.00 to $5000.00,

TECKTRONIX 515 Oscilloscope $550.00. New Condition. Connecticut Instruments, Brookfield, Conn.

## RADIO ENGINEERING & INSTRUCTION

BACHELOR of Science in Electronics Engineering. Degree in 4 years of Home Study. No resident attendance necessary. Pacific International College of Arts and Sciences, Primarily a correspondence school. Resident classes also available if desired. 5719-U Santa Monica Boulevard, Los Angeles 38, California.

ELECTRONICS! Associate degree—29 months. Technicians, field engineers, specialists in communications, missiles, computers, radar, automation. Start February, September, Valparaiso Technical Institute, Dept. N, Valparaiso, Indiana.

CALCULUS. Powerful Modern Mathematics. Easy Practical Lessons, First Four $1, Mathco, 4256-3 Minmor, Cincinnati 17. Ohio.

LEARN: Electronics. Radio & Television. Become a well-paid Technician in your own business, or in a good paying position. Either Residence or Home Study Course. American Technical School, P. O. Box 567, 923—8th. St., Des Moines, Iowa.

ENGINEERING and Art Degrees earned through home study. Electronics, Electrical, Mechanical, Civil, Physics, Business Administration, Liberal Arts. When writing, specify course desired. Pacific International College of Arts & Sciences, primarily a correspondence school. Resident classes also carried. 5719-C Santa Monica Boulevard, Hollywood 38, California.

USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog Free. (Courses Bought). Lee Mountain, Pisgah, Alabama.

## WANTED

CASH Paid! Sell your surplus electronic tubes. Want unused, clean radio and TV receiving, transmitting, special-purpose, Magnetrons, Klystrons, broadcast types. Want military and commercial lab test equipment such as G.R., H.P., AN UPM prefix. Also want commercial Ham Receivers & Transmitters. For a fair deal write: Barry Electronics Corp., 512 Broadway, New York 12, N. Y. (Walker 5-7000).

WANTED: Tubes-Special Purpose and Receiving. Top prices for Klystrons, Power Tubes, Thyratrons, T.V. and Receiving Tubes. Tubes must be unused. Also laboratory grade test equipment such as manufactured by HP and GR and AN UPM prefix. V. & H. Radio & Electronics, 2053 Venice Blvd., Los Angeles 6, California.

CASH For Used Short-Wave Ham Receivers, Transmitters & Accessories. Treger W9IVJ, 2023 N. Harlem Ave.. Chicago 35. Tuxedo 9-6429.

CYLINDER and old disc phonographs. Edison, Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Classified, Electronics World, Box 50, 1 Park Ave., N. Y C. 16, N. Y.

WANTED: Surplus measurement model 78 or 80 signal generators. Also Federal 804 or used Motorola two-way equipment. State quantity, price and condition. Communication Service, Inc., 3209 Canton Street, Dallas, Texas.

## TAPE & RECORDERS

RENT Stereo Tapes—over 900 different—all major labels—free catalog. Stereo-Parti, 1608-L, Centinela Ave.. Inglewood 3, California.

TAPE Recorders, HI-Fi Components. Sleep Learning Kits, Tapes. Unusual Values. Free Catalog. Dressner, 69-02R 174 St., Flushing 65, N. Y.

AMPEX, Concertone, Crown, Ferrograph, Presto, Tandberg, Pentron, Bell, Sherwood. Rek-O-Kut, Dynakit, Others. Trades. Boynton Studio, 10RT Pennsylvania, Yonkers, N. Y.

RECORDERS, Stereo Tapes, Hi-Fi Components, Tremendous Values, Catalog, Efsco, 270-H Concord, West Hempstead, N. Y.

UNUSUAL Budget Values. Tape recorders, tapes and Hi-Fi components. Send for package quotations and free catalogue. Budget Hi-Fi Distributors, 83-06 Vietor Ave.. Elmhurst, N. Y.

## HIGH-FIDELITY

INDUCTORS for Crossover Networks. 118 types in stock. Send for brochure: C & M Coils, 3016 Holmes Avenue N. W. Huntsville. Ala.

PRICES? The Best! Factory-sealed Hi-Fi Components? Yes! Send for free catalog. Audion, 25T Oxford Road, Massapequa, N. Y.

DISGUSTED with "Hi" Hi-Fi Prices? Unusual Discounts On Your High Fidelity Requirements. Write. Key Electronics, 120 Liberty St., New York 6, N. Y. CLoverdale 8-4288.

RECORDERS, Hi-Fi. Free Wholesale Catalogue. Carston 125-R East 88, NYC 28.

## REPAIRS and SERVICING

SPEAKERS repaired fast, any type, write for price list. JaMac, 8845 N.E. Sandy Blvd., Portland, Oregon.

ALL Makes High Fidelity Speakers Repaired. Amprite, 70 Vesey St., N.Y. 7, N.Y. BA 7-2580

## BUSINESS OPPORTUNITIES

RADIO Parts Stores and Hi-Fi Salons! Someone "borrowing" your personal copy of Electronics World each month? You ought to be taking advantage of Electronics World convenient re-sale plan. Sell copies in your store . . . perform a good service for your customers . . . with no risk involved. For details, write: Direct Sales Department, Electronics World, One Park Avenue, New York 16, New York.

ESTABLISHED Electrical Manufacturers' Agent located in Dallas and Houston is expanding into electronics sales. Interested manufacturers write Morgan, 1013 Slocum, Dallas 7, Texas.

## MISCELLANEOUS

WESTERN Radio Amateur Surplus Magazine $2.00 Year. E. H. Marriner 528 Colima St., La Jolla. California.

PHONOGRAPH Records cheap, postpaid. Catalogue. Paramount, Box 2026-N, Pine Castle, Fla.

# SHOPPING GUIDE
## *Classified*

A HANDY GUIDE TO PRODUCTS, NOT NECESSARILY ELECTRONIC, BUT OF WIDE GENERAL INTEREST.

## BUSINESS OPPORTUNITIES

EARN Extra money selling advertising book matches. Free Samples furnished. Matchcorp, Dept. MD-10, Chicago 32, Ill.

MAKE $25-$50 Week, clipping newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. National, 81-DG, Knickerbocker Station, New York.

FOREIGN Employment Information—$1 Parks, Box 1665A, Lake City, Seattle 55, Wash.

## STAMPS & COINS

TERRIFIC Stamp Bargain! Israel—Iceland—Vatican Assortment—plus exotic triangle set—also fabulous British Colonial Accumulation—Plus large stamp book—All four offers free—Send 10¢ to cover postage. Empire Stamp Corp., Dept. Z2, Toronto, Canada.

THREE Brilliant uncirculated Mexican Silver Dollars $1.00. Universal Services, Box 675, San Antonio 6-S1, Texas.

## PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

COLORFUL Autumn—New York State. Eight Colorslides $1.00. Eddings. Roberts Ave.. Corning. N. Y.

## HELP WANTED

WANT a good overseas or stateside job with higher pay?? Transportation paid. Men—Women. Free Information. Employment Headquarters. 79 Wall Street. Dept. R-4, New York 5.

OVERSEAS Employment. American Firms and United States Government. Comprehensive Job Information $2.00. Foreign Opportunities, Box 172, Columbus 16. Ohio.

JOBS in Paris! Copenhagen! Rome. all Europe. Hi-paid jobs with American Companies thru Europe. Many jobs available. All Fields. Travel. Adventure in exciting Europe. Complete information. registration and six months' advisory service from Europe's oldest employment service: $2.00 ($2.50. Airmail). European Employment Service, P. O. Box 3973, Frankfurt/M. 1, Germany.

## MISCELLANEOUS

OPTICAL Bargains—Request Free Giant Catalog "CJ." 120 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. Amazing war surplus bargains. Edmund Scientific Co.. Barrington. New Jersey.

"WINEMAKING: Beer, Ale Brewing." Illustrated. $2.00. Eaton Books, Box 1242-TC, Santa Rosa, California.



# INDEX OF Advertisers

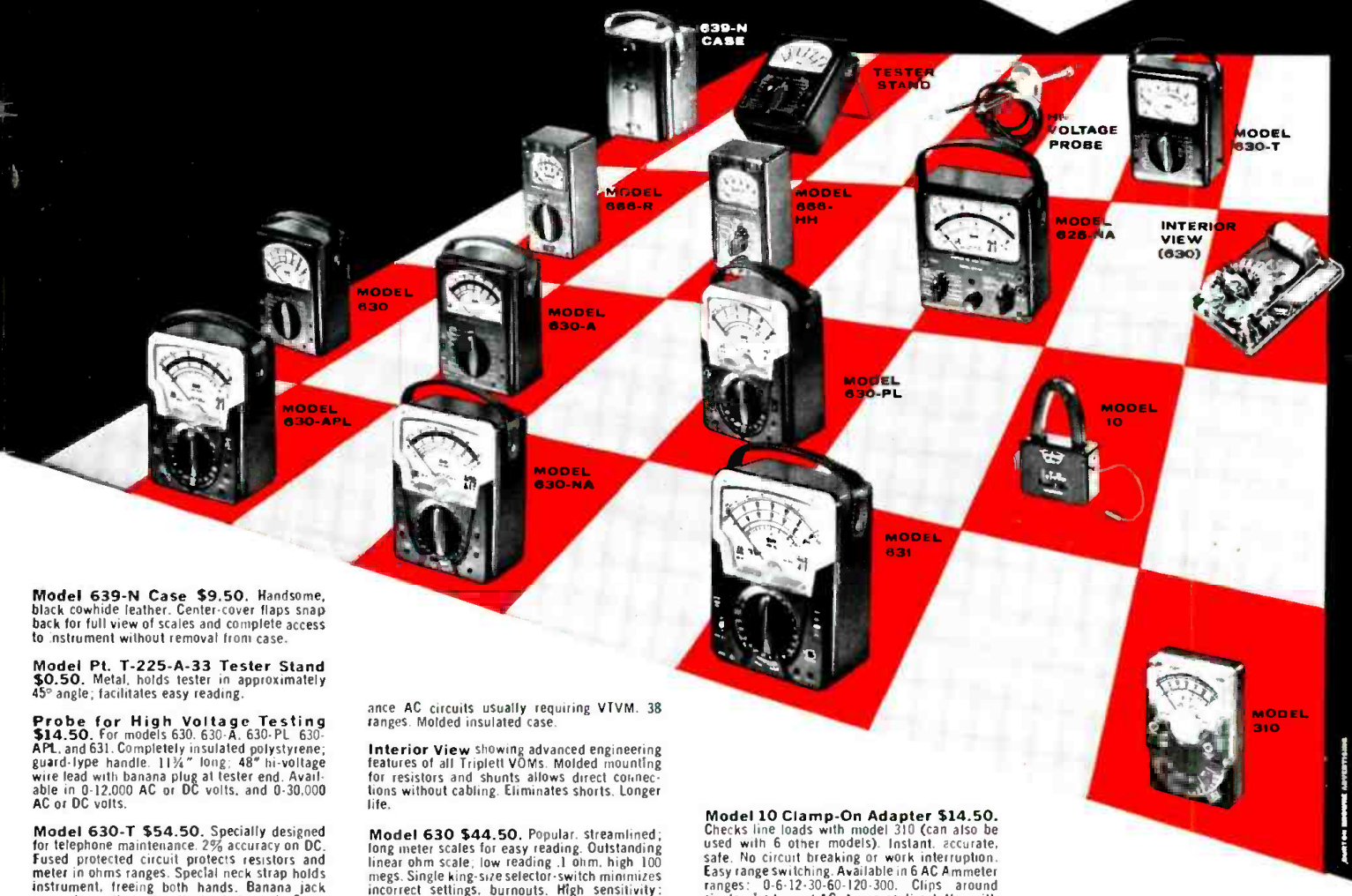
JANUARY 1960

*. . . the smartest move you can make*

# *is to* TRIPLETT VOMs

*. . . the world's most complete line of VOMs for every purpose!*

TRIPLETT
*Quality. . .*
*First to last*




**Model 639-N Case $9.50.** Handsome, black cowhide leather. Center-cover flaps snap back for full view of scales and complete access to instrument without removal from case.

**Model Pt. T-225-A-33 Tester Stand $0.50.** Metal, holds tester in approximately 45° angle; facilitates easy reading.

**Probe for High Voltage Testing $14.50.** For models 630, 630-A, 630-PL 630-APL, and 631. Completely insulated polystyrene; guard-type handle. 11¾" long; 48" hi-voltage wire lead with banana plug at tester end. Available in 0-12,000 AC or DC volts, and 0-30,000 AC or DC volts.

**Model 630-T $54.50.** Specially designed for telephone maintenance. 2% accuracy on DC. Fused protected circuit protects resistors and meter in ohms ranges. Special neck strap holds instrument, freeing both hands. Banana jack connectors eliminate all shock hazard. Completely insulated case protects from ground.

**Model 666-R Pocket VOM $29.50.** Hand size, ideal for electrical maintenance. With recessed range knob it fits easily into case. AC rectifier pre-calibrated unit for easy replacement. Banana jacks at panel top prevent leads falling over meter dial. Single king-size selector switch minimizes incorrect settings, burnouts, 20 ranges. Molded case streamlined, fully insulated.

**Model 666-HH Pocket VOM $27.50.** Compact, hand-size, 3" meter integral with panel, adjusted to 400 microamperes at 250 millivolts. Only 3 jacks necessary for all ranges. 19 ranges.

**Model 625-NA $54.50.** Dual sensitivity for extra ranges; large mirror scale for super readability. 3-color meter scale 5" long, 6" instrument. 0-50 microamp. AC volts at 10,000 O/V for checking many audio and high impedance AC circuits usually requiring VTVM. 38 ranges. Molded insulated case.

**Interior View** showing advanced engineering features of all Triplett VOMs. Molded mounting for resistors and shunts allows direct connections without cabling. Eliminates shorts. Longer life.

**Model 630 $44.50.** Popular, streamlined; long meter scales for easy reading. Outstanding linear ohm scale; low reading .1 ohm, high 100 megs. Single king-size selector-switch minimizes incorrect settings, burnouts. High sensitivity: 20,000 ohms per volt DC; 5,000 AC. Molded, fully insulated case.

**Model 630-A $54.50.** Laboratory type; ½% resistors for greater accuracy. Long mirrored scale eliminates parallax. Banana jacks, low resistance connections; high flux magnet increases ruggedness. Single king-size selector switch minimizes incorrect settings, burnouts. Molded fully insulated case.

**Model 630-PL $44.50.** Instant-vision, wider spread scales; streamlined case; handsome modern design. Unbreakable window. Outstanding linear ohm scale; low reading .1 ohm; high to 100 megs. Single king-size selector switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch. High sensitivity: 5,000 ohms per volt AC; 20,000 ohms per volt DC.

**Model 10 Clamp-On Adapter $14.50.** Checks line loads with model 310 (can also be used with 6 other models). Instant, accurate, safe. No circuit breaking or work interruption. Easy range switching. Available in 6 AC Ammeter ranges: 0-6-12-30-60-120-300. Clips around single wire to read AC. Amperes direct. Use with adapter 101 to instantly divide 2-conductor cords. Molded case fully insulated, black plastic with engraved white markings.

**Model 630-APL $54.50.** Laboratory type with ½% resistors, more accurate movement. Long mirrored scales eliminate parallax. Unbreakable window. Single king-size switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch. High sensitivity: 5000 ohms per volt AC; 20,000 ohms per volt DC. Molded case fully insulated.

**Model 630-NA $74.50.** Super DeLuxe with 70 ranges nearly double conventional types. Frequency compensated from 35 cps to 20 kc. Temperature compensated. Accurate within 1½% full scale reading on DC. Large open front meter easy to read. Unbreakable window. Mirrored scale. Meter protection against overloads. Molded fully insulated case.

**Model 631 Combination VOM and VTVM $64.50.** Two fundamental units at the price of a single tester. The No. 1 instrument for all electronic men. Battery operation assures VTVM stability and long life. Sensitivity PLUS. 1.2 volt (VTVM) range is equal to more than nine million ohms per volt. Large easy to read meter with unbreakable face. Single king-size selector switch minimizes incorrect settings, burnouts. Molded case fully insulated.

**Model 310 $34.50.** The only complete miniature VOM with 20,000 ohms per volt and selector range switch. Self-shielded against strong magnetic field. Rugged, high torque, barring instrument. Unbreakable plastic meter window. Converts to common probe—frees one hand—by fitting interchangeable test prod into top. Standard sensitivity 20,000 ohms per volt DC, and 5,000 ohms per volt AC. Accuracy 3% DC. Molded fully insulated case.

TRIPLETT
*Quality. . .*
*First to last*

**TRIPLETT ELECTRICAL INSTRUMENT COMPANY**
**BLUFFTON, OHIO**


# The good news is getting around

## Have you checked the big dealer profits on RCA Monogram Picture Tubes?

Head for your RCA Distributor... and get the facts firsthand!

**RADIO CORPORATION OF AMERICA**
*Electron Tube Division* *Harrison, N. J.*