WHY DO LOUDSPEAKERS SOUND DIFFERENT?

RADIO & TELEVISION NEWS

OCTOBER
1956
35 CENTS
in U. S. and Canada

World's Leading Electronics Magazine

IN THIS ISSUE

WESTERN UNION "OPERATOR 25"

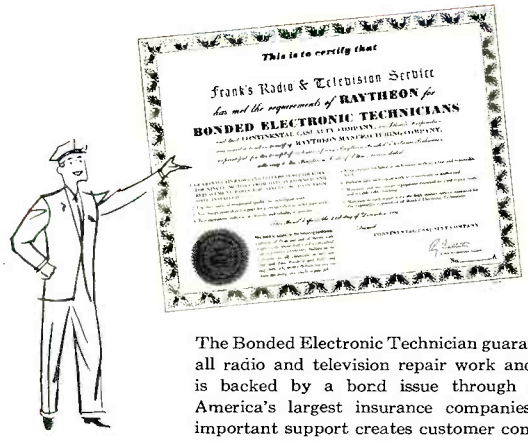
Raytheon Bonded Dealers are listed with Western Union "Operator 25". Potential customers needing TV or Radio repairs need only call Western Union by number and ask for "Operator 25". She'll give them the name and phone number of the Raytheon Bonded Dealer nearest the customer. More business for Bonded Dealers.

NATIONAL ADVERTISING

10 million readers a month will be urged to use Raytheon Bonded Electronic Technicians for their TV and Radio repairs. A powerful, exclusive advertising campaign designed solely to stimulate service business for Raytheon Bonded Dealers.

only RAYTHEON® BONDED DEALERS have all these business-building assets

RAYTHEON BONDED BACKING



The Bonded Electronic Technician guarantee on all radio and television repair work and parts is backed by a bond issue through one of America's largest insurance companies. This important support creates customer confidence and results in more customers — more profit and more prestige.

EXCLUSIVE RAYTHEON BONDED DEALER PROMOTION MATERIAL

Raytheon Bonded Dealers receive a registered Bond Certificate, Decals, ID Cards, Creed Displays — all designed to bring attention to their Bonded status. Special ads, mailing pieces and countless sales and shop aids are available exclusively to Raytheon Bonded Dealers.

Your sponsoring Raytheon Tube Distributor will be happy to discuss the Raytheon Bonding program with you. Better call him today.

RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

Raytheon makes all these { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes, Power Rectifiers and Transistors, Nucleonic Tubes, Microwave Tubes

RAYTHEON®

Excellence in Electronics

RADIO & TELEVISION NEWS is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), at 64 E. Lake St., Chicago 1, Ill. Entered as second-class matter July 21, 1948, at the Post Office, Chicago, Ill., under the act of March 3, 1879. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. SUBSCRIPTION RATES: Radio & Television News—one year U. S. and Possessions, and Canada $4.00; Pan-American Union countries $4.50; all other foreign countries $5.00.

COVER PHOTO: The Signal Corps' newest combat camera weighs only 8 pounds. The entire system tips the scale at 55 pounds. Civilian versions of the camera were used at the political conventions. See page 94. (Official U.S. Signal Corps Photo)

First in radio-television-audio-electronics

Average Net Paid Circulation 229,357

RADIO & TELEVISION NEWS

Reg. U. S. Pat. Off.

Radio News Trademark Reg. U. S. Pat. Office • Television News Trademark Reg. U. S. Pat. Office.

CONTENTS

OCTOBER, 1956

MEMBER INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC

ZIFF-DAVIS PUBLISHING COMPANY

WILLIAM B. ZIFF (1898-1953) FOUNDER

Editorial and Executive Offices

366 Madison Ave., New York 17, N. Y.
MU 7-8080

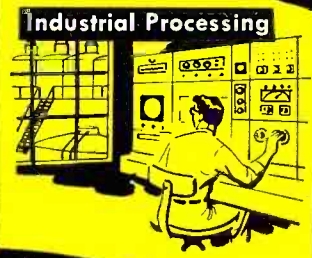
VOLUME 56 • NUMBER 4

ABC Member Audit Bureau of Circulations

SUBSCRIPTION SERVICE: All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Subscribers should 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 of this magazine.

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.

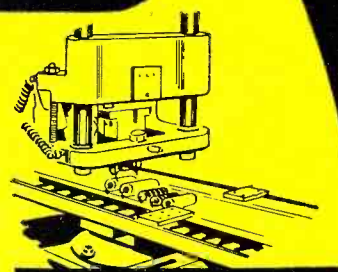
ATTENTION: MEN 17 to 55



Does your present job offer advancement?

PREPARE NOW AT HOME FOR A PROFITABLE CAREER IN

AUTOMATION ELECTRONICS!



PRACTICAL NEW TRAINING METHOD IS THOROUGH, DOWN-TO-EARTH!

In plant after plant, many machines are being designed to run themselves. This is called "Automation." The jobs of some men who used to run these machines are gradually disappearing. Every year sees more changes; more unskilled jobs being replaced. But it's *making* many new jobs too—good-pay, solid-future jobs in plants, offices and elsewhere—for men who are trained in Automation Electronics.

NOW IS THE TIME TO GET YOUR TRAINING

The design, operation and maintenance of controls that regulate the new "automatic equipment," is a promising field of the future. It's still uncrowded. There's time to get in on the ground floor if you act now.

NO PREVIOUS TECHNICAL TRAINING NEEDED

Many men 17 to 55, regardless of present job, even men without previous technical training or advanced education, can train for good jobs in Automation Electronics. DeVry Technical Institute offers effective training in your own home with movies, plenty of practical equipment and easy-to-read texts. Or get all of your training in DeVry's large well-equipped training laboratories in Chicago . . . one of the finest of its kind!

WE HELP YOU GET STARTED IN THE FIELD

When you've completed the DTI training, you'll have the know-how—the practical training you need to hold down a good job in Automation. Our effective Employment Service will help you get started toward many wonderful and exciting opportunities. You have nothing to lose—and much to gain. Send that coupon now so we can tell you about it.

MANY SUCCESSFUL GRADUATES

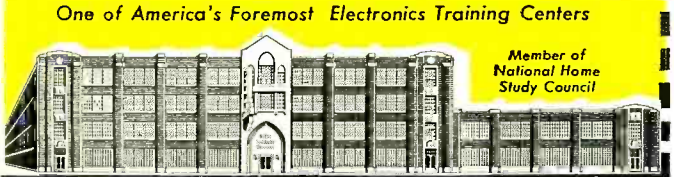
For 25 years, DTI has been building men for better jobs. Our files contain many letters from men who have won success in electronics and who give much credit to their DTI training.

GET INTERESTING NEW BOOKLET

The interesting story of "Automation and YOU" is yours for the asking. Simply fill in . . . mail the coupon. See how DeVry's training programs may prepare YOU for a start in this coming new field.

BUILDING MEN FOR BETTER JOBS 1931 1956
25 YEARS
DeVry Technical Institute
CHICAGO ILLINOIS

One of America's Foremost Electronics Training Centers



Member of National Home Study Council

DeVRY TECHNICAL INSTITUTE

CHICAGO 41, ILLINOIS

FORMERLY

DeFOREST'S TRAINING, INC.

GET THIS BOOKLET FREE

DeVRY TECHNICAL INSTITUTE, Dept. RN-10-M
4141 Belmont Avenue, Chicago 41, Ill.

I would like further information about the newer Electronic opportunities in AUTOMATION, also facts on how you may help me to prepare.

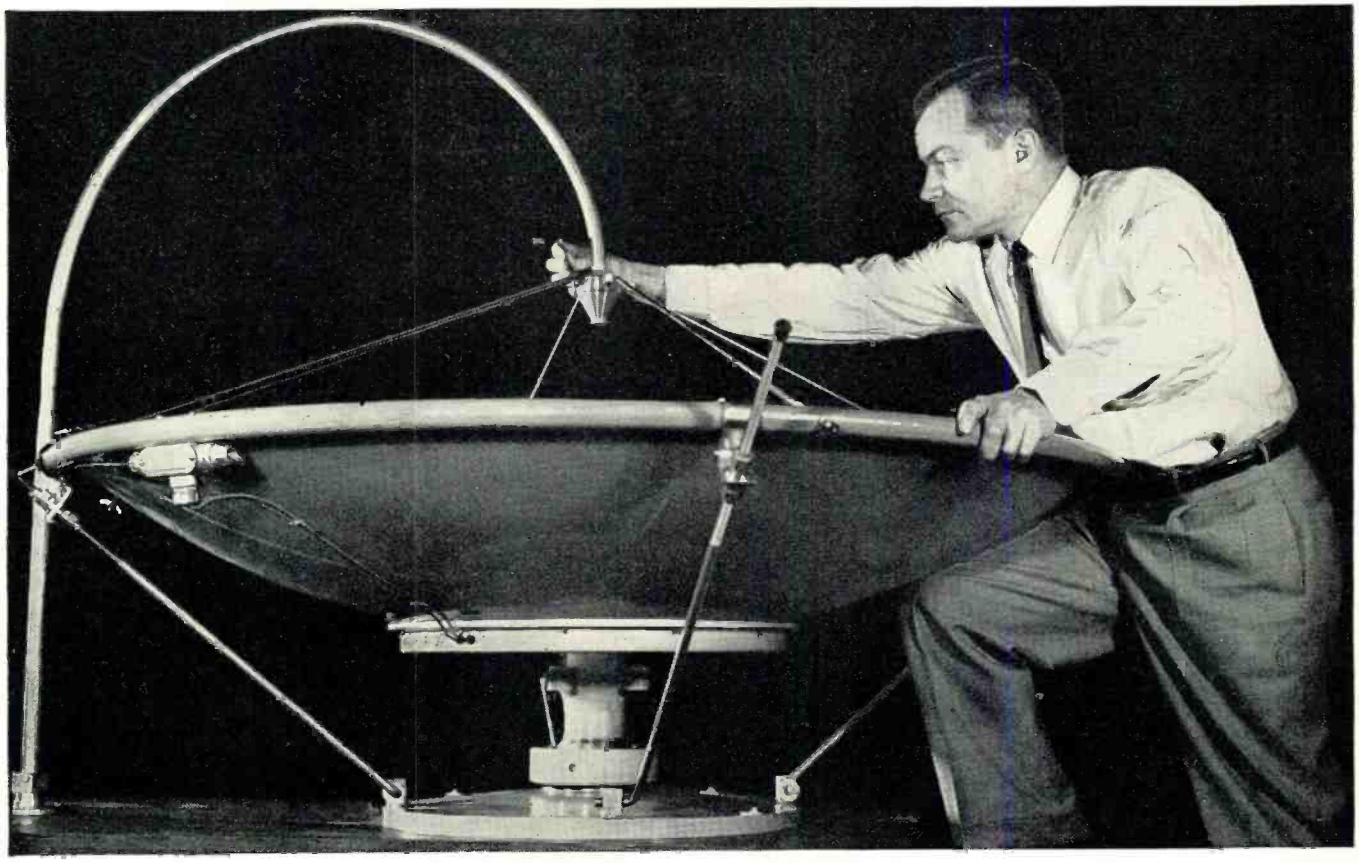
Name_____ Age____
Please Print

Street_____ Apt.____

City_____ Zone____ State____

1040 **DTI's training is available in Canada**

TEACHING A GIANT TO TAKE SHORT STEPS



Bell Laboratories' Dr. J. W. Fitzwilliam adjusts a waveguide feed to a parabolic dish reflector. Dr. Fitzwilliam, who has a Ph.D. in physics from Massachusetts Institute of Technology, leads the practical development of Bell's new 11,000-mc. system. Components had to be developed to operate in a frequency band not previously utilized.

The giant microwave highway that carries your TV programs along with telephone conversations from coast to coast has a versatile new partner — an entirely new microwave system which was created, and is now being developed, at Bell Laboratories. The new system operates at 11,000 megacycles — a much higher frequency than ever before used in telephone service.

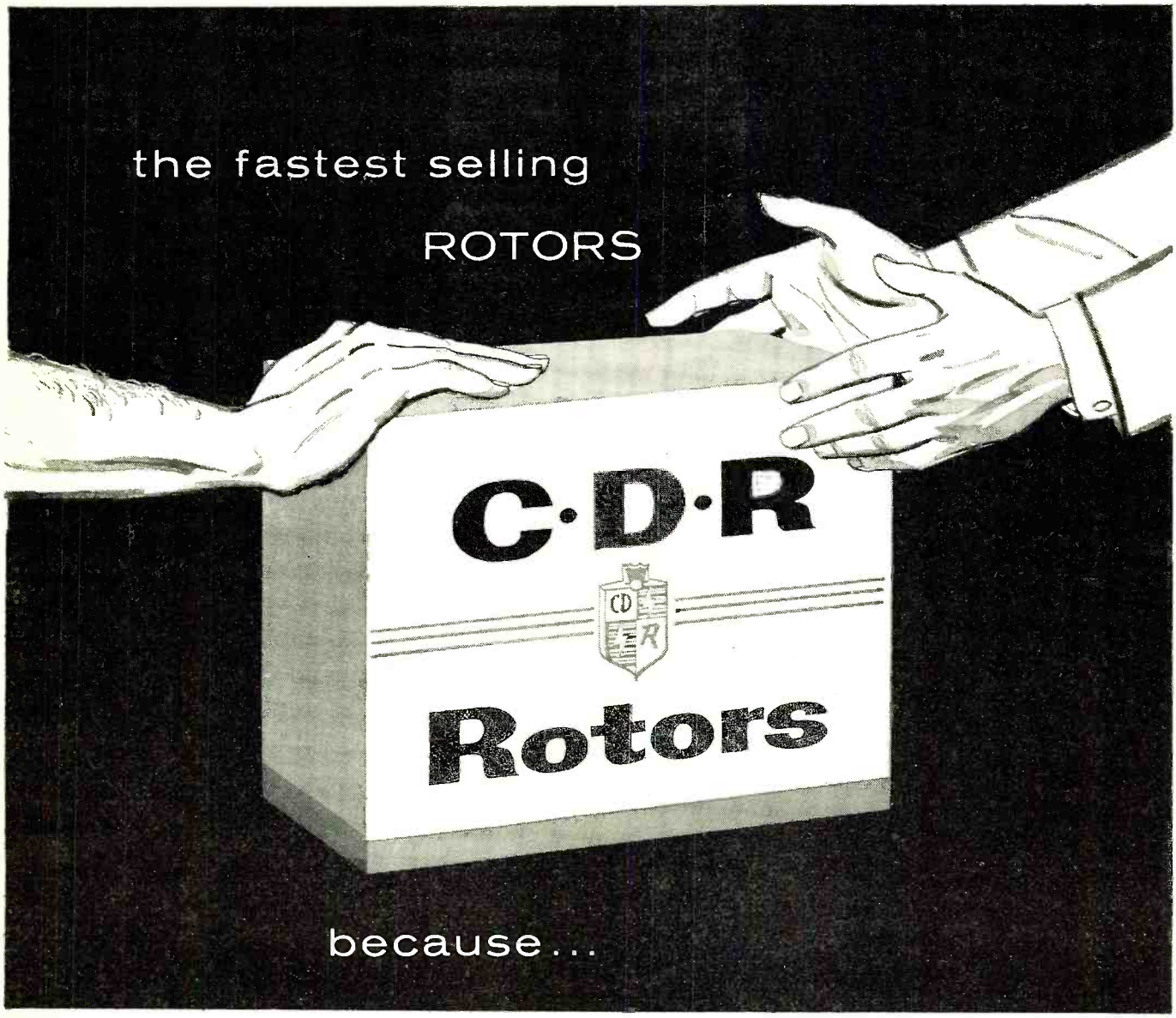
Bell's present microwave systems — operating at 4000 megacycles — were designed for heavy traffic and long distances. The new system is designed especially for lighter traffic and shorter distances—up to 200 miles. Its traffic capacity is extremely flexible. Depending on traffic needs, the system can provide only one one-way or as many as three two-way broadband channels. Each two-way channel can carry 200 telephone conversations simultaneously or one television program in color or black and white in each direction along a route. The new microwave system, which is already being operated experimentally, will be valuable in providing additional telephone service and television programs for cities in remote areas.

This is another example of how research and development work at Bell Telephone Laboratories help the Bell Telephone System to serve you better.

Mr. L. C. Tillotson, who originated the new system, adjusts the klystron-isolator combination which made the system feasible. Mr. Tillotson, an M.S. from the University of Missouri, is in charge of research in microwave applications.

BELL TELEPHONE LABORATORIES

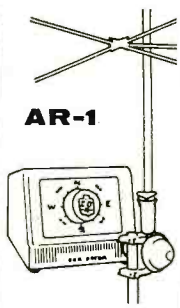
WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



- Pre-Sold to millions every week on TV
- The Most Complete Line . . . A Model for Every Need
- Superior Engineering . . . they're Tried-Tested-Proven

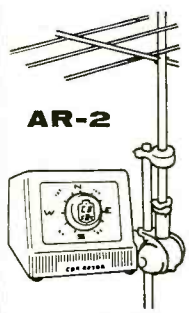
AR-22

Completely AUTOMATIC version of the TR-2 with all the powerful features that made it famous.



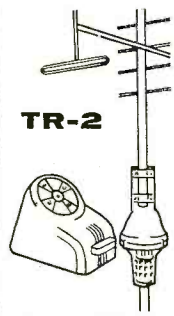
AR-1

Completely AUTOMATIC rotor, powerful and dependable. Modern design cabinet. 4 wire cable.



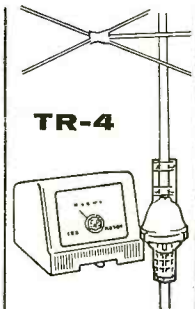
AR-2

Completely AUTOMATIC rotor with thrust bearing. Handsome cabinet, 4 wire cable.



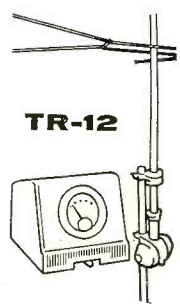
TR-2

Heavy-duty rotor with plastic cabinet, "compass control" illuminated perfect pattern dial, 8 wire cable.



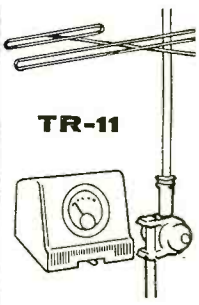
TR-4

Heavy-duty rotor, modern cabinet with METER control dial, 4 wire cable.



TR-12

Combination value . . . complete rotor with thrust bearing. Modern cabinet with meter control dial, uses 4 wire cable.



TR-11

Ideal budget all-purpose rotor, new modern cabinet featuring meter control dial, 4 wire cable.

CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

THE **RADIART** CORP.
CLEVELAND 13, OHIO

For the RECORD

AUTOMATION NEEDS MANPOWER

THE SUBJECT of automation and its effect upon labor has received wide publicity in the newspapers of this country. Feature articles have appeared in our industrial trade journals and in other media discussing the pros and cons of automation and its effect on our economy.

There are now in daily use a large number of computer installations throughout this country. Perhaps the largest of these is the one designed and constructed by *I.B.M.* for use in conjunction with the Air Force National Defense Program. Giant computers such as this require an army of specialists not only to finalize the basic design, but to construct and operate this complicated device. But first, a special plant employing thousands of workers was erected and in spite of the use of highly automated production tools in the assembly of the various sub-sections of the main unit, it was still necessary to employ skilled labor on a grand scale.

A large number of trained specialists worked several years over the original concept before the design was finalized and it was necessary to hire a large working force of other technical people trained specifically to carry out the original design. Still more skilled personnel were and are required for the continuous maintenance of the equipment. Without this vast army of designers, engineers, operators, installers, and clerical help, this computer could not have been brought into existence.

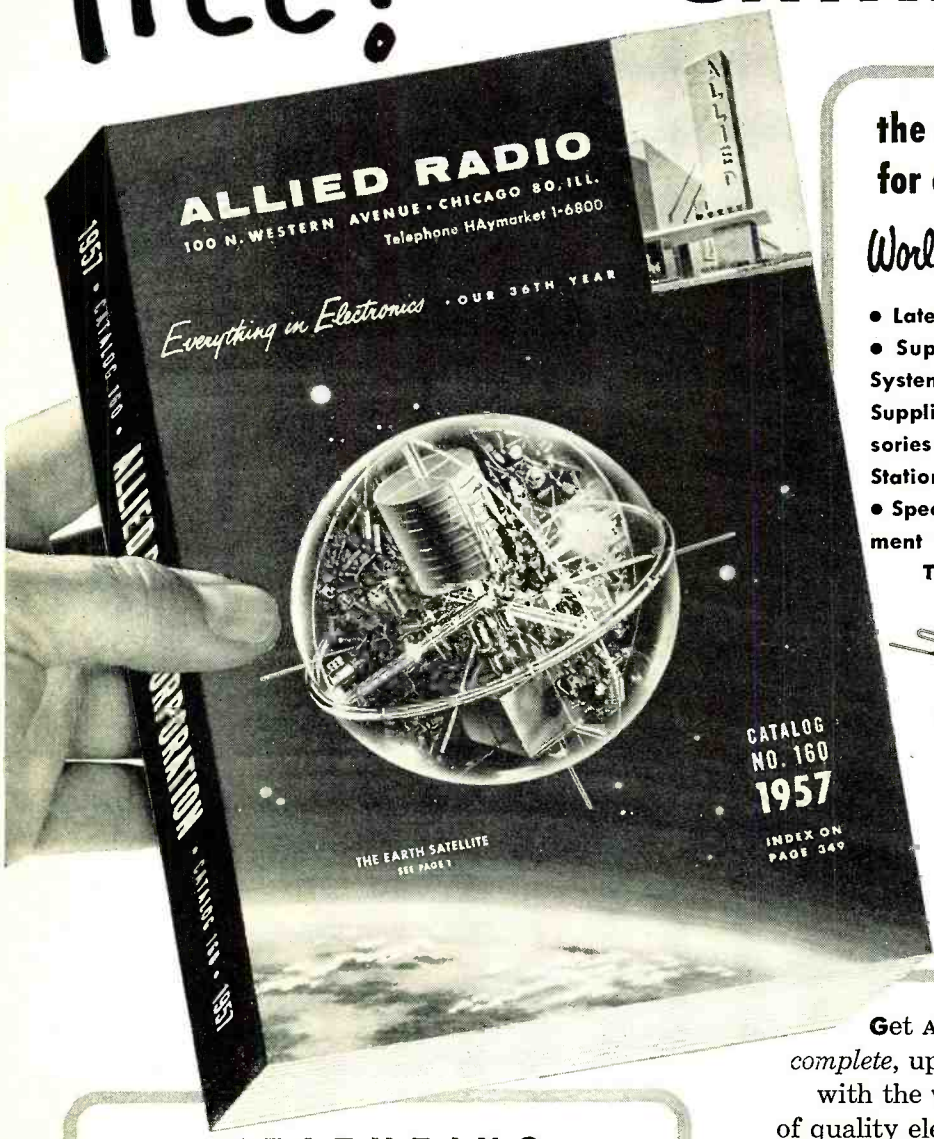
Another example is the computer installed at the Army Signal Supply Agency in Philadelphia. The very latest in electronic computing equipment has been installed so that complete world-wide records can be maintained and continuously evaluated. Records of stock are kept, supply demands are noted, routine decisions are made, and many other daily tasks performed by this computer. This particular installation utilizes a great number of magnetic tape recorders whose primary function is to store instructions for the programming of the computer, to retain inventory figures, and to supply other pertinent facts which result from the "memory" capabilities of the device. Recording speeds on the order of 75 inches-per-second are used along with a seven-head recording mechanism so that seven tracks of information may be recorded and read simultaneously.

In order to design and manufacture such a complicated device, a large number of technical personnel was again required. Once a computer is installed and placed in operation, however, there is still the daily necessity for continual maintenance and adjustment of the unit. As an example, six engineers and three technicians get up at the crack of dawn (or before) and report to the machine at 5:20 every morning in order to set up and check the machine for the day's operation.

Contrary to many beliefs, more personnel is required on the payroll than was actually required at the Supply Agency prior to the installation of the computer. This may be attributed to several factors, some of which are as follows: Workers previously classified as clerical help *per se* will probably be up-graded and trained to meet the more severe demands for skilled labor as a result of the installation of the computer. This, then, would increase the earning capabilities of the workers. Because of the extreme speed of the unit, much more can be accomplished and more data can be processed in a shorter period of time. Accordingly, it will be necessary to have more people capable of carrying out the "decisions" made by the computer. These then are two examples where additional labor is required through automation.

In the case of the military, however, where every attempt must be made to conserve manpower, we find that the use of computers contributes to this requirement to a large degree. Consider, for example, the case of defensive armament on the new B-52 intercontinental jet bomber. This long-range aircraft originally required the services of six gunners to operate its defensive weapons. The computer permits the same defensive advantages and requires but a single operator to fire the guns. The B-52 employs a single movable turret comprising four 50-caliber guns. This armament is tracked and aimed by radar and by optical devices which feed the information into the airborne computer. The computer sets up the fire control problem, aims the guns, and determines the point of intersection, and then tells the gunner when to fire. The action is precise and deadly. While the above represents a military application of electronic computers, we must not overlook the widespread interest in commercial applications of automation. We conclude, therefore, that the computer—in spite of its great capability —will, because of its very peculiar requirements, make more and more demands for skilled personnel for its operation. . . . . O.R.

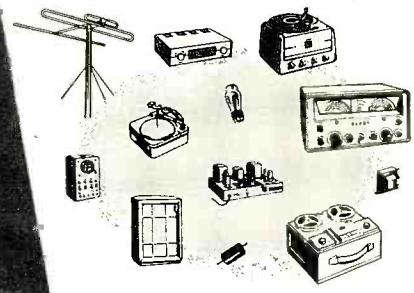
free! ALL ED'S 957 value-packed 356-page CATALOG



the only COMPLETE catalog for everything in electronics

World's Most Complete Stocks

- Latest Hi-Fi Systems and Components
- Super-Value KNIGHT-KITS
- P. A. Systems and Accessories
- Recorders and Supplies
- TV Tubes, Antennas, Accessories
- Amateur Receivers, Transmitters, Station Gear
- Test and Lab Instruments
- Specialized Industrial Electronic Equipment
- Huge Listings of Parts, Tubes, Transistors, Tools and Books...



FEATURING

SUPER-VALUE knight-kits: Finest electronic equipment in money-saving Kit form—Test Instruments, Hi-Fi kits, Hobbyist kits, Ham kits. Easiest to build and you SAVE MORE.

EVERYTHING IN HI-FI: World's largest selection of quality Hi-Fi components and complete music systems—available for immediate shipment from stock. Own the best in Hi-Fi for less!

Get ALLIED's 1957 Catalog—it's *complete*, up-to-date—356 pages packed with the world's largest selection of quality electronic equipment at lowest, money-saving prices. Get *every* buying advantage at ALLIED: fastest shipment, expert personal help, lowest prices, guaranteed satisfaction . . .

EASY-PAY TERMS: Only 10% down, up to 18 months to pay. Available on orders over $45. Fast handling—no red tape.

send for the leading electronic supply guide

free

ALLIED RADIO CORP., Dept. 1-K-6
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 356-Page 1957 ALLIED Catalog

Name.....

Address.....

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

Our 36th year

ALLIED RADIO

World's Largest Electronic Supply House

TEST 5 TUBES in 4 SECONDS EACH...ACCURATELY!

WITH THE NEW ADVANCED ENGINEERED

precise MODEL 116

Gm. & Em. ULTRAFAST TUBE & TRANSISTOR TESTER

Completely NEW!

PRECISE MODEL 116K in kit form..... **$69.95**
PRECISE MODEL 116W factory wired..... $19.95
Incl. carrying case and cover

Servicemen know the Precise Model 111 (the winner in an independent survey) easily rates "the finest tube tester in the field" at any price, BUT FOR AN ON THE JOB QUICK-TEST . . . the fastest, most accurate is the PRECISE Model 116. What's more you test tubes the foolproof method inherent in the famous Precise Model 111.

Did you ever wish you could plug in 5 of the same type tubes at once and check each one individually by rotating a switch? YOU CAN WITH THE PRECISE MODEL 116—Plug in 5 IF tubes and let them heat up at once and then check each one separately by rotating the TUBE BANK switch. ACTUALLY CHECK 5 TUBES IN 20 SECONDS, 4 SECONDS PER TUBE.

The Precise Model 111 taught the lesson that IF amplifier tubes (like the 6BC5 or 6AU6) should be tested for Gm (mutual transconductance) while the power amplifiers (like the 6L6) should be tested for Em (emission)—that's ULTRAFAST Model 116 test! It checks each section of each tube separately . . . by rotating the FUNCTION SWITCH . . . each triode of a dual triode is checked individually . . . each diode and the triode of a duo-diode-triode is separately tested and not lumped as in other testers . . . and a pentode is tested as a pentode—not a diode. TRANSISTORS, SHORTS, GAS, LIFE, Em, Gm etcetera can be tested with the PRECISE Model 116.

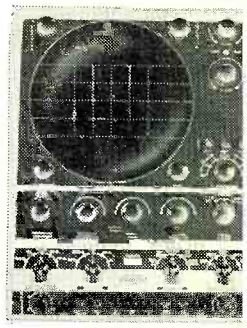
You can inexpensively extend the Precise Model 116 to test filament current, etc. The Model 116 gives an accurate, ultra-fast (3 basic knobs for testing) check of television tubes!

No Surplus—An etched panel—beautiful Moleskin covered wood carrying case and cover and specially simplified instructions makes the PRECISE MODEL 116 THE FINEST FAST-CHECK TUBE TESTER AND DOLLAR EARNING TRAVELING COMPANION A TV SERVICEMAN EVER HAD.

Not yet at your distributor. Order NOW to insure early delivery.

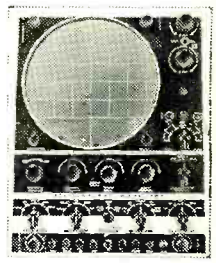
SEE YOUR LOCAL DISTRIBUTOR FOR PROOF OF WHAT WE OFFER — OR WRITE US FOR DOCUMENTARY RESULTS OF AN INDEPENDENT SCIENTIFIC SURVEY.

THE FAMOUS MODEL #111
111K **$79.95**
111W $139.95
Incl. Carrying Case & Cover

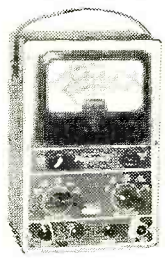


THE FIRST LOW PRICED 7" COLOR SCOPE
300K **$99.95**
300W $199.50

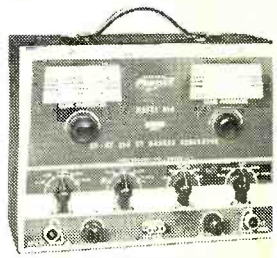
LOW PRICED 5" SCOPE
315K $49.95
315W $84.95



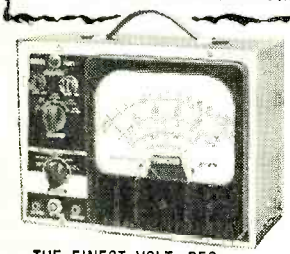
THE FIRST AND ONLY 8½" COLOR SCOPE
308K **$129.50**
308W $229.50



LOWEST PRICED WIRED 4½" VTVM
909K $25.98
909W **$37.50**

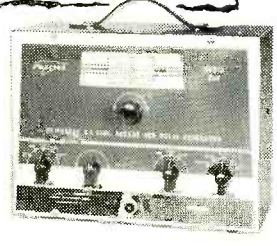


RF—AF—BAR GENERATOR with pre-assembled* head
630K $33.95
630KA* $38.95
630W $53.95



THE FINEST VOLT. REG, 7" VTVM KIT
9071K $35.95
9071W $49.95

LOW PRICED RF SIGNAL GENERATOR "BEST BUY" IN GEN. FIELD
610K $23.95
610KA pre-assembled head..... $28.95
610W $39.95



UNIV. AF, SINE, SQ, & PULSE GEN.
635K $33.50
635W $52.50

Prices slightly higher in the West. Prices and specifications subject to change without notice.

PTAK . $2.9
PTAW . $4.2

WRITE FOR CATALOG RN-10

SEE THE MANY MORE PRECISE INSTRUMENTS AND PROBES AT YOUR DISTRIBUTOR TODAY

precise DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.

Spot Radio News

★ **Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

AN EXTREMELY ENCOURAGING prediction that the future of the ultra-highs looked bright indeed, made by the FCC's headman during an appearance before the communications subcommittee of the Senate Commerce Committee, impressed the committee so, that they granted general approval of the Commission's long-range program to shift all, or a major portion, of the TV stations to u.h.f.

Admitting that he had received no definite assurances that all of technical problems that now obtain on the high bands could be resolved, the chief commissioner said that he was confident though that engineers would eventually solve this problem, as they have solved other problems that have troubled the broadcasting industry. The Commission is doing everything possible, the Senators were told, to help manufacturers develop more efficient antennas, accessories, receivers, and transmitters for the upstairs frequencies.

THE RECENT AIR COLLISION in the Far West and the flurry of warnings that more crashes are certain to come, if some drastic rules are not adopted, prompted the Radio Technical Commission for Aeronautics in Washington to issue a notice announcing release of a special report on mid-air collision control that they had prepared.

The report, prepared by a committee comprising more than 35 members of organizations representing all segments of the aviation industry concerned with air-traffic control, details a series of stiff requirements that an electronic proximity warning system should meet to reduce the hazard of mid-air crashes.

The requirements provide that a warning be given to the pilot of the penetration by another aircraft of a protected volume of airspace; *i.e.*, horizontal airspace protection over a radius of 10 miles surrounding the aircraft; vertical protection for 800 feet above and below flight level at all altitudes up to 30,000 feet and 1600 feet above and below flight level at higher altitudes. The requirements also specify reliability under all weather conditions, availability to all types of aircraft, simplicity of operation and of interpretation of information, and accurate maintenance capabilities.

Also set forth in the report are requirements for more complex designs which will reduce the dimensions of the protected airspace in congested areas and which will provide additional protection against potential collision hazards during descents and climbs.

A GIANT AIR-CONDITIONED 6000-tube electronic computing machine that could save up to two years in the costly development of advanced-design jet engines has been built for the Air Research and Development Command.

One of the largest ever constructed (35 by 100 feet and 12 feet high, covering a floor space that is about the equivalent of three average-sized homes), this unique computer (an analogue type) will enable engineers

(*Continued on page* 16)

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

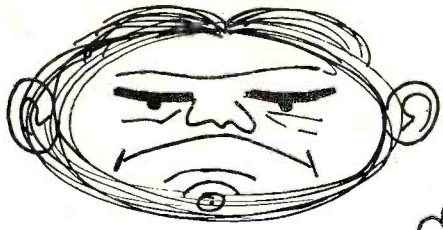
STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Illinois	Peoria	WIRL-TV	8	180-186	316
"	Springfield	WMAY-TV	2	54-60	100
Louisiana	New Orleans	WWL-TV	4	66-72	50
Massachusetts	Greenfield	WRLP	58	734-740	18.2
North Carolina	Raleigh	WRAL-TV	5	76-82	100
Texas	Corpus Christi	KSIX-TV	10	192-198	212

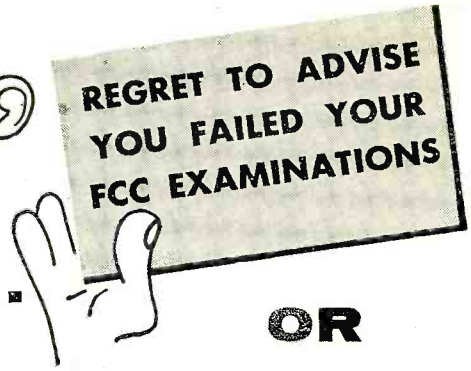
NEW CALL LETTER ASSIGNMENTS

Arizona	Flagstaff	KOLF-TV	9	186-192
Louisiana	Baton Rouge	WCNS	40	626-632
Montana	Kalispell	KGEZ-TV	8	180-186

*ERP=(effective radiated power, kw.)

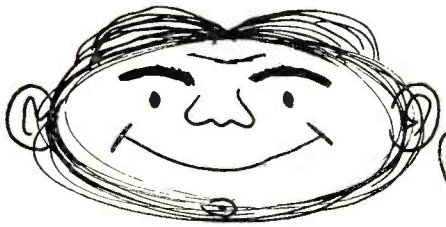
6 months from today

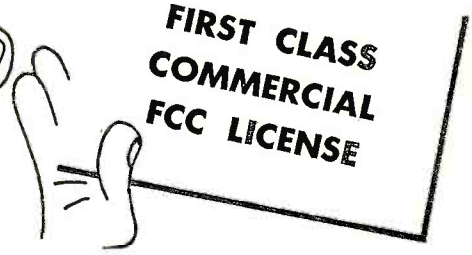




WHICH WILL YOU HOLD...

OR





add technical training to your practical experience. GET YOUR FCC LICENSE QUICKLY!

then use our effective JOB FINDING SERVICE!

WE GUARANTEE YOUR FCC LICENSE

If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind until you successfully obtain your Commercial License.

HERE'S PROOF FCC LICENSES CAN BE SECURED IN A FEW HOURS OF STUDY With OUR Training AT HOME In Spare Time.

Name and Address	License	Time
Walter Eggers, Pacific Grove	1st	12 weeks
Paul Reichert, West Salem, Ohio	2nd	10 weeks
Harold Phipps, LaPorte, Indiana	1st	28 weeks
John J. Johnson, Boise City, Okla.	2nd	12 weeks
James Faint, Johnstown, Pa.	1st	26 weeks

Employers Make OFFERS Like These to Our Graduates Every Month

Broadcast Station in Illinois: "We are in need of an engineer with a first class phone license, preferably a student of Cleveland Institute of Radio Electronics: 40 hour week plus 8 hours overtime."

West Coast Manufacturer: "We are currently in need of men with electronics training or experience in radar maintenance. We would appreciate your referral of interested persons to us."

Our Trainees Get Jobs Like These Every Month

CHIEF ENGINEER

"Since enrolling with Cleveland Institute I have received my 1st class license, served as a transmitter engineer and am now Chief Engineer of Station WAIN. I also have a Motorola 2-Way Service Station. Thanks to the Institute for making this possible."

Lewis M. Owens, Columbia, Ky.

TEST ENGINEER

"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse.) A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."

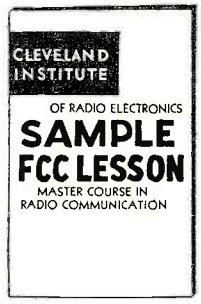
Boyd Daugherty, Falls Church, Va.

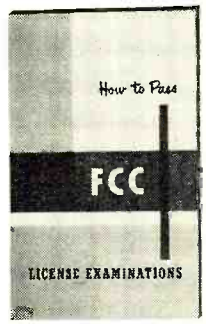
WE CAN PROVIDE HUNDREDS OF NAMES IN YOUR AREA ON REQUEST

Carl E. Smith, E.E., President

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-95, 4900 Euclid Ave., Cleveland 3, Ohio

Get these valuable BOOKLETS FREE!





Member of National Home Study Council

Cleveland Institute of Radio Electronics

Dept. RN-95, 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

Widest choice makes it easy to enjoy

TRUE HIGH FIDELITY

Whatever your space and budget, you find the exact answer in the complete selection of E-V 2, 3 and 4-way speaker system components

Your enjoyment of high-fidelity reproduction depends largely on the efficiency of your loudspeaker system. For only with properly engineered speaker components can you obtain the range, the cleanliness of tone, the realism you want.

With today's most complete line, ELECTRO-VOICE makes it easy for you. You can start with an economical, integrated 2-way coaxial or 3-way triaxial speaker...and expand it as you desire to a multi-way system with the E-V Building-Block Plan. Or, you can choose now a complete, separate 2-way, 3-way, or 4-way speaker system which more efficiently reproduces each section of the audio spectrum.

In E-V speakers, you have the advantage of heaviest, most powerful magnets, edgewise-wound voice coils, scientifically treated cones, and many other features that provide highest efficiency with the least discernible distortion.

What's more...the exclusive E-V Radax principle of high-frequency propagation... the exclusive E-V mid-range coaxial diffraction driver-horns...the exclusive E-V Super-Sonax very-high-frequency drivers...are all designed to bring high-fidelity sound reproduction even closer to perfection.

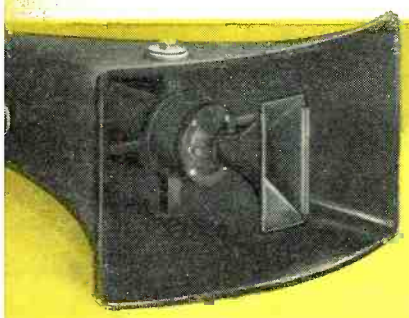
That is why your friends will recommend ELECTRO-VOICE. *Look...and listen... for your own satisfaction.*

SEPARATE 2-WAY SPEAKER SYSTEM

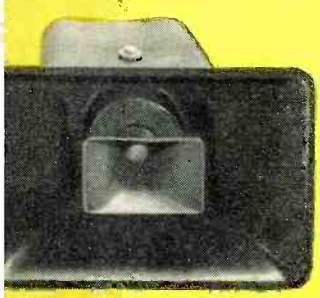
SEPARATE 3-WAY SPEAKER SYSTEM

SEPARATE 4-WAY SPEAKER SYSTEM

Over 50 combinations of matched components are now available factory-installed in enclosures



MID-RANGE COAXIAL



CHOICE OF 39 DIFFERENT DRIVER UNITS

Radax Coaxial Integrated 2-way Speakers in Economy and Super Series . . . in 8-inch, 12-inch, and 15-inch sizes ...from $29.50 to $85.00 net.

TRX Triaxial Integrated 3-way Speakers in Economy and Super Series . . . in 12 inch and 15-inch sizes ...from $64.00 to $145.00 net.

Low-Frequency Drivers (Woofers) for separate multi-way speaker systems in Economy and Super Series . . . in 12-inch, 15-inch and 18-inch sizes ...from $33.00 to $115.00 net.

Mid-Range Coaxial Driver-Horns for separate multi-way speaker systems . . . in 12-watt and 25-watt sizes ...from $33.00 to $52.00 net.

Mid-Bass Driver-Horn Assembly for long-path indirect radiator applications ...$38.00 Net.

Treble Diffraction Horns ...from $18.00 to $22.00 net.

High-Frequency Drivers in 25-watt and 30-watt sizes ...from $42.50 to $58.00 net.

Super-Sonax Very-High-Frequency Drivers (Super-Tweeters) in Economy and Super Units ...from $21.00 to $33.00 net.

High-Frequency Level Control for adjustment to room acoustics ...$3.90 net.

Crossover Networks for separate multi-way speaker systems ...from $9.50 to $75.00 net.

Building-Block Kits of matched components for expansion of existing economy speaker systems ...from $34.50 to $112.00 net.

All components are designed for use in your own or in E-V recommended enclosures. E-V "Do-it-Yourself" Enclosure Kits are also available.

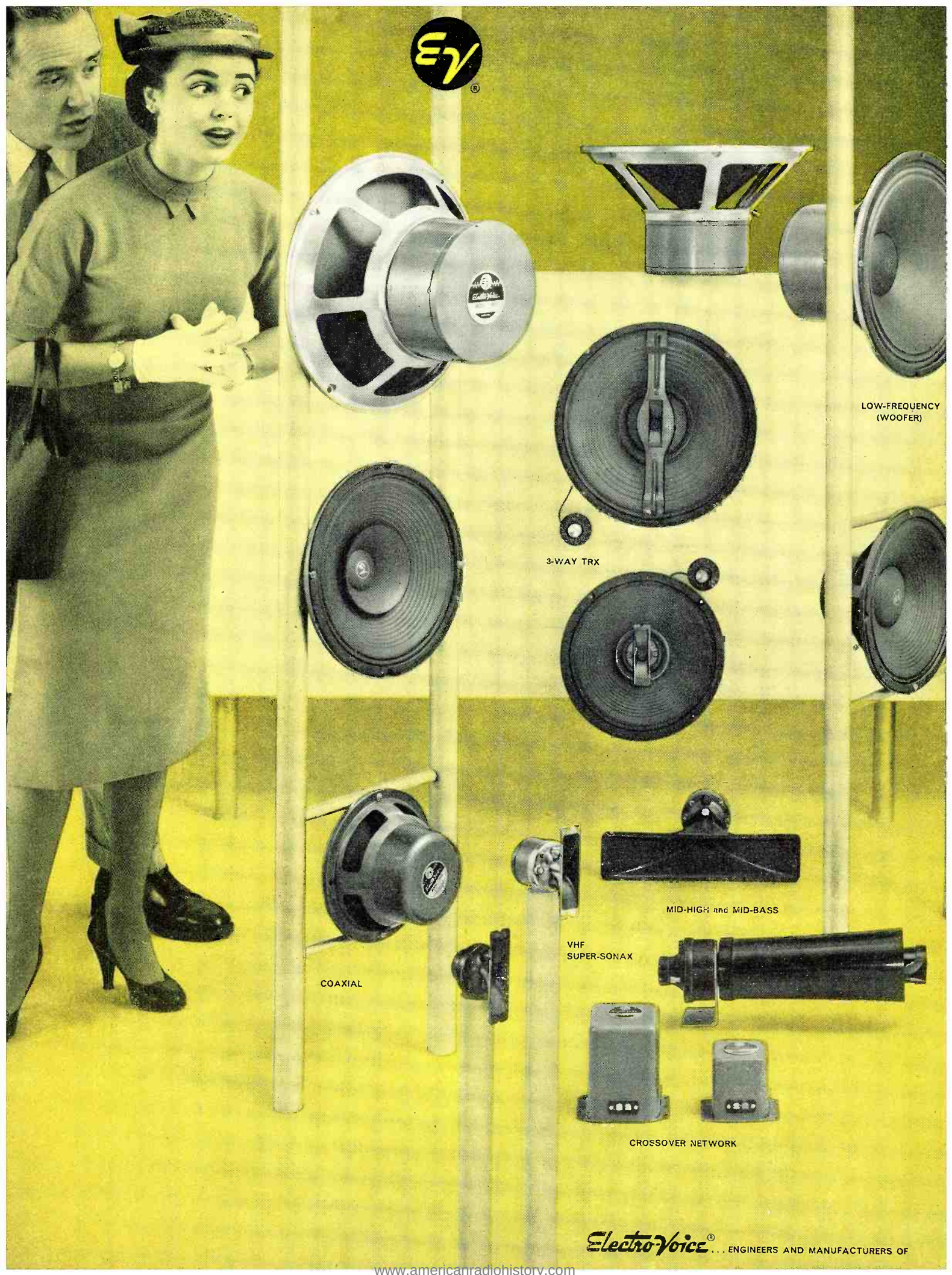
New Catalog-Guide gives quick facts on speaker systems for high-fidelity reproduction. Send 25c to cover postage and handling for No. 117-N610

NO FINER CHOICE THAN **Electro-Voice®**

ELECTRO-VOICE, INC. • BUCHANAN, MICHIGAN

Export: 13 E. 40th St., New York 16, U.S.A., Cables: Arlab

HIGH-FIDELITY SPEAKER SYSTEMS. AMPLIFIERS. TUNERS. PHONO CARTRIDGES. ENCLOSURES. DO-IT-YOURSELF KITS. MICROPHONES AND PUBLIC ADDRESS EQUIPMENT



Electro-Voice® . . . ENGINEERS AND MANUFACTURERS OF

to *fly* jet engines before they are built, and to forecast, in actual control tests, performance characteristics of jet engines that are still on the drawing board. (Checking out an experimental engine normally takes up to six months and costs several million dollars in the wind-tunnel and flight-test phases.)

The computer will become the *brain* for a jet-engine simulator that will reduce the costly wind-tunnel testing and cut down the time and cost of flight testing; both vital phases in the race to develop stronger and faster aircraft.

Flying the computer, an engineer can become a *test pilot* and in a matter of a few hours can see how his blueprint engine reacts to such conditions as giving it the throttle at 20,000 feet altitude, 40 degrees below zero air temperature, and at a speed of 1260 miles an hour.

Previously, it has not been possible to check out a pre-production engine-control system on a sufficiently large number of engines of one type. In many instances, the engine is either not available and its expected performance data are lacking, or, if an experimental prototype of the engine is available, engineers have been unwilling to risk the expensive prototype in gruelling tests.

In operation, the machine works this way: Engineers study the specific problem at hand and reduce it to mathematical form. They then convert it into equations. The computer works out these equations electrically and comes up with the answer in the time it takes an air molecule to pass through the actual engine.

In addition to the 6000 tubes in the computer, there are 140,000 feet of wire and 1700 indicating lights. It also has 2750 knobs or dials, 8200 plug jacks, 300,000 soldered joints, and 100,000 solderless connectors.

An estimated 85,310 man-hours went into the finished product, roughly equivalent to 42 man-years of work. Approximately 8350 hours (2½ man-years) was spent in the drafting stage, and 44,960 man-hours or 23 man-years, in engineering.

MEASUREMENTS OF THE SPEED and attenuation of high frequency sound waves in monatomic gases (helium, neon, argon, krypton, and zenon) were completed recently in Washington by the Bureau of Standards.

While the immediate purpose of these measurements was to assist in the verification of theories of non-uniform gases, the results were found to have a bearing on upper-atmosphere flight, the propagation of shock waves, and the problems of high-speed gas dynamics generally. For example, aerodynamic research has shown that the motion of an airplane or missile through the air is decisively affected by conditions in the so-called boundary layer of air immediately surrounding the moving object. This layer is characterized by the occurrence of large

(*Continued on page* 132)

You Can Train a Home for Good Pay Jobs in

RADIO-TELEVISION

Fast Growing Industry Offers Good Pay, Security, Bright Future

Training PLUS OPPORTUNITY is the ideal combination for success. Today's OPPORTUNITY field is Radio-Television. Over 125 million home Radios plus 30 million sets in cars and 40,000,000 Television sets mean big money, opportunity for trained Radio-Television Technicians. More than 4,000 Radio and TV Broadcasting stations offer interesting and important positions for technicians, operators. Color Television, portable TV sets, Hi-Fi, other developments assure future growth. Radio, Television are both growing. Need for trained technicians is increasing!

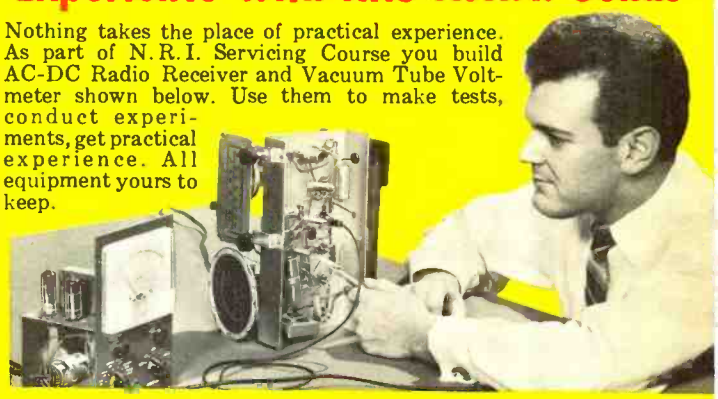
J. E. SMITH
Founder

Find Out What Oldest and Largest Home Study Radio-Television School Offers You

Since 1914—for more than 40 years—N.R.I. has been training ambitious men at home in spare time for Radio-TV. Thousands of successful graudates say N.R.I.'s 50-50 training method is a fast, easy, effective way to higher earnings, desirable jobs. Carefully planned experiments and practice with equipment supplied free of extra charge, bring basic principles, techniques to life right in your own home. Find out what dependable training can do for you.

You Learn by Doing—Get Practical Experience with Kits N.R.I. Sends

Nothing takes the place of practical experience. As part of N.R.I. Servicing Course you build AC-DC Radio Receiver and Vacuum Tube Voltmeter shown below. Use them to make tests, conduct experiments, get practical experience. All equipment yours to keep.



Add to Your Income Starting Soon

Make $10-$15 a Week Extra Fixing Sets in Your Spare Time

Soon after enrolling, many N.R.I. students start earning extra money fixing neighbors' radio sets. Many earn enough extra to pay entire cost of course and provide capital to start their own full time Radio-TV business after getting N.R.I. Diploma. If you want a job with a future, find out how you can train at home for Radio-Television. Mail Postage Free postcard for Sample Lesson. See how practical it is to learn at home. Get 64-Page Catalog, too. See equipment you get, outlines of courses, facts about opportunities in this growing field. Prices of N.R.I. Courses are low, terms easy.

See Other Side

N.R.I. Training leads to good pay jobs like these. BROADCASTING: Chief Technician, Chief Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P. A. Systems, Television Receivers, Electronic Controls, FM Radios, Hi-Fi. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician . . . **AND MANY OTHERS.**

N.R.I. TRAINED THESE MEN

Thanks N.R.I. for Good Start

"Right now I am doing spare-time repairs on Radios and Television. Going into full time servicing soon." C. HIGGINS, Waltham, Mass.

Quit Job to Start Business

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." W. F. KLINE, Cincinnati, Ohio

Engineer with Station WHPE

"I operated a successful Radio repair shop. Then I got a job with WPAQ and now I am an engineer for WHPE." VAN W. WORKMAN, High Point, N. C.

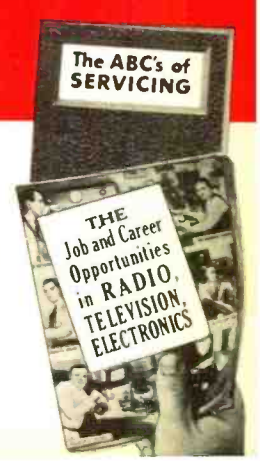
N.R.I. Started His Way up

"I was a cab driver earning $35 a week. Then I enrolled with N. R. I. Now tester with TV maker." J. H. SHEPHERD, Bloomington, Ind.

CUT OUT AND MAIL CARD NOW

SAMPLE LESSON AND CATALOG BOTH FREE

NO STAMP NEEDED! WE PAY POSTAGE



This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive 64-Page Catalog.

NATIONAL RADIO INSTITUTE, Dept. E
Washington 9, D. C.

Please mail me the FREE sample lesson and 64-Page Catalog. (No Salesman will call.)

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

Address .....

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

Approved Member, National Home Study Council

Practice Servicing-Communications with Kits of Parts N.R.I. Sends

YOU BUILD AC-DC Superhet Receiver

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

YOU BUILD Signal Generator

You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical I.F. amplifiers in receiver circuits. Make tests, conduct experiments.

YOU BUILD Broadcasting Transmitter

As part of N.R.I. 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 N.R.I.'s easy-to-understand texts.

Radio-Television Can Give You a Good Job with a Future

N.R.I. Graduates do Important Work — Get Important Pay

Chief Engineer with Station

"I am Chief Engineer of Station KGCU in Mandan, N. D. I also have my own spare time business servicing high frequency, two-way communications systems." R. BARNETT, Bismarck, N. D.

Paid for Instruments out of Earnings

"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix car Radios for garages. I paid for instruments out of earnings." G. F. SEAMAN, New York, N. Y.

Has Own Radio-TV Business

"We have an appliance store with our Radio and TV servicing and get TV repairs. During my Army service, N.R.I. training helped get me a top rated job." W. M. WEIDNER, Fairfax, S. D.

See Other Side

Here is a line of work that people respect—a vocation where you can advance, win a place for yourself, earn good pay and gain much personal satisfaction in what you are able to do. And you can learn at home in your spare time. Smart fellows everywhere are using their spare time to develop new knowledge, new skills. They know it is the trained man who gets ahead, gets the better job, drives the better car, is respected for what he knows and can do.

Be a Skilled Technician

The technical man is looked up to. He should be. He does important work, gets good pay for it. Radio-Television offers that kind of work. There are more than 40 million Televisions, 150 million home and auto Radios. Millions more are sold each year. There are splendid opportunities for the man well trained in Radio-Television Servicing or Broadcasting. Micro-Wave Relay, Aviation and Police Radio, Two-Way Communications for buses, taxis, trucks, etc. are expanding—making more jobs, greater opportunity.

You Can Train in Spare Time

Keep your job until you're ready for a better one. Learn at home. N.R.I. Courses are planned for men who can study only during spare time. You get many kits to build equipment, get practical experience. You work on circuits common to both Radio and TV. Equipment you build "brings to life" things you learn in N.R.I.'s easy-to-understand texts. Experienced N.R.I. instructors, technicians, specialists devote full time to making sure you get the best and simplest Radio-TV training. Train as fast or as slow as you like.

Tested Way To Better Pay

N.R.I. Training is practical, thorough. You get the benefit of N.R.I.'s 40 years experience training men for success in Radio-Television. Most successful N.R.I. men start without any knowledge of Radio, many without a high school education. Find out what Radio-Television training can mean to you. Make a decisive move today toward becoming one of that select group—a Radio-TV Technician. Send for Actual Lesson and 64-Page Catalog, both FREE. **NATIONAL RADIO INSTITUTE, Dept. E, Washington, D.C.**

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

16th and U Sts., N. W.

Washington 9, D. C.

SAMPLE LESSON AND CATALOG BOTH FREE

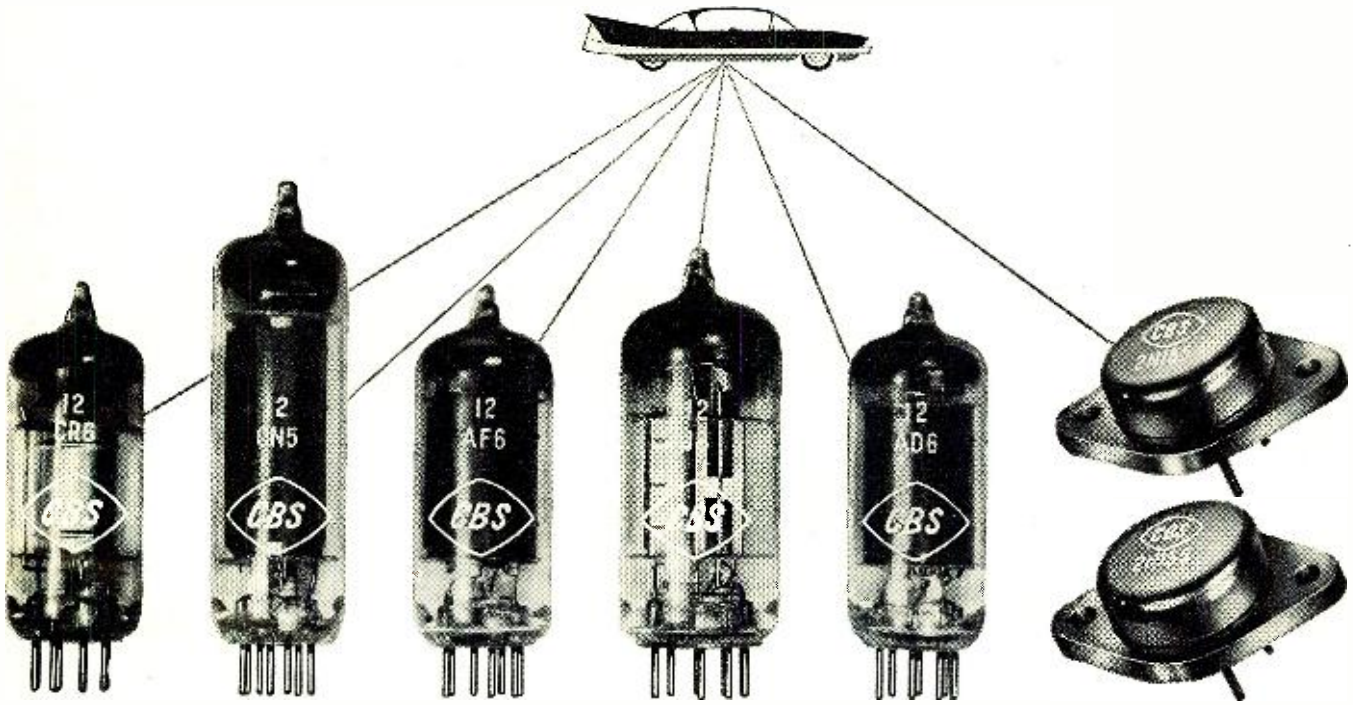
CUT OUT AND MAIL POSTAGE-FREE CARD

a look at the latest in AUTO RADIO

Here are some typical CBS tubes and transistors you will be discovering in 1957 "hybrid" auto radios. They combine the advantages of new CBS power output transistors and modern CBS low-voltage mobile radio tubes. All power for them is drawn directly from the 12-volt battery; the vibrator power pack is eliminated. Both the tubes and transistors are especially designed for hybrid auto radio.

As the 1957 automobiles come into use this fall, you will find CBS ready to supply you with these new tubes and transistors. That's only natural. CBS pioneered the first auto radio tube kit. CBS has specialized for years in supplying auto radio tubes to leading set manufacturers. And now CBS advanced-engineering pioneers again with new hybrid auto radio components.

Whether it's tubes or transistors — whatever you need for auto radio — old, modern, or ultramodern . . . make it CBS. Replace with the same tubes and transistors the original equipment designer specifies . . . CBS.

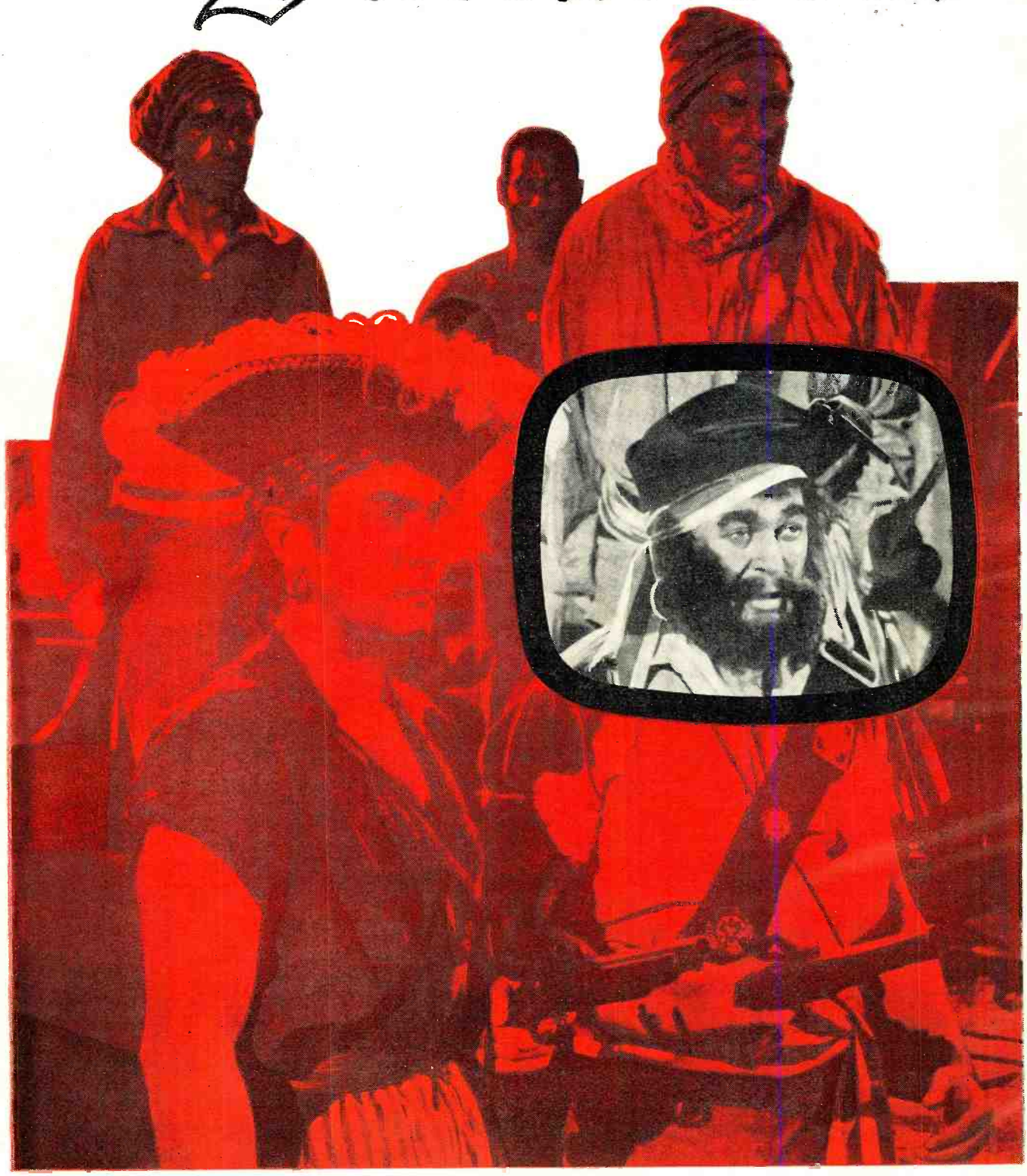


CBS tubes • semiconductors

Reliable products
through Advanced-Engineering

CBS-HYTRON
Danvers, Massachusetts
A Division of Columbia Broadcasting System, Inc.

The "Buccaneers"



Sylvania's new TV show will be televised nationally over CBS stations every Saturday night. Check your local listings for time and station.

new Sylvania TV SHOW

launches a dramatic new advertising program for TV Service Dealers

Biggest TV news this fall for you as a service dealer is Sylvania's new adventure thriller "The Buccaneers." Packed with exciting pirate lore, Sylvania's new TV show offers entertainment for the entire family.

And it offers you a brand-new opportunity to build your service business through a dramatic new consumer advertising campaign, "TV SMOG."

Millions of TV set owners will be reminded that TV Smog comes from old worn out picture tubes and receiving tubes. And they'll be reminded to see the service dealer who displays the Sylvania Radio & TV service sign for a TV Smog check-up.

To supplement this powerful TV advertising, a complete campaign in *TV Guide* magazine will also steer the TV set owner to you for a TV Smog check-up.

Get behind this TV Smog promotion: identify yourself as the dealer in your neighborhood who features "Silver Screen 85" picture tubes and Sylvania's quality brand receiving tubes.

And keep in touch with your Sylvania distributor for new Buccaneer promotion pieces and premiums.

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Building, Montreal

LIGHTING · RADIO · ELECTRONICS
TELEVISION · ATOMIC ENERGY

SYLVANIA

Within the Industry

ERNEST B. MULLINGS has been promoted to the post of assistant advertising manager of the *Heath Company,* according to Robert Erickson, president of the firm. He has specialized in electronics, was an Army radio instructor, holds a ham license, operating with call letters of W8VPN.

Mr. Mullings' previous experience as a project engineer and technical editor, rewrite man, editor of government news releases, and senior technical correspondent for *National Radio Institute* provides a background which will serve him in good stead in his new position. For the past two years he has been responsible for all copy preparation appearing in the company's advertising.

In his new position he will assist Mr. C. M. Edwards, the firm's advertising manager.

* * *

FERRODYNAMICS CORPORATION has been formed to manufacture magnetic recording tapes for commercial, home, and military applications. The firm has established headquarters at Lodi, New Jersey . . . **C. M. SALISBURY AND ASSOCIATES** has been established as a manufacturers' representative firm with headquarters at 1453 7th Avenue, San Francisco 22, California. The agency will cover the northern California territory, servicing industrial accounts and jobbers . . . **SARGENT-RAYMENT CO.** of Oakland, California has changed its corporate name to **ELDORADO ELECTRONICS CO.** and is diversifying its operations to include research, development, and manufacture of nuclear and industrial electronic devices for both commercial and military markets . . . **STEWART-WARNER ELECTRONICS** has entered the facsimile transmission and reception equipment field with the purchase of the entire facsimile business of **THE ALLEN D. CARDWELL ELECTRONICS PRODUCTIONS CORPORATION** . . . As part of its expansion program, **AMPHENOL ELECTRONICS CORPORATION** has purchased the assets of the **EXACT METAL SPECIALTIES COMPANY,** a Chicago screw machine firm . . . **FEDERAL TELEPHONE AND RADIO COMPANY** of Clifton, N. J. has purchased certain assets of a subsidiary of **ELECTRONICS SPECIALTY COMPANY** of Los Angeles . . . **HAYDN SOCIETY RECORD COMPANY** has been reorganized and refinanced under the leadership of Howard Rikoon, who represents the group of businessmen which purchased the firm. Former offices at 40 East 19th St., New York City are being temporarily retained as headquarters . . . **PRECISION METER CO., INC.** has been formed at 126 Greenpoint Avenue, Brooklyn 22, N. Y. The firm will manufacture a full line of meters and handle the production of special meters on a custom basis . . . **THORDARSON-MEISSNER** of Mt. Carmel, Illinois has purchased all the assets and goodwill of the transformer division of **MARK ELECTRONICS** of Bloomfield, New Jersey. All production facilities will be transferred to Mt. Carmel . . . **CARRIER CORPORATION** has announced the formation of **COLORADO RESEARCH CORPORATION** in Denver. The new subsidiary will specialize in electronics and applied physics . . . Formation of a new manufacturing entity, known as **UTRAD CORPORATION,** to continue the operation of the transformer division of **UTAH RADIO PRODUCTS, INC.** has been announced. The new company has headquarters at 812 E. State Street, Huntington, Indiana.

* * *

MORGAN A. GUNST, JR. has been named vice-president of *Chromatic Television Laboratories, Inc.* and general manager of the firm's West Coast development laboratory in Emeryville, California.

He joined the *Paramount Pictures* affiliate in 1951 as manager for military contracts. Until his appointment as general manager, he served as product manager. The company is engaged in research and development in the color television and radar fields utilizing the *Lawrence* color tube.

He was formerly associated with the radiation laboratories of the University of California and M.I.T. He also served as a senior engineer for *Lockheed Aircraft Company.*

* * *

JOHN N. McCAUL has been named supervisor of sales service engineering for electronic products of *Sylvania Electric Products Inc.* He will make his headquarters at Teterboro, New Jersey . . . *Bell Sound Systems, Inc.* of Columbus, Ohio has named **JOHN S. BOYERS** to the post of manager of engineering . . . **WALTER T. HANNIGAN,** former chairman of the board of governors of "The Representatives of Electronic Products Manufacturers, Inc." and chairman of the association's New England Chapter passed away recently . . . **ROBERT F. FELAND, JR.** has been appointed sales manager of *Cal-Tronics Corp.* of Los Angeles . . . *Ampex Corporation* of Redwood City, California has elected **ROBERT SACKMAN** vice-president and appointed **RUSSELL J. TINKHAM** mana-

GET IN ON THE TV BOOM!

L. C. Lane, B.S., M.A. President, Radio-Television Training Association. Executive Director, Pierce School of Radio & Television.

TRAIN FOR A TOP-PAY JOB AS A TELEVISION TECHNICIAN

NO PREVIOUS EXPERIENCE NEEDED — study AT HOME in your SPARE TIME

Next to the atom and hydrogen bombs, the biggest noise being made today is by the booming radio-television-electronics industry.

Now, while the boom is on in full force, is the time for you to think about how you can share in the high pay and good job security that this ever-expanding field offers to trained technicians.

Just figure it out for yourself. There are more than 400 television broadcasting stations operating right now and hundreds more to be built; more than 34 million sets in the country and sales increasing daily. Soon moderately priced color television sets will be on the market and the color stampede will be on.

All these facts mean that good jobs will be looking for good men. You can be one of those men if you take advantage of my training *now* — the same training that has already prepared hundreds of men for successful careers in the radio-television-electronics field.

No experience necessary! You learn by practicing with professional equipment I send you. Many of my graduates who now hold down good paying technician jobs started with only grammar school training.

RADIO-FM-TV TECHNICIAN TRAINING

If you have previous Armed Forces or civilian radio experience you can finish your training several months earlier by taking my FM-TV Technician Course. Train at home with kits of parts, plus equipment to build YOUR OWN TV RECEIVER. ALL FURNISHED AT NO EXTRA COST!

FM-TV TECHNICIAN TRAINING

After you finish your home study training in the Radio-FM-TV Technician Course or the FM-TV Technician Course you get two weeks, 50 hours, of intensive Laboratory work on modern electronic equipment at our associate school in New York City, Pierce School of Radio & Television.
THIS EXTRA TRAINING IS YOURS AT NO EXTRA COST WHATSOEVER. My courses are complete without this extra training, however. It is just an added opportunity for review and practice.

EXTRA LABORATORY TRAINING IN NEW YORK CITY AT NO EXTRA COST!

VETERANS!

My School fully approved to train Veterans under new Korean G. I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

LEARN BY DOING

As part of your training I give you the equipment you need to set up your own home laboratory and prepare for a BETTER-PAY TV JOB. You build and keep an Electromagnetic TV RECEIVER designed and engineered to take any size picture tube up to 21-inch, (10-inch tube furnished. Slight extra cost for larger sizes.) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power supply. Everything supplied, including all tubes.

EARN WHILE YOU LEARN Almost from the very start you can earn extra money while learning by repairing radio-TV sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training from spare time earnings . . . start their own profitable service business.

FCC COACHING COURSE Qualifies you for Higher Pay! Given to all my students AT NO EXTRA COST. Helps you qualify for the TOP JOBS in Radio-TV that demand an FCC license! Full training and preparation at home for your FCC license.

YOU GET THESE *free!*

Radio-Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
Dept. T-10C, 52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Send me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make TOP MONEY IN TELEVISION. I understand I am under no obligation.

(PLEASE PRINT PLAINLY)

Name_____ Age____

Address_____

City_____ Zone____ State____

I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Cameraman & Studio Technician Course

VETERANS! Write discharge date

ager of audio custom engineering . . . **STANLEY S. SIEVERS** has been named television field engineer for *Kay Lab,* San Diego electronics and television equipment manufacturer . . . *G-C Electronics Mfg. Co.* of Rockford, Ill. has appointed **WILLIAM H. DEAN** to the post of sales manager . . . **WILLIAM F. SHARKEY** has been named advertising manager of *I.D.E.A., Inc.,* Indianapolis, Indiana electronics manufacturing firm. He joined the company in 1949 . . . **ROBERT C. KOCMOUD** is the new sales promotion manager of *General Cement Mfg. Co.* of Rockford and all of that firm's sales divisions.

* * *

WALTER CLEMENTS is the new jobber sales manager of *Littelfuse, Inc.* of Des Plaines, Ill.

In his new position, Mr. Clements will direct the company's sales activities to the electronic and automatic replacement markets. He formerly served as sales engineer for the firm, joining the company in 1950 as a member of the sales department.

* * *

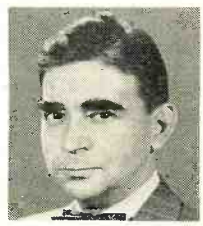
DONALD H. STOVER, formerly service manager of *Sentinel Radio Corporation,* has been appointed Service Coordinator of the Radio-Electronics-Television Manufacturers Association, filling the vacancy created by the resignation of Al Coumont.

Mr. Stover will continue Mr. Coumont's work in coordinating the industry's service activities and, in addition, will undertake an intensive field job of promoting the Association's vocational training program for radio-TV-electronic technicians in vocational schools throughout the country.

Before joining *Sentinel* in 1953, Mr. Stover was associated with the *RCA Institute* in Chicago and the *RCA Victor* Employee Training Program and the *RCA Service Company* at Camden, N. J.

* * *

DR. HERBERT BANDES has been appointed to the newly created post of chief engineer, semiconductors, of the Electronics Division of *Sylvania Electric Products Inc.*



In his new post, Dr. Bandes will be responsible for the development and engineering of transistors, diodes, and other semiconductor devices manufactured at the division's plants in Woburn.

Dr. Bandes joined the firm as a senior engineer in 1944. He received his doctorate in physical chemistry from the University of Michigan in 1938.

* * *

LAFAYETTE RADIO is now servicing its mail order customers from a new building at 165-08 Liberty Avenue, Jamaica, New York. The company's metropolitan

(*Continued on page* 146)

NATIONAL SCHOOLS

proudly presents

FOR MEN WHO WANT TO EARN MORE MONEY

TELERAMA* • ALL 8 BRANCHES OF TELEVISION • ELECTRONICS • RADIO IN ONE DYNAMIC, MODERN SHOP METHOD, HOME TRAINING COURSE

*Registration applied for

Another great advance in **HOME STUDY TRAINING.** Let National Schools, of Los Angeles, a practical Technical Resident Trade School for over 50 years, train you at home by Shop-Method, for today's unlimited opportunities in **ALL 8 BRANCHES** of the Television, Electronics, Radio Industry.

Check all you receive in *One Master Course* at One Low Tuition

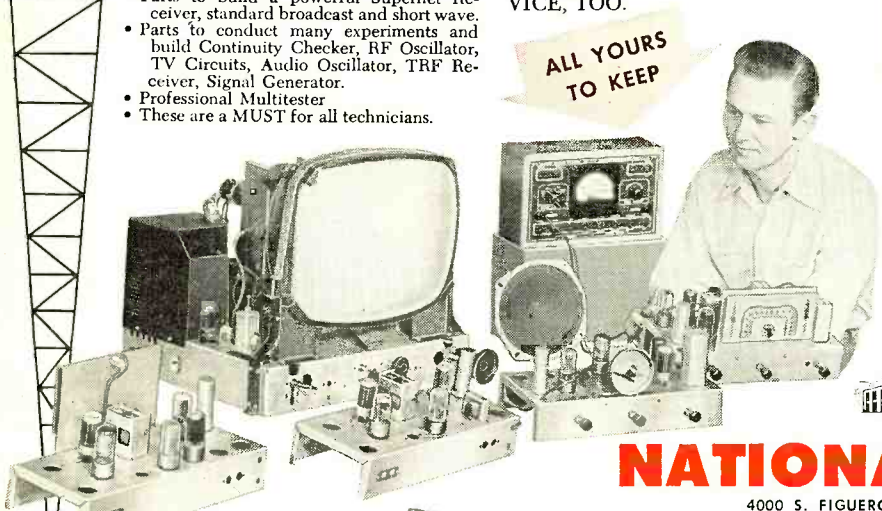
1. **Television — Including Color TV**
2. **Radio — FM and AM**
3. **Industrial Electronics**
4. **Sound Recording and Hi-Fidelity**
5. **Preparation for FCC License**
6. **Automation**
7. **Radar and Sonar**
8. **Communications**

ALL OF THIS MODERN, NEWEST, PRACTICAL EQUIPMENT IS YOURS TO KEEP!

- Parts to Build a modern TV set, including large screen Picture Tube.
- Parts to build a powerful Superhet Receiver, standard broadcast and short wave.
- Parts to conduct many experiments and build Continuity Checker, RF Oscillator, TV Circuits, Audio Oscillator, TRF Receiver, Signal Generator.
- Professional Multitester
- These are a MUST for all technicians.

YOU DO MANY PRACTICAL JOBS. You do servicing, circuit analysis and many other down-to-earth experiments. You build a modern TV set from the ground up . . . with equipment kits we give you, including a new large screen picture tube and professional Multitester, at no additional charge.

EARN AS YOU LEARN! Many of our students earn their entire tuition and more in Spare Time jobs we show them how to do while learning. YOU GET GRADUATE ADVISORY SERVICE, TOO.



L. J. ROSENKRANZ
President of NATIONAL SCHOOLS

This Master-Shop-Method course is completely up-to-date. Here in Los Angeles, the TV and Electronics center of the world, we are able to keep in constant touch with the industries' latest developments. As a student, you will quickly master all phases at home . . . in your spare time. Your earning power will grow with every lesson. Just as thousands of National Schools graduates do every day, you can handle servicing, manufacturing, repairing, hundreds of other jobs, or make good money in your own business. SECURE YOUR FUTURE—NOW. SEND COUPON BELOW.

IN THESE MODERN TV STUDIOS, SHOPS AND LABORATORIES, your Shop Method Home Study Course was developed by experienced instructors and engineers. What an advantage that is to you at home — each lesson is tested, proved, easy to understand. You can master the most up-to-date projects, such as color TV set repair, printed circuits — even prepare for F.C.C. License and industrial electronics without taking a special course. TAKE YOUR FIRST STEP NOW TO A TOP-PAY JOB IN TV, ELECTRONICS, RADIO. SEND COUPON BELOW TODAY

APPROVED FOR VETERANS AND NON-VETERANS

NATIONAL SCHOOLS

4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF.
187 N. LA SALLE ST., CHICAGO 1, ILL.
IN CANADA: 811 W. Hastings St., Vancouver, B. C.

MEMBER

NATIONAL COUNCIL OF TECHNICAL SCHOOLS 1914

NATIONAL HOME STUDY COUNCIL

FREE!

Fully illustrated "CAREER" BOOK in TV, Radio, Electronics. AND actual Sample Lesson—yours at no cost, no obligation SEND COUPON NOW—TODAY!

NATIONAL SCHOOLS
TECHNICAL TRADE TRAINING SINCE 1905
Los Angeles, California

GET FAST SERVICE—MAIL NOW TO OFFICE NEAREST YOU!

NATIONAL SCHOOLS, DEPT. RH-106

4000 S. FIGUEROA ST. LOS ANGELES 37, CALIF. OR 187 N. LA SALLE ST. CHICAGO 1, ILL.

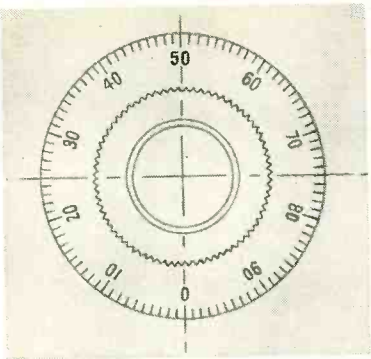
Rush free TV-Radio "Opportunity" Book and sample lesson. No salesman will call.

NAME_____ BIRTHDAY_____ 19__

ADDRESS_____

CITY_____ ZONE____ STATE_____

VETERANS: Give Date of Discharge_____



New heavyweight champion!

Hallicrafters new SX-101 receiver employs heaviest chassis in industry... incorporates V.F.O. feature*...has 2000° disc logging counter.

It's all amateur—and as rugged as they come! Hallicrafters presents the complete answer to ham reception, with every essential needed for today and for the future.

First—built like a battleship. Bigger. Heavier. Second—a marvel of stability—the result of 22 years of experience and development. Third—it brings you a long list of new features:

- **Complete coverage of 7 bands—160, 80, 40, 20, 15, 11-10 meters.**
- **Special 10 mc. pos. for WWV, plus coverage of major MARS frequencies.**
- **Exclusive Hallicrafters upper/lower side band selection.**
- **S-meter functions with A.V.C. off.**
- **Tee-notch filter.**
- ***Local oscillator output available for use in heterodyne V.F.O.**

PLUS: Band in use individually illuminated... built-in crystal calibrator... antenna trimmer... dual conversion... full gear drive from tuning knob to gang condensers... five steps of selectivity from 500-5000 cycles... sensitivity—less than 1 microvolt on all bands... direct coupled series noise limiter... 50 to 1 tuning knob ratio... and many more.

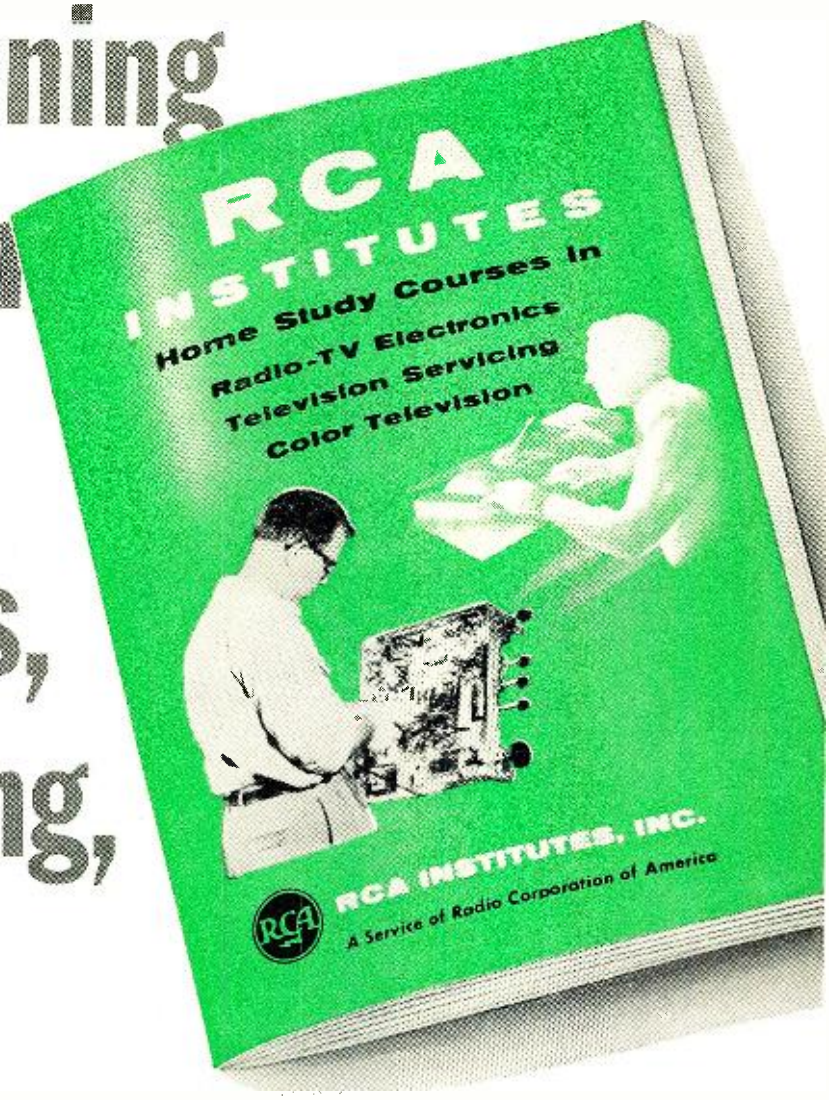
For full specifications see it at your Radio Parts Supplier today!

NEW
FROM
hallicrafters
CHICAGO 24, ILLINOIS

WHERE THE BEST IDEAS IN COMMUNICATIONS ARE BORN

EXPORT SALES: Philips Export Co.
100 East 42nd Street, New York 17, New York

RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV



SEND FOR THIS FREE BOOK NOW!

The instruction you receive and equipment you get (and keep) will start you on your way. Pay-as-you-learn. You pay for only one study group at a time. This 52 page book contains complete information on Home Study Courses for the beginner and the advanced student.

RCA Institutes, Inc., Home Study N-106.
350 West Fourth Street New York 14, N. Y.
Without obligation, send me FREE CATALOG on Home Study Courses in Radio, Television and Color TV. No solesman will call.

Name .....
Please Print
Address .....
City ..... Zone ..... State .....

VETERANS
KOREAN G.I.
P.L. 550
CHECK HERE
( )

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

NEW 16-PAGE G-E 108 PROMOTION

Progress Is Our Most Important Product

GENERAL ELECTRIC

161-1A4

CATALOG OFFERS AND TV-SERVICE AIDS!

THE "new-look" picture at left shows *your* store with General Electric's eye-catching displays installed! These displays highlight the big G-E catalog of promotional and TV-service aids that is just off the press—help make the book a sure guide to more tube, parts, and service volume.

Included are a dozen signs, decals, and streamers for your store identification alone—among them a brand-new Sign-a-rama that flashes different colors three times every two seconds. There are 18 attractive mailers and postcards to pull business . . . 19 copy-tested ads in mat form . . . many doorknob hangers, "out" cards, and other sales-builders. The catalog also lists service helps galore, from job tickets to 10 ingenious mechanical aids to faster, more economical service work.

Pick up your copy of the catalog from your G-E tube distributor . . . or, if your location makes this inconvenient, write direct to General Electric. Just clip, fill out, and mail the handy coupon below! *Electronic Components Division, General Electric Company, Schenectady 5, N. Y.*

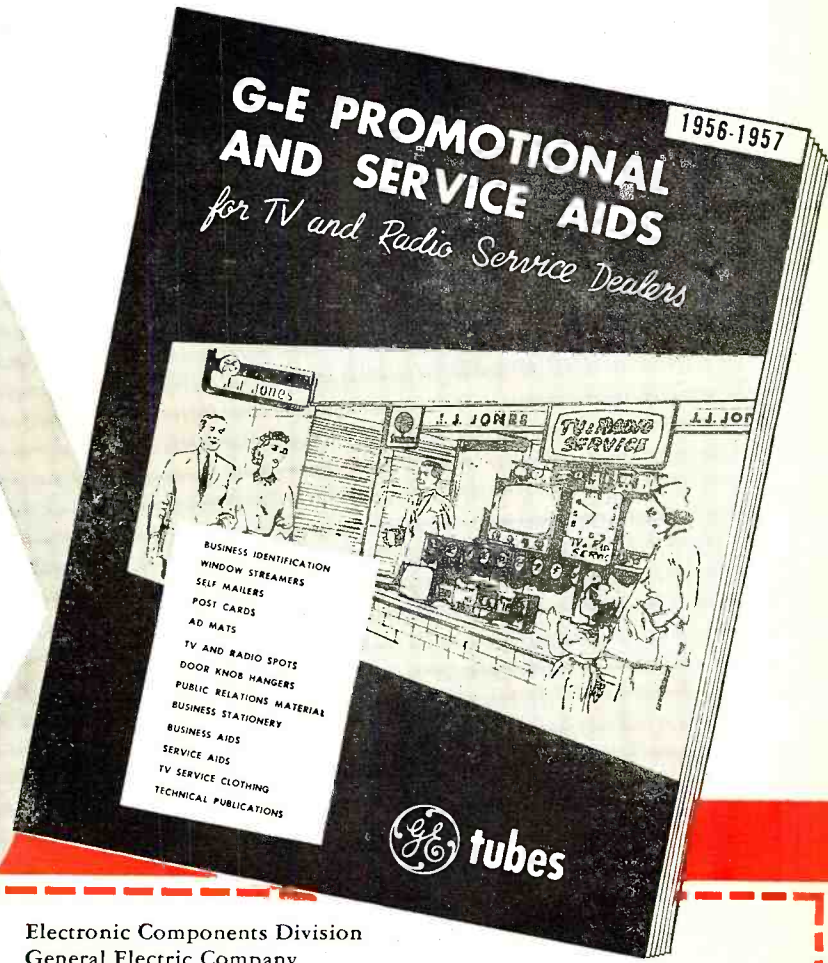
GENERAL ELECTRIC'S 108 BUSINESS AIDS INCLUDE—

For store identification:
- Multi-color Sign-a-rama
- Projecting outdoor signs
- Window and counter signs
- Clock signs
- Window and truck decals

Window valances & streamers
Direct-mail material
Postcards
Ad mats
TV and radio spots

Public-relations helps:
- Doorknob hangers
- Children's Color Book
- Customer TV service reports
- Giveaway booklets

Business stationery
Business aids
Service aids
TV service clothing
Technical publications



Electronic Components Division
General Electric Company
Bldg. #3—C.A.R.T., Schenectady 5, N. Y.

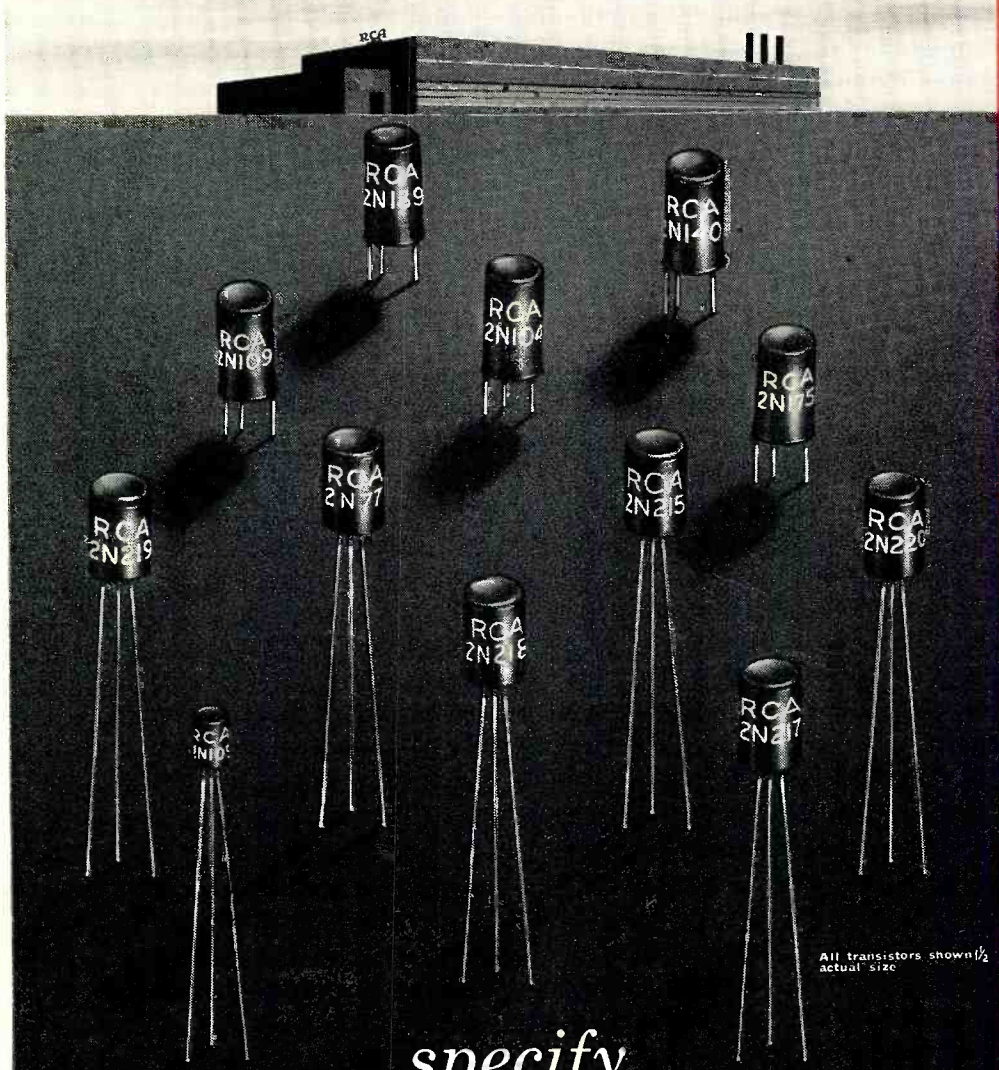
Please rush your 16-page illustrated catalog of business-promotion and service aids (ETR-589-D) to:

YOUR NAME.....

STREET ADDRESS.....

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

FOR QUALITY IN QUANTITY



specify

RCA TRANSISTORS

Whether you are a "ham," experimenter, service technician, or design engineer—building a rig, becoming familiar with transistors, replacing one in a set, or constructing a production prototype—you want exactly what RCA TRANSISTORS offer—high quality, long life, and uniformity of electrical characteristics. Because of the exceptional uniformity in characteristics of RCA transistors, each RCA TRANSISTOR of a type can be replaced with RCA transistors of the same type without need for circuit adjustments. Whether you need a few, one hundred, or one hundred thousand transistors —*for quality, specify RCA TRANSISTORS.*

AVAILABLE THROUGH RCA DISTRIBUTORS . . . NOW!

RCA TRANSISTORS

SEMICONDUCTOR DIVISION, SOMERVILLE, N. J.

RCA-2N77 . . . For low-power audio-frequency amplifier service. Has flexible leads which may be soldered or welded into the associated circuits.

RCA-2N104 . . . For low-power audio-frequency applications. Has a linotetrar 3-pin base.

RCA-2N105 . . . For low-power audio-frequency amplifier service where extremely small size is a requirement. Has flexible leads which may be soldered or welded into the associated circuits.

RCA-2N109 . . . For class B push-pull power output stages of battery-operated portable radio receivers and audio amplifiers operating at power output levels of approximately 150 milliwatts. Has a linotetrar 3-pin base.

RCA-2N139 . . . For 455-Kc intermediate-frequency amplifier applications in transistorized portable radios and automobile radios. Has a linotetrar 3-pin base.

RCA-2N140 . . . For converter and mixer-oscillator applications in standard-AM-broadcast-band transistorized portable radios and automobile radios. Has a linotetrar 3-pin base.

RCA-2N175 . . . Low-noise type (6 db max.) for use in preamplifier or input stages of transistorized audio amplifiers operating from extremely small input signals. Has a linotetrar 3-pin base.

RCA-2N215 . . . Has same electrical characteristics as 2N104 but has flexible leads.

RCA-2N217 . . . Has same electrical characteristics as 2N109 but has flexible leads.

RCA-2N218 . . . Has same electrical characteristics as 2N139 but has flexible leads.

RCA-2N219 . . . Has same electrical characteristics as 2N140 but has flexible leads.

RCA-2N220 . . . Has same electrical characteristics as 2N175 but has flexible leads.

NEW PLANT IN OPERATION . . . To meet the ever-increasing demand for high-quality RCA TRANSISTORS, a new plant has been constructed at Somerville, N. J. It is equipped with the most modern production and inspection facilities to maintain RCA's high standards for *quality.*

NEW! COLOR and Black-&-White LAB & TV 5" OSCILLOSCOPE #460
KIT $79.95. Wired $129.50

The FINEST professional 5 mc wide-band scope value. Ideal for research, h-f & complex waves, plus Color & Monochrome TV servicing. Flat from DC to 3.58 mc ±1 db (color burst freq.), flat DC to 4.5 mc +1, −3 db. Vert. sens. 25 rms mv/in. Vert. Z 3 megs. Has the following outstanding features not found in scopes up to several times its price, kit or wired:

VERTICAL AMPLIFIER: direct-coupled (DC) thruout to eliminate l-f phase shift; **push-pull thruout** for negligible distortion; **K-follower coupling** between push-pull pentode stages for extended h-f resp. (minimizes h-f phase shift, extends useful resp. to 10 mc); full-screen undistorted vert. defl; 4-step freq-compensated decade step attenuator up to 1000:1. **SWEEP CIRCUIT:** perfectly linear sweeps, 10 cps – 100 kc (ext. cap. for down to 1 cps); **pre-set TV vert. & hor. positions** (30 & 7875 cps); automatic sync. ampl. & limiter eliminates sync amplitude adj. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; anti-glare filter; bezel fits std photo equipt. **OTHER IMPORTANT FEATURES:** High intensity trace CRT. Finest sq. wave resp. (.06 usec rise time). Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in voltage calibration. Intensity mod. Sawtooth & 60 cps outputs. Astigmatism control. Retrace blanking. Instant, drift-free full-screen vert. positioning & 2X full-screen hor. positioning. **Bal., cal., astig. adj. externally accessible.** 5UP1 CRT, 2–6AU8, 2-6CB6, 1-12AU7A, 2-6J6, 1-6AX5, 1-1V2. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. Designed for easy building at home with no special equipment. 13" x 8½" x 16". 30 lbs.

SCOPE DIRECT PROBE* #PD: KIT $2.75. Wired $3.95. Eliminates stray-pick-up & signal re-radiation.

SCOPE DEMODULATOR PROBE* #PSD: KIT $3.75. Wired $5.75. Demodulates AM carriers between 150 kc and 250 mc.

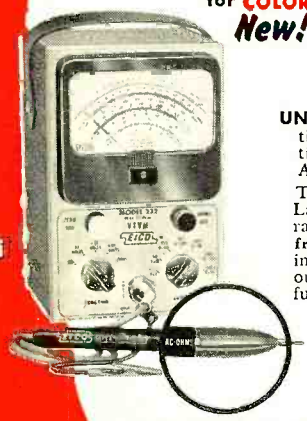
SCOPE LOW CAPACITY PROBE* #PLC: KIT $3.75. Wired $5.75. For signal tracing in high frequency, high impedance & wide-band circuits (as in TV) without distortion from overloading or frequency discrimination.

150 kc to 435 mc with ONE generator!

New! RF SIGNAL GENERATOR #324
KIT $26.95. Wired $39.95
for COLOR and Monochrome TV servicing

New wide-range, stable generator – better value then generators selling at 2 or 3 times its cost! Ideal for: IF-RF alignment, signal tracing & trouble-shooting of TV, FM & AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: **150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. 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 volts needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 volts. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. Tubes: 12AU7, 12AV7, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 8" x 10" x 4¾". 10 lbs.

The specs are the proof...
4 NEW BEST BUYS by EICO



for COLOR and Monochrome TV servicing

New! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)
KIT $29.95. Wired $49.95

UNI-PROBE: exclusive with EICO! Terrific time-saver! Only 1 probe performs all functions—a half-turn of probe-tip selects DC or AC-Ohms.

The new leader in professional peak-to-peak VTVMs. Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't-burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak 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. 12AU7, 6AL5, selenium rectifier; xfmr-operated. 8½" x 5" x 5". Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 7 lbs.

New! DELUXE PEAK-to-PEAK VTVM #249
with 7½" METER & UNI-PROBE (pat. pend.)
KIT $39.95. Wired $59.95

Calibration without removing from cabinet

All the advanced & exclusive features of #232—PLUS the extra convenience and readability of its big 7½" meter. Your ideal bench instrument.

VTVM RF PROBES* #PRF-11 or PRF-25: KIT $3.75. Wired $4.95. Accuracy ±10%. Use with any 11 or 25 megohm VTVM.

VTVM HV PROBE #HVP-2: Wired $4.95. Complete with multiplier resistor. Measures up to 30 kv with any VTVM or 20,000 ohms/volt VOM.

*Only EICO probes have all these features: fully shielded; rugged terminal board parts mounting; shock-mounted, floating construction; swivel-action; color-coding; easy parts accessibility.

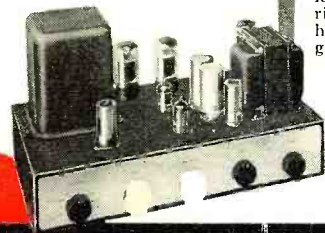
COMPLETE with Preamplifier, Equalizer and Control Section

New! 20-WATT Ultra-Linear Williamson-type HIGH FIDELITY AMPLIFIER #HF20
KIT $49.95. Wired $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price. kit or wired. Every detail, down to the etched, brushed solid brass control plate, is of the fine quality EICO is famous for.

Rated power output: 20 watts (34 w peak). **IM distortion (60 cps: 6 kc/4:1) at rated power:** 1.3%. **Mid-band harmonic distortion at rated power:** 0.3%. **Maximum harmonic distortion between 20 and 20,000 cps at 1 db under rated power:** approx. 1%. **Power response (20w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Frequency response (¼w):** ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps.

5 feedback equalizations for LP's & 78's including RIAA. Variable turnover feedback tone controls do not affect volume & permit large boosts or cuts at either end of audio spectrum with mid-freqs. unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. 4 hi-level switched inputs: tuner, tv, tape, auxiliary (xtal/ceramic phono or 2nd tuner); 2 low-level inputs for proper loading with all leading magnetic, FM & quality xtal cartridges. Hum bal. control. Extremely fine output transformer has interleaved windings, tight coupling, careful balancing & grain-oriented steel. 8½" x 15" x 10". 24 lbs.



These amazing EICO values are **NOW IN STOCK** at your nearest distributor. Examine them side-by-side with **ANY** competitor. You'll see for yourself why indeed EICO is your **BEST BUY.** Fill out coupon on reverse page.

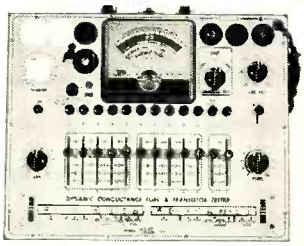
EICO

TURN PAGE FOR MORE EICO VALUES...

84 Withers Street, Brooklyn 11, New York

Prices 5% higher on West Coast

the specs are the test that tells who's best!



for COLOR & Monochrome TV servicing

NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

Unexcelled testing thoroness & accuracy. **Checks transistor collector current & Beta** using internal dc power supply. **Tests all receiving tubes** including subminiatures (& Color & Monochrome tv pic tubes with accessory adapter). **Composite indication of mutual conductance, plate conductance, & peak emission.** Simultaneous sel. of any 1 of 4 combinations of 3 plate, 3 screen, & 3 ranges of control grid voltage. Grid voltage variable over 3 ranges with 5% accurate pot. **New series-string voltages** for 600, 450 & 300 ma types. 5 ranges meter sens. with 1% precision shunts & 5% accurate pot. 10 SIX-position lever switches for free-point connection of every tube pin or cap. 10 pushbuttons for **rapid** insert of any tube element in leakage circuit & **speedy** sel. of individual tube sections. **Direct reading of inter-element leakage *in ohms*.** New gear-driven rollchart. Steel case with cover & handle. Sensitive 200 *ua* meter.

NEW

for COLOR & Monochrome TV servicing

TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

The FINEST service instrument of this type ever offered in either kit or wired form at ANY price! Outstanding ease & accuracy in FM & TV (including Color) alignment. **Entirely electronic sweep circuit** with accurately biased Increductor: **superb linearity** on both sides of selected center freq. **Newly-designed AGC circuit** automatically adjusts osc. for max. output on each band with min. amplitude variations. Sweep gen. range 3-216 mc in 5 OVERLAPPING FUND. BANDS. Sweep width continuously variable from 0-3 mc lowest max. deviation to 0-30 mc highest max. deviation. **Variable marker gen.** range from 2-75 mc in 3 FUND. BANDS plus a calibrated harmonic band (60-225 mc). Variable marker calibrated with **int. xtal marker gen. 4.5 mc xtal included.** Ext. marker provision. Double pi line filter. **Edge-lit hairlines** eliminate parallax.

Turn page for other EICO ad

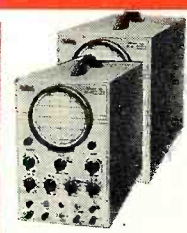
FREE 1956 EICO CATALOG!

Tells you how to SAVE 50% on your test equipment costs!

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

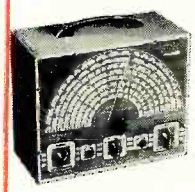
New! **GEIGER COUNTER #803**
KIT $19.95 Wired $29.95

(less batteries)
Professional, all-electronic, sensitive, rugged—at lowest cost! Indicates by neon lamp & headphone clicks.

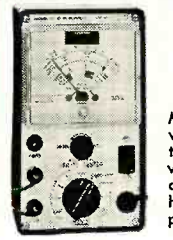


5" PUSH-PULL OSCILLOSCOPE #425
KIT $44.95
Wired $79.95
•
7" PUSH-PULL OSCILLOSCOPE #470
KIT $79.95
Wired $129.50

VACUUM TUBE VOLTMETER #221
KIT $25.95
Wired $39.95
•
DELUXE VTVM #214 (7½" METER)
KIT $34.95
Wired $54.95

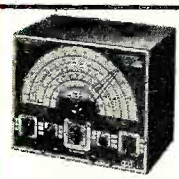


RF SIGNAL GENERATOR #320
KIT $19.95
Wired $29.95
150 kc-34 mc, calibrated harmonics to 102 mc. Pure or mod. RF, & Colpitts osc. 400 cps sine outputs.

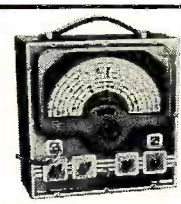


NEW!
REDI-TESTER #540
KIT $12.95
Wired $15.95
Multi-range ac/dc voltmeter, ammeter, ohmmeter, wattmeter, leakage checker for home & auto repairs.

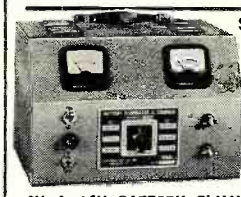
#944 FLYBACK TRANSFORMER & YOKE TESTER
KIT $23.95
Wired $34.95
• fast check all flybacks & yokes in or out of set.
• spots even 1 shorted turn!



Range 500 kc—228 mc on fund. Cont. sweep width control, 0—30 mc.
KIT $34.95
Wired $49.95
TV/FM SWEEP GENERATOR #360
5MC-4.5MC CRYSTAL .....$3.95 ea.



1% accuracy on all 7 ranges. Range 75 kc—150 mc. Volt reg.
KIT $39.95
Wired $59.95
DELUXE RF SIGNAL GENERATOR #315



Sep. volt-meter & ammeter
KIT $29.95
Wired $38.95
6V & 12V BATTERY ELIMINATOR & CHARGER #1050

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
KIT $24.95
Wired $39.95
DELUXE MULTI-SIGNAL TRACER #147

Reads 0.5 ohms—500 megs, 10 mmfd—5000 mfd power factor.
KIT $19.95
Wired $29.95
R-C BRIDGE & R-C-L COMPARATOR #950B

NEW!
HI-FI PREAMPLIFIER #HF-6
KIT $24.95 Wired $37.95. With Power Supply: KIT $29.95. Wired $44.95
Feedback circuitry thruout! Preamp-equalizer, tone controls, scratch & rumble filters, K-follower output.

20,000 Ohms/Volt MULTIMETER #565
KIT $24.95
Wired $29.95

1000 Ohms/Volt MULTIMETER # 536
KIT $12.90
Wired $14.90

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

For FREE 1956 catalog, mail coupon NOW!

EICO®
84 Withers St. • Brooklyn 11, N. Y.

Prices 5% higher on West coast and subject to change without notice. ©56

EICO, 84 Withers Street R-10
Brooklyn 11, New York

Send FREE 1956 Catalog and name of neighborhood EICO jobber.

Name.....
Home Address.....
City.....Zone.....State.....
Occupation.....

1945 to 1955: a decade of Know-How & Value Leadership in Kits & Instruments—over ½ million sold to date!

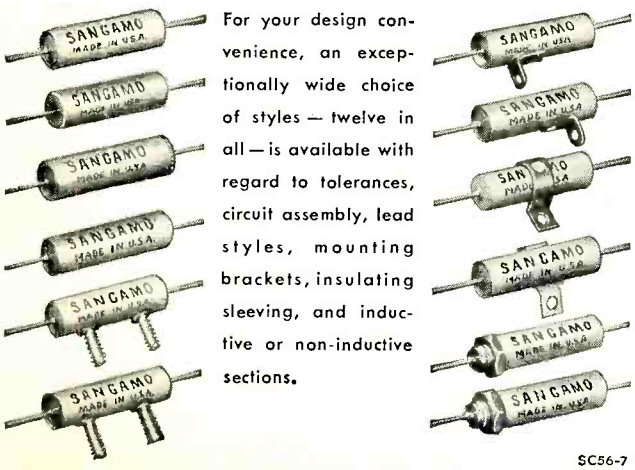
High reliability manufacturing of miniaturized paper tubular capacitors -- hermetically sealed in metal cans

To produce subminiature paper capacitors free from any possibility of latent defects, for use in the most critical applications, the Sangamo Electric Company has recently intensified its high reliability program of fabrication and inspection methods.

Incoming materials for these capacitors are rigidly inspected to meet stringent high reliability standards and are stored in areas where temperature, humidity and dust are controlled at all times.

Complete production histories are kept on the basis of small capacitor lots. X-raying of individual units, heat tests, vibration tests, altitude tests, and total destruction tests of a given percentage of all finished units assure components with an extremely low AQL. Testing facilities and resultant performance characteristics are far in excess of military specifications. Specify these high reliability capacitors for your critical applications.

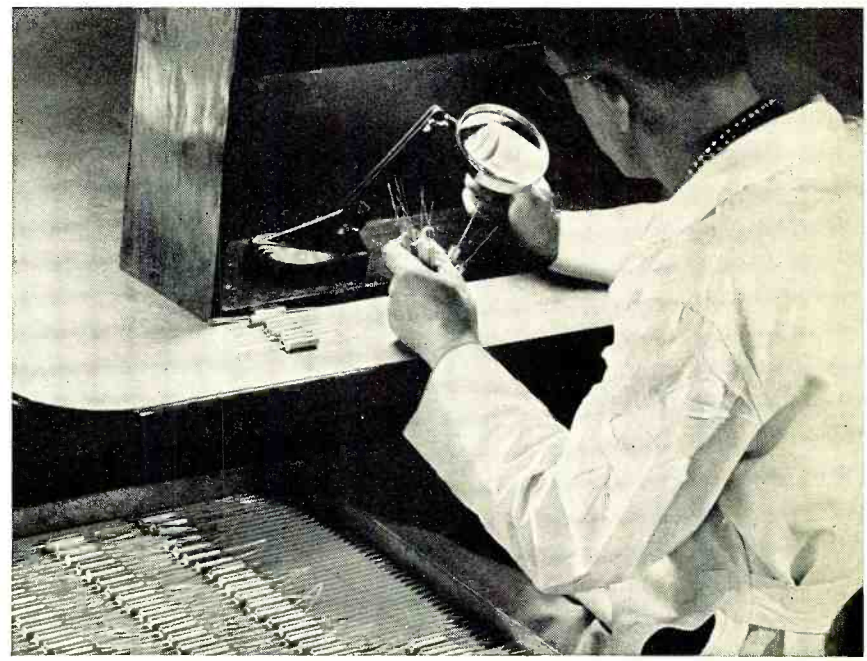
Mail the coupon below for Sangamo's *NEW Engineering Catalog TS-105A.* It contains full information, including an easy-to-follow cross reference showing each variation listed in MIL-C-25 versus the comparable Sangamo unit.



For your design convenience, an exceptionally wide choice of styles — twelve in all — is available with regard to tolerances, circuit assembly, lead styles, mounting brackets, insulating sleeving, and inductive or non-inductive sections.

SC56-7

SEPARATE FACILITIES are maintained for the exclusive processing and manufacture of high reliability capacitors. Only specially trained, highly skilled operators, who wear special clothing to prevent any possible source contamination, work here.



OIL-FILLED CAPACITORS are subjected to vacuum under elevated temperatures, then are individually examined to insure complete hermetic seal.

SANGAMO ELECTRIC COMPANY

Capacitor Division

SPRINGFIELD, ILLINOIS

Please send me your NEW Engineering Bulletin TS-105A.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

PHOTO BY ALLAN D. CRUICKSHANK

Another reason why today's fastest selling high fidelity record changer is **Collaro**

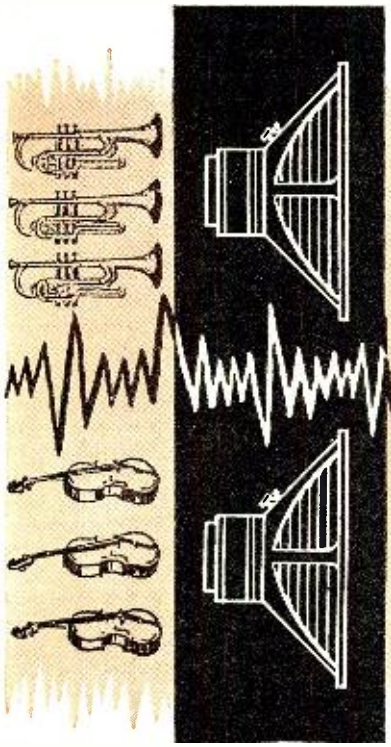
*** Simple Installation —**

the pre-wired audio cable and the power cord with standard plugs eliminate need for making solder connections. Pre-cut mounting board available.

MEMBER INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC

For other features and new popular price, see your hi-fi dealer or write Dept. PK-4

ROCKBAR CORPORATION 650 Halstead Avenue, Mamaroneck, N. Y.



Why Do Loudspeakers Sound Different?

By NORMAN H. CROWHURST

A discussion of the various loudspeaker characteristics with regard to frequency response, nonlinear distortion, and the wave distribution of the loudspeaker propagation.

IN THE quest for high fidelity one often meets what seems to be an indefinable something about a particular reproduction. Often when we compare various loudspeakers, there seem to be differences that are difficult to account for in simple terms of frequency response or distortion, a subtle difference in tone, whereby one loudspeaker seems to give much more effective presentation of brass instruments than another, while the second one seems more effective on strings. And yet careful listening tests, as well as measurements, would suggest that both units were sensibly free from resonances in the response curve and of very similar fidelity.

The other day, for example, while listening to an extremely good loudspeaker unit, a friend commmented that a solo violin—while it sounded definitely like a single instrument—*sounded like a very large violin!* This was not because the instrument was played particularly loud or because it emphasized any particular harmonics in the violin. It sounded perfectly natural yet it did sound unnaturally "large."

Based on the usual concept of sound reproduction, these differences are rather difficult to explain. We are told that the original sound waves are converted into electrical impulses and then reconverted into sound waves, by which is meant a succession of pressure variations that are propagated through space. Based on this simple concept, we ask ourselves, if the pressure fluctuations propagated faithfully copy the original, how can there be any difference? The fact is that matters are a little more complicated than this simple statement would lead us to believe.

Because the differences we note are difficult to explain in accepted terms does not mean, however, that they cannot be accounted for by physical phenomena. There is nothing psychic about the reproduction of sound. The impression conveyed to us has to be transmitted by means of wave propagation and it must be some characteristic of this transmission that makes us aware of these subtle differences.

Because a better understanding of these things will undoubtedly enable readers to make a more intelligent and critical approach to the "ultimate" in high fidelity (please note the author does *not* suggest anyone will ever reach it!), we shall endeavor to explain some of the things that can produce these differences. There are three physical factors about the performance of a loudspeaker which are responsible, either individually or jointly, for the differences we notice: (1) the frequency response and its effect upon transient performance, (2) forms of nonlinear distortion due to the loudspeaker unit itself and, certainly not the least important, (3) the wave distribution of the loudspeaker propagation.

We have been taught that sound is propagated by means of a longitudinal vibration. This technical expression means that air particles in the path of sound travel vibrate to and fro along the direction in which the sound wave is traveling. While, fundamentally, this is true, we encounter so many complicating factors that, in practice, it is seldom completely true. When considering sound transmitted over vast distances this fundamental principle applies closely, but it is not customary to place a loudspeaker in a field and go listen to it half a mile away! Under our more usual listening conditions sound is not propagated in quite this simple manner, as we shall see.

Frequency Response and Transients

Taking up the matter of frequency response, it can be rather potently illustrated by a microphone that was once developed. Due to the fact that microphones in those days were beset by numerous resonance problems, the idea was conceived of designing a microphone with just one big resonance, so as to avoid all the little ones.

To do this, the diaphragm was mounted so as to provide a resonance with the interior of the microphone, which consisted of just one large cavity. All the smaller cavities were connected with this cavity by holes that were large enough to avoid producing individual resonances. This cavity was then loosely filled with some kind of acoustic damping material that reduced the amplitude of the resonance somewhat but still left a response with a peak about 30 db high at a frequency in the region of 600 cycles.

When an electrical absorption circuit with a dip or hole about 30 db deep at this same frequency and of the correct bandwidth was applied, the over-all response came out very close

to flat. At the time the microphone was developed it had a measured response much closer to flat than had ever been produced before without finagling.

But did this mean that the acoustic resonance would never be audible? While the microphone did sound quite good, the resonance nevertheless did show up on occasion. An acoustic resonance not only amplifies that particular frequency to somewhere in the region of thirty times the intensity of frequencies above and below it, but it takes time to build up this resonance and also time for the resonance to decay again. In the case of the electrical absorption circuit this, too, takes time to build up the resonant action and to decay away again.

The result of this fact showed that while steady tones were uniformly reproduced throughout the entire frequency spectrum, frequencies in the vicinity of 600 cycles did not behave the same on transients. The growth and decay rates of these tones passed on to the electrical circuit differed from the growth and decay rate of the original sound, because of this buildup and die-away effect in both the acoustical and electrical resonances.

Well, no modern loudspeaker produces an effect as drastic as this! At the same time, however, the frequency response is achieved by judicious manipulation of various resonance effects, due to various portions of the diaphragm under breakup conditions and so on. While this may ultimately result in a response curve that is flat within ±4 db, or some such figure, over the entire audio band, *the unit retains a form of coloration that becomes particularly noticeable on transients.*

It is true that the ear cannot perceive differences of as little as 4 db at different points in the frequency response taken as an over-all synthesis of sound, but it can perceive differences in the buildup and decay characteristics of individual tones, when they differ either from the original sound, or from another reproduction of the same transcription. The kind of differences caused by these features is particularly noticeable on the reproduction of the instruments that are struck or plucked, and which are generally recognized as being difficult to reproduce with fidelity.

Non-Linear Distortion

Much work has been done and published about distortion in amplifiers, but nowadays amplifier distortion is at such a low level that *any* loudspeaker will produce more distortion than a modern amplifier.

Harmonic distortion is not too important, because all tones possess harmonics and slight changes in the exact magnitude of individual harmonics in the reproduced sound do not noticeably alter the character of the tone. The important aspect of distortion is the intermodulation it produces.

Reproduction that is relatively free from intermodulation distortion brings out the character of all the different tones clear and distinct, whereas the presence of intermodulation, by producing low level spurious tones all over the spectrum, confuses the sound and makes the individual tones no longer clear, separate, and distinct. The different instruments in an orchestra, for example, do not sound like separate instruments but part of a cacophony of sound.

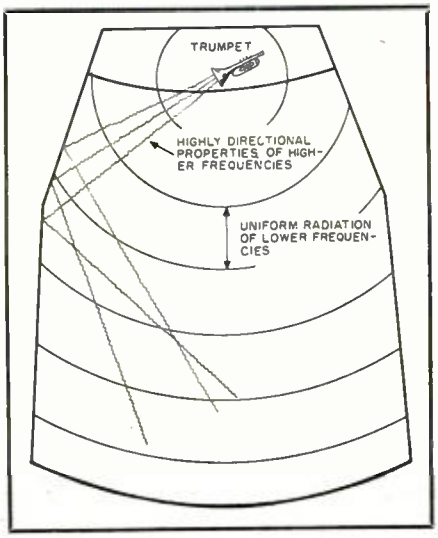
Wave Distribution

The foregoing bases for difference in sound are both fairly well known. The third one—the reasons related to wave distribution—is less well known and yet probably, in many respects, quite as important.

Of recent years there has been a realization that the high frequencies from a loudspeaker do not get distributed as uniformly as the lower frequencies. This is the reason behind the construction of acoustic lenses and other devices to distribute the high frequencies better. But is uniform distribution of all the component frequencies natural sound?

Consider, for example, a solo trumpet played in an auditorium. Due to the very property of loudspeakers just mentioned, the fundamental and lower frequency components in the trumpet get distributed in all directions, while the upper harmonics get squirted along the axis of the trumpet, as suggested in Fig. 1. If you happen to be on the axis of the trumpet, the sound is usually uncomfortably intense. A more usual listening position is off axis, where the lower frequencies reach you directly while the higher frequencies ricochet around the auditorium before reaching you. This gives you the sound characteristic of the trumpet being played in the particular auditorium where you happen to be. If the sound reaches you in some different manner, it would not sound as natural.

Fig. 1. The characteristic of a trumpet or similar instrument, played in an auditorium, is partly due to the different way it distributes the fundamental and higher harmonics of the tones it plays. The lower frequencies are distributed uniformly, while the higher ones get "squirted" by the horn of the trumpet. Any other way of distributing its sound would result in reproduction that did not sound like a horn.



As another example, think of a grand piano. When the top is closed, the sound from the piano is much quieter than with the top open. But this is not the only difference: the character of the sound changes too—not that one can pinpoint the change in character as being a difference in the evident resonances or frequency response of the piano—*it is a difference in the way the sound comes out.*

This difference is due to the fact that the sound board of a grand piano is horizontal; it radiates downwards from the under side of the piano, toward the floor; and it also radiates upwards and is reflected from the top, when this is supported at its conventional angle as shown at Fig. 2. The combined radiation of sound waves due to this effective *double source* produces the sound recognized as characteristic of a grand piano. No other form of sound radiation can quite duplicate it.

The grand piano is one example of a wave that is not longitudinally propagated. The waves emanating from top and bottom of the sound board are out-of-phase—one pushes when the other pulls. This means that air particles in the path of sound away from the piano have a movement that is partially up and down, instead of simply to and fro.

This aspect would probably not be so important, were it not for our binaural perception. To prove how binaural perception helps distinguish sounds one from another and identify the characteristics of individual sound, it is instructive either to make a recording with a microphone well away from the source of sound and then listen to the reproduced sound on playback in the same room or to listen to the sound on headphones and compare the sound in the headphones with the sound in the room.

In either case a distinct difference will be noted. The sound received by the microphone and recorded, or relayed to the headphones; as the case may be, not only lacks the character of the original sound, but also possesses an apparently emphasized degree of room reverberation. The room sounds twice as "echo-y" as it does listening to the live sound.

The reason for this is that our two ears can discriminate between the original sound and the echo, for example, due to the fact that they travel in different directions around us, but the microphone has no means of discriminating between sounds from different directions.

The use of a ribbon or other directional type of microphone will help to reduce the excess reverberation effect, but it will not convey a more satisfactory impression of the original character, for the reason that it discriminates against the reverberation, rather than enabling it to be heard as

a separate entity, as happens, subconsciously, in the original.

This is the principal reason why various systems of so-called stereophonic sound achieve a greater realism for many presentations than *any* single loudspeaker system. Stereophonic improves many presentations, but still sounds unnatural with some program material.

From the foregoing it becomes evident why different loudspeakers with apparently identical responses do present different instruments more effectively. A loudspeaker, for example, that has a tweeter ejecting a narrow angle of sound will present trumpets more effectively, because the radiation of the reproduced sound is more like the radiation from the original instrument. The lower frequencies get distributed uniformly into the room, while the high frequency components get squirted from the tweeter rather like the original trumpet.

A large reflex cabinet with various vent arrangements and apertures, perhaps down both sides, for sound to emerge from or a folded horn, gives a more realistic presentation of grand piano music than a single direct radiator type unit, for reasons that become evident from the foregoing discussion of the characteristics of a grand piano.

Placement in Listening Room

One could go on to a detailed discussion of many other instruments and kinds of presentation, but there is just one more feature to be mentioned which contributes to the differences between loudspeakers. This is the effect of the room in which they are placed and their position in that room.

All our living rooms are shaped like some kind of large box, with definite dimensions, and any box tends to be an acoustic resonator at a whole sequence of frequencies. The fundamental frequency will be the one at which the whole volume of air in the room resonates, and above this there will be a whole family of resonant frequencies set up by reflections between the wall opposite the speaker and the one behind it. Each member of the family of frequencies will be characterized by the fact that its half wavelength will divide into this room dimension an integral number of times.

When the loudspeaker is placed against one wall facing the opposing wall then the particular family of frequencies emphasized by that dimension of the room will get emphasized in the reproduction from the loudspeaker. If the loudspeaker is moved to a different wall, or where the dimension of the room happens to be different, then a new family of frequencies will get emphasized and change the apparent tone of the loudspeaker. This is illustrated in Fig. 3.

This explains why even the same loudspeaker put in different positions in the room sounds entirely different. Maybe when placed along one side wall, the family of frequencies that gets emphasized happens to coincide with natural resonances of the speaker itself and the result is that the speaker sounds particularly peaky; whereas placing it against another wall tends to minimize these same resonances and the response sounds much smoother in general.

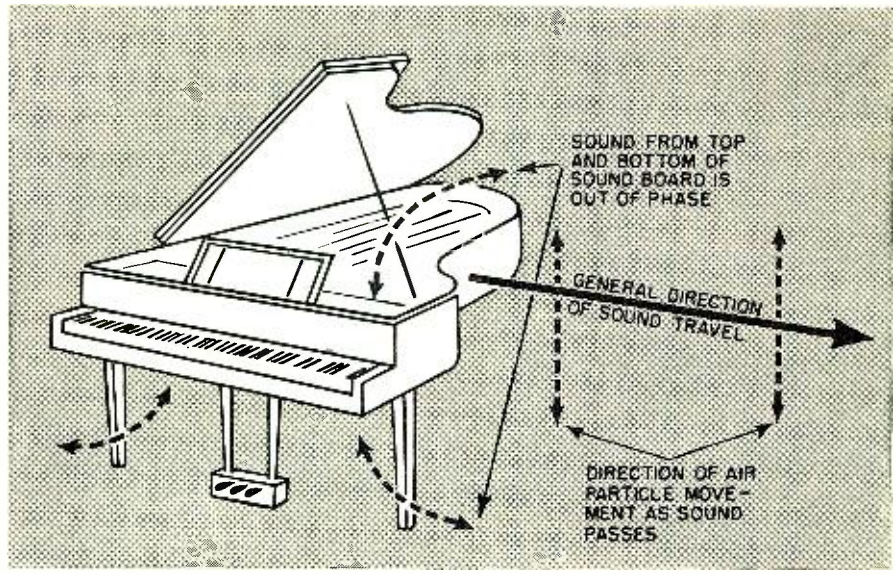


Fig. 2. Part of the character associated with a grand piano is due to its own particular way of propagating sound, shown here. As a result, the wave radiated is not the conventional longitudinal type of vibration, but appears to be transverse, at least in normal sized studios. If this kind of propagation is not duplicated, some of the "grand piano sound" inherent in the instrument will be irrevocably lost.

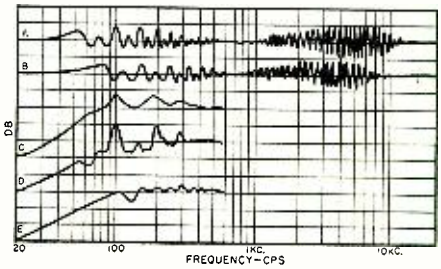
Usually the best position for a loudspeaker is in the corner of a room facing diagonally across it. In this way none of the natural reflections of the room get emphasized particularly although, of course, standing waves are set up at various frequencies.

Summing up, then, we can see that loudspeakers sound different because of: (1) The peculiarities in their construction that contribute to their frequency response, and particularly the effect that these peculiarities have on transient reproduction; (2) Nonlinear distortion that introduces a degree of intermodulation that is sometimes not suspected; this generally tends to confuse the clarity of sound. In fact, the better a loudspeaker is in this respect, the more readily will the other two defects described here be observed. The confusion of sound caused by intermodulation in earlier loudspeakers actually was partly responsible for convincing listeners that the reproduction was more faithful than it really was, because it disguised the other effects we have mentioned; and (3) Finally there is this question of the wave pattern distributed by a loudspeaker.

It would seem from our discussion that no single loudspeaker system could reproduce equally well all kinds of sound material. Maybe this is an argument for setting up a listening room with a variety of reproducers, rather like an audio center, so that one can select the type of reproducer best suited to the program material being handled at the moment. In any event, this kind of variation is a very useful feature from the viewpoint of loudspeaker manufacturers, because it enables them to make a variety of loudspeakers, all of which find a market because they serve a useful purpose. It is impossible to establish one particular unit as universally best.

We have not mentioned the differences in characteristics of individual people's ears, a term which we will take to include both the organ of hearing and the translating faculty of the brain! This again modifies the impression received and accounts for the fact that tastes differ—why different people will give you different answers as to which is the best sounding speaker. But let's not start all over! —30—

Fig. 3. How speaker placement in a room can affect response. At (A) and (B), curves representing the character the room adds to sound when the speaker is against an end and a side wall respectively, in a room approximately 20 by 12 feet. The variations at the lower frequencies are due to characteristic resonances associated with room dimensions and speaker placement; the rapid fluctuations at higher frequencies are due to standing waves set up by reflections from all kinds of surfaces in the room, and vary considerably from point to point. The fluctuations responsible for more noticeable differences in tone are those at the lower frequencies. At (C), the response of a loudspeaker without room effects and at (D) and (E), the same speaker in positions corresponding to curves (A) and (B). Note that the peaks in (D) are accentuated, while those in curve (E) are minimized. Refer to article.



Modularized Sets now available

The sets shown here are in production and being sold. Why are modules used? Are they to be replaced or can they be repaired when bad?

THE radio and television sets on this and the facing page appear to be conventional receivers; they are however, the first commercially available sets which use a recently developed component which promises to revolutionize the manufacture of electronic equipment and its servicing. The components are modules and their use in electronic equipment enables the manufacturer to utilize automation to a higher extent than heretofore possible.

The use of printed wiring has many advantages for the manufacturer—it is cheaper, more uniform, and can be produced more rapidly than conventionally wired chassis. However, one potential advantage of the use of printed-wiring boards has not been realized and that is the saving of space. Circuits using printed or etched wiring with conventional components occupy about the same amount of space as a conventional chassis with point-to-point wiring. This is due to the fact that components must be placed side-by-side and the "wiring" be fairly wide for satisfactory conduction since it is rather thin. Also, an appreciable amount of the circuit board is used to insulate the "wires" from each other. The use of modules overcomes these drawbacks and allows for the most efficient use of printed wiring.

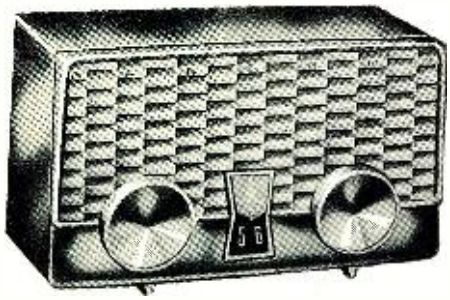
Note the chassis used in the *Motorola* model 66L1 portable radio. Just about all of the conventional fixed components in this chassis have been modularized, *i.e.,* printed or placed onto wafers which are then stacked vertically and connected as a unit to the chassis. The large electrolytic capacitor, selenium rectifier, i.f. transformers, tuning capacitor, volume control, and switches are not modularized because of their size or function. Actually, therefore, the amount of space taken by the complete chassis is little more than the volume of the components themselves This allows for the ultimate in compactness and the greatest amount of flexibility in the design of the final product. There are other advantages to the manufacturer in the use of modules. The circuits can be more rigidly controlled and are more uniform because the manufacture of modules is completely automatic; they are even tested by the same machine that makes them.

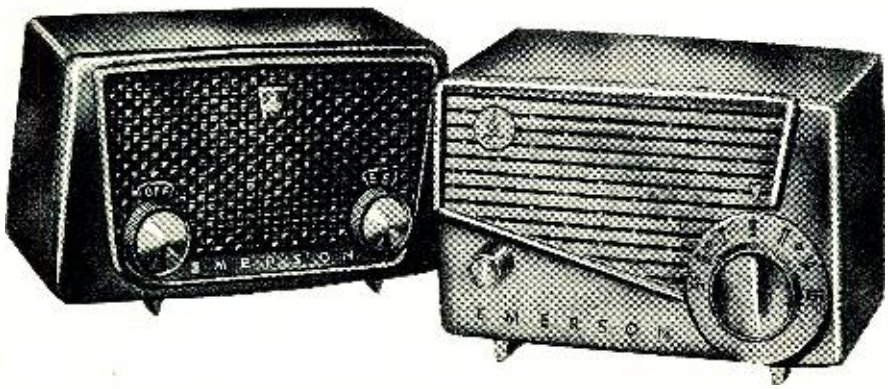
The total price of a module of five wafers, for example, is at present higher than the price of the same five conventional components wired into a chassis separately. However, this price differential will most certainly disappear with large-scale production and use. As a matter of fact, the cost of using modules will be less than that of using conventional components because of the savings in labor and time.

Modules allow a degree of standardization not yet attained in the electronics industry. It is conceivable that, in time, three or four standard modules will be combined in various ways to make any radio receiver. The same can be true for TV. This will simplify the stocking of parts and will make for less expensive inventory.

For the consumer, the use of modules means ultimately lower cost products. With the decrease of labor cost and, eventually, parts cost, will come a decrease in price of radio receivers and most certainly television sets. Whether modularized equipment will require less servicing has not yet been determined and to this end one experiment being carried out by the *Emerson Radio and Phonograph Corp.* is of interest.

Among the television receivers now





Three Emerson a.c.-d.c. table model radios using modules are shown here. They are the model 853 (above), model 852 (below) and model 851 (below right).

The Motorola a.c.-d.c. — battery portable radio model 66L1 shown on the left uses the modularized printed chassis shown on right.

marketed by this company are two chassis which contain modules in part of their production runs. Half of these chassis contain a printed-wiring panel using conventional components; the other half contains a similar printed-wiring board using modules. The consumer will not know which set he has, but the manufacturer will, and is keeping close watch on these sets. In this way, *Emerson* will be able to make very accurate comparisons as to the cost, operation, and serviceability of modularized receivers. The basic models used in this experiment are the 1200, 1202, 1206, 1208, and 1220. The chassis involved are the 120325 and 120306. Each of these models has a u.h.f. counterpart. The section of the receiver which is modularized consists of the vertical and horizontal oscillators and sweep circuits.

Servicing

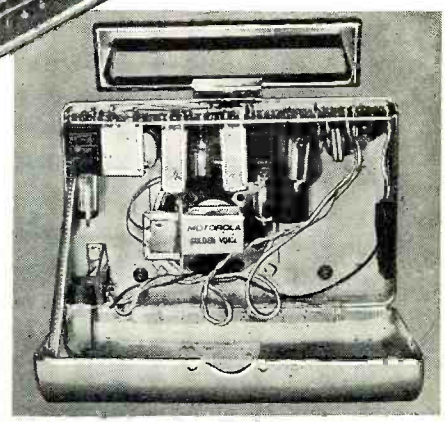
When defective, modules are replaceable like vacuum tubes, except that they must be unsoldered from the circuit. Special tools for this purpose are now or will shortly be available. One new item is a small soldering pot which contains a molten solution of solder. The bottom of the printed-wiring board, where the module is connected, is dipped into this pot. The hot solder melts the connections holding the module onto the board and the module may be taken off with ease.

Another tool which may be shortly available is a special soldering iron and soldering gun tip, shaped in such a way that it engages all of the module connections at the same time, allowing them all to be heated simultaneously for removal.

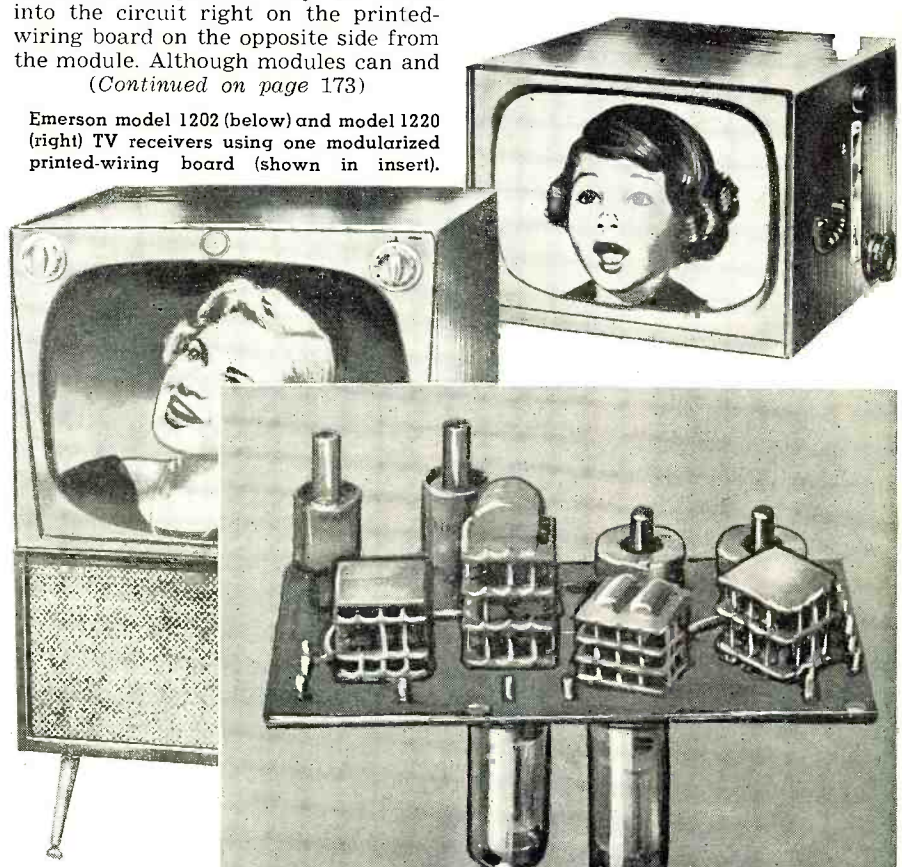
In general, when trouble is encountered in a module, it is advisable to replace it. Replacement modules for the ones used in the *Emerson* and *Motorola* receivers are now available from their distributors and cost between $2.50 and $3. With widespread use of modules, it is fairly certain that components manufacturers will make modules available through regular electronics parts distributors.

When necessary, modules can be repaired. A faulty wafer or individual component may be tracked down in the same way as is presently done in conventional circuits. "Risers" or vertical wires are used to connect the various wafers together and to the circuit board. Conventional test equipment can be used to test the components which appear between the various "risers" and connecting points. If a faulty component is found, a new conventional component may be wired into the circuit right on the printed-wiring board on the opposite side from the module. Although modules can and

(*Continued on page* 173)



Note how compactly the modularized chassis fits into the Motorola set, above.



Emerson model 1202 (below) and model 1220 (right) TV receivers using one modularized printed-wiring board (shown in insert).

By FRANK HADRICK and HUGH S. WYETH
Service Division, Admiral Corporation

Installation Notes on ADMIRAL COLOR SETS

Hints for installing the new Admiral low-priced color sets — also, unusual color TV circuits are explained.

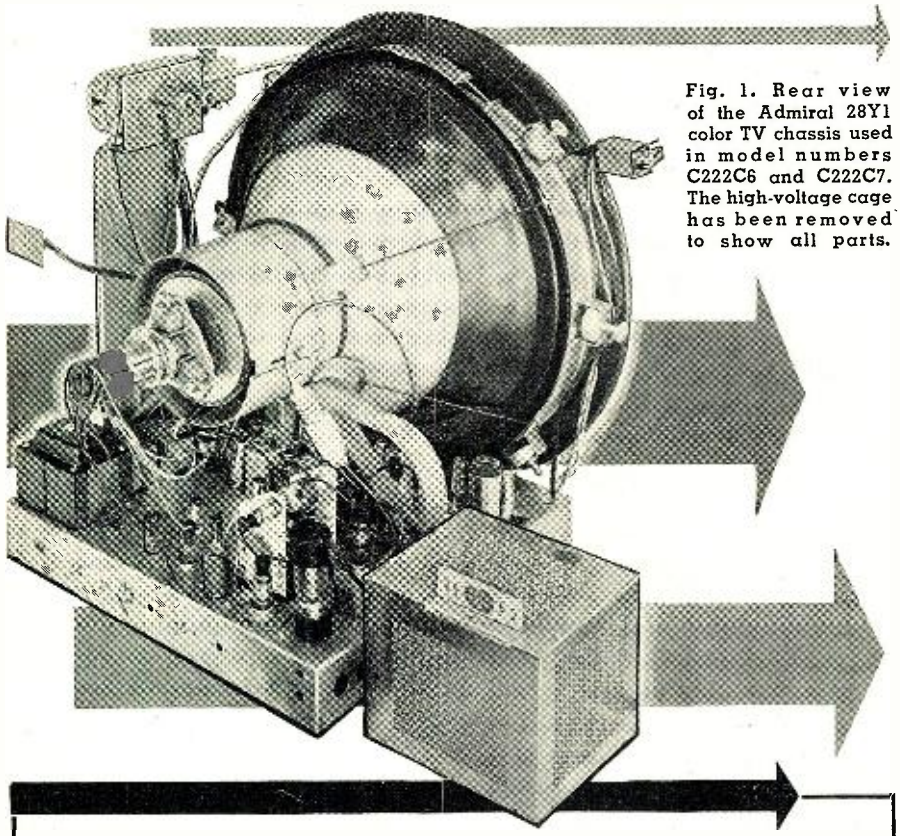
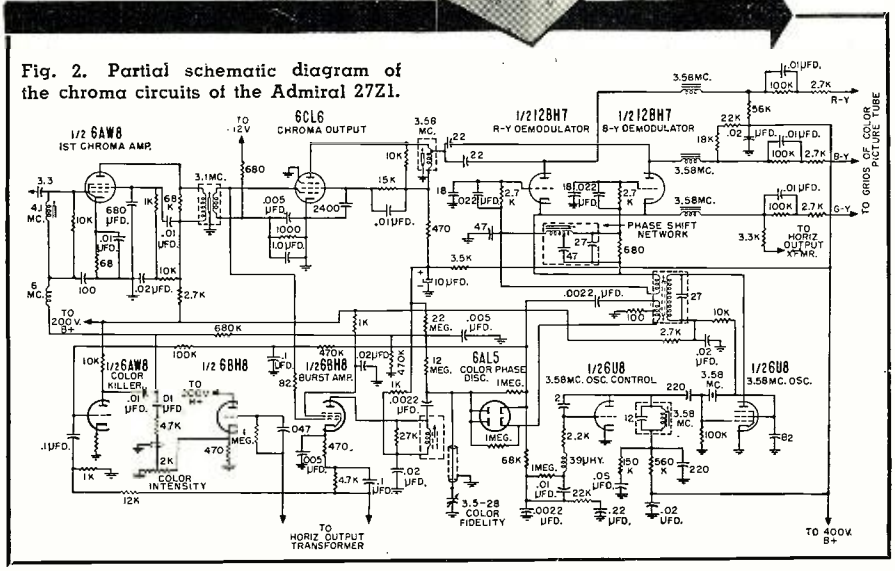


Fig. 1. Rear view of the Admiral 28Y1 color TV chassis used in model numbers C222C6 and C222C7. The high-voltage cage has been removed to show all parts.

Fig. 2. Partial schematic diagram of the chroma circuits of the Admiral 27Z1.



GOOD service begins with a good installation. The basic installation and convergence procedures required by the *Admiral* color TV receivers using the 21AXP22A three-gun color picture tube (see Fig. 1) are described in detail in the service notes for these sets. These should be studied very carefully before an installation is attempted. A few basic installation rules which apply to the *Admiral* sets will be reviewed here for emphasis.

The service technician should be equipped to disable the various safety interlocks incorporated in these sets. A clip lead can be used to bypass the interlock switch behind the picture window. A common installation and service tool will undoubtedly be the plastic "plug" required to disable the high-voltage shorting interlock when the cabinet back is removed.

Although the metal parts of the picture tube are demagnetized by the factory before the receiver is shipped, they sometimes become remagnetized before the receiver is finally installed, making it impossible to obtain satisfactory purity and convergence. As a precautionary measure to avoid lost time, many technicians routinely demagnetize the picture tube with the receiver in its final operating position in the customer's home, before making any adjustments. This means that another service tool for color will be a suitable degaussing or demagnetizing coil. These can be purchased, or the technician can wind his own. About 400 turns of No. 20 magnet wire wound on a 12- to 14-inch diameter form and equipped with a long a.c. power cord, works very well.

The color stripe signal transmitted by many TV stations consists of a burst of 3.58 mc. appearing just before and immediately following the horizontal blanking pulse in the composite black-and-white video signal. Since, therefore, the receiver color circuits are gated on by this stripe signal only during horizontal retrace time, it is necessary to shift the phase of the horizontal oscillator so the horizontal flyback pulse will coincide with at least part of the 3.58 mc. color stripe burst immediately following the blanking pedestal. Shorting the color stripe test point on the back apron of the *Admiral* chassis to the chassis produces the necessary phase shift of the horizontal sync pulses, thus shifting the phase of the horizontal oscillator and allowing the color stripe to be correctly reproduced with the receiver otherwise properly tuned and adjusted.

The last but most important part of every color receiver installation should be instructing the customer. The operating instructions packed with the receiver should be reviewed with all those who will operate and use the

(*Continued on page* 174)

Realistic High Fidelity

The R-J enclosure for an 8" speaker.

The Hartley "Dual Baffle" speaker system.

PanaSonic 8" speaker in its newly designed companion bass reflex cabinet.

LOUDSPEAKER BAFFLES AND ENCLOSURES

By
H. A. HARTLEY
Audio Consultant

Part 7. A discussion of loudspeaker baffles and enclosures and the important role they play in realistic reproduction.

SOME aspects of audio engineering, such as amplifier design, can be done with precision. Speakers, as the last few articles in this series have indicated, are not such an exact science; room acoustics is partly exact, partly guesswork; the design of speaker mountings and enclosures can be undertaken on a strict mathematical basis. But when you come to the practical usage of speakers in their enclosures in *your* listening room, there is a combination of unforeseen factors that makes the final decision a matter of quite exceptional difficulty. Here, more than anywhere else, the decision comes from the sort of reproduction you like, and it could be that what I like is not what you like. Yet throughout this series the aim is to guide you into achieving realism, that is, freedom from distortion.

The response of a speaker measured in free air is directly associated with its design. If it were a perfect speaker with a linear response it might not sound so good in a room with nonlinear characteristics as another with a less perfect performance. The defects of the speaker might neutralize the defects of the room. But a perfect speaker's response is modified by the way it is mounted or housed, and no mounting is perfect; every type, flat baffle, cabinet, or horn, has its own acoustic properties, for none is acoustically inert. When the speaker is used in your nonlinear listening room, four sets of data affect the final performance—the speaker in free air, the behavior of the mounting or housing, the performance of the speaker when mounted, and the room acoustics. These four factors cannot be merged in any precise and scientific manner, but I can lay down for you a number of guiding principles to bring some sort of order out of the seeming chaos.

There are as many different ways of mounting or housing speakers as there are designers who had a brainwave. Some enclosures work very well with certain speakers, because the enclosures were designed to neutralize the defects of the particular units for which they were designed. Some speakers work well with horns, others do not; some work better on flat baffles than in boxes, and so on. What you must not do is to choose a speaker that appeals to you for certain reasons, an enclosure that may make an entirely different appeal, and bring them together in a room without regard to any other consideration than where the combination looks best or is most convenient. Of course, you can do just that if you want to, but the odds against your getting realistic reproduction are pretty high. What, then, is the best way of setting about the problem?

Flat Baffles

At low frequencies, the sound waves from the front and back of a speaker diaphragm must be separated, because the sound from the front is 180° out-of-phase with respect to that from the back. At medium and high frequencies the wavelength is too short for cancellation to occur, but bass frequencies have wavelengths up to several feet. Without some form of baffle reproduction of low frequencies is impossible, and a large baffle is needed for very low frequencies. Fig. 20 shows the bass attenuation resulting from the use of various sizes of finite circular baffles. You will notice that an 8-foot diameter baffle causes a loss of 5 db at 70 cps, so the problem is a very real one, for where can we place even an 8-foot baffle in a room without it being an eyesore? Note particularly a point not always realized: you can't make good this loss by giving the amplifier a bass boost, for the loss is inherent in the mechanics of the sound waves themselves in relation to the baffle; if you try bass boosting you are, in effect, pouring your audio watts down the drain.

From time to time audio enthusiasts have decided to put up with the inconvenience of a large baffle in the interests of high fidelity, but there are two reasons why they didn't get it. Of course, they got the bass, but they got other things they didn't bargain for. It is not difficult to appreciate that a large baffle is likely to be less rigid than a small one unless it is very thick and heavy. Since all baffles are flexible to some degree, they will bend when "activated" by a speaker. Every baffle has its own natural resonant frequency, which you can prove for yourself by hitting it with your closed fist. But it also produces harmonic frequencies, for the thud you hear when hitting it does not sound like the note of a pure sine wave. The harmonics are the result of the baffle noding; second harmonic nodes occur by bending across a diagonal or a midway axis; third harmonic by bend-

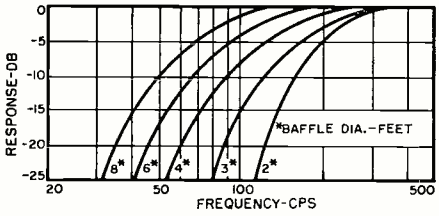


Fig. 20. Base loss of finite circular baffles.

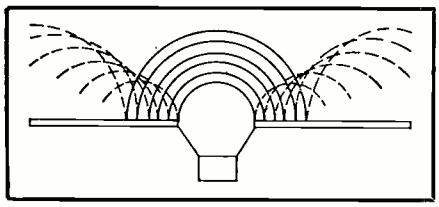


Fig. 21. Waves radiating from speaker are reflected from baffle, causing interference.

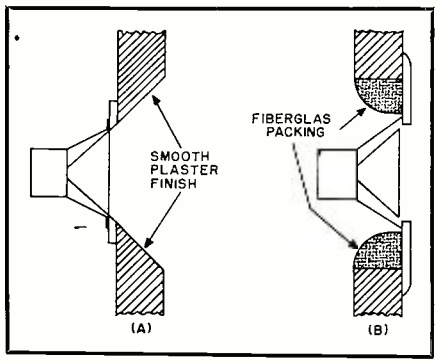


Fig. 22. Mounting a speaker in a wall. (A) Speaker on small baffle on the far side of the wall from the listening room. The hole in the wall should be funnel-shaped, smoothed off with plaster. (B) Speaker mounted in the wall. Front baffle covers a hole twice the diameter of the speaker. The hole can be circular or square but must be "radius-ed" off with Fiberglas or similar material. In each case the treatment is needed to avoid "tunnel effect."

ing across two axes dividing the baffle into three equal zones, and so on. Harmonics up to the 7th can be perceived, and in this way a speaker may reproduce a sine wave input as a pure note, but the activated baffle becomes a producer of complex notes. The cure for this is to make the baffle as stiff as possible by strong bracing, particularly along the outer edges.

Another form of distortion occurs even with an infinitely rigid baffle. Fig. 21 shows a section of a speaker mounted on a flat baffle. The emergent sound waves have a hemispherical form and partially impinge on the front of the baffle. From this they are reflected in the way I have described in an earlier article. In the diagram the emergent waves are shown by solid lines, the reflected waves by dashed lines. These waves mutually interfere and cause uneven response.

Finally the placement of the speaker on the baffle has a bearing on the response. The effective size of the baffle is the shortest distance from the center of the front of the speaker, round the baffle, and on to the center of the back. This distance is equal to the diameters of the circular baffles covered in the graph of Fig. 20. In a square baffle, those parts outside the circle can have no baffling effect. If the speaker is exactly in the center of the baffle and a response curve is taken of the speaker so mounted, there will be found a characteristic narrow dip in the lower register. This can be avoided by placing the speaker off center or making the baffle of irregular shape, but the effective baffle size is reduced, for still the shortest path from front-to-back determines the bass cut-off.

The only truly satisfactory flat baffle is the time-honored one of mounting the speaker in a wall between two rooms. Such a baffle is virtually infinite, it is rigid, and, with suitable draperies, is non-reflecting. The short tunnel in the wall should be flared at not less than a 45° angle outwards from the speaker when the speaker is mounted on the far side of the wall from the listening room. If the front of the speaker is flush with the wall, then the hole in the wall must be about twice as large as the speaker, the front sealed with a small thick baffle, and the empty space filled with Fiberglas or similar sound absorbing material. See Fig. 22.

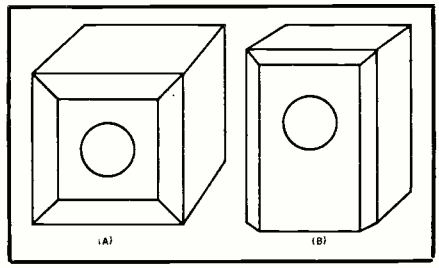
From what has been said it will be fairly obvious that closet and cupboard doors do not form very good baffles, unless they are strong and thick. Moreover the space behind the door may cause undesirable reverberation effects, which will be considered more fully in the next section.

Folded Baffles

The flat baffle can be made more compact by being folded into a box. As before, the effective baffle size is the distance from the front of the speaker, across the front, along a side and on to the back of the speaker. As far as pure baffling is concerned it is of no consequence whether the box type cabinet is large and shallow or small and deep, but there is a great difference in the acoustic properties of two such enclosures.

A box baffle partially encloses a column of air; this air will resonate at a frequency determined by its volume, as happens with organ pipes. For a given size of pipe the frequency of the emitted sound depends on whether the pipe is open or closed ("stopped"). An open back box baffle resembles a short wide pipe; a closed box baffle is like a stopped pipe. A shallow box baffle has very little air column resonance, and so needs no treatment except bracing to prevent cabinet resonance. A deep box baffle (of cubical shape, for example) has a pronounced air column resonance, and lining it with sound-absorbing material has no effect on this resonance. The lining will help damp out cabinet resonance and standing waves caused by reflection from the interior sides of the box, but the contained air is still in the box.

Fig. 23. Deeply chamfered cabinet edges give smoother bass response. See text.



Whether the back is closed or open, distortion caused by reflected waves (Fig. 21) will occur. The distortion is revealed by an irregular response particularly at the lower end of the frequency spectrum. It has been proved that these irregularities can be smoothed out by chamfering the edges of the cabinet, as shown in Fig. 23. If the box is quite spherical there are no irregularities at all, as could be imagined from a consideration of the disposition of the reflected waves; but a spherical enclosure is an extremely inconvenient thing to make. Chamfered corners are, therefore, the best compromise, and if the floor-type enclosure of Fig. 23B is adopted, the speaker should be located so that it is not equidistant from the top and sides, nor in the center between top and bottom. An intermediate position will be the best way of obtaining an asymmetrical baffle to avoid the dip mentioned previously.

This type of enclosure, since nothing can be done to eliminate air column resonance, should be rather large and shallow, which suggests the floor type; but if such an enclosure is placed against the wall, the air is trapped and the air resonance will be pronounced. With a definite closed back, new problems are encountered, and these will be discussed later. For the moment I just point out that cabinets of the Fig. 23B type should be placed across the corner of the room and the top should *not* be of triangular form to close the gap between cabinet and walls.

Hartley "Boffle"

I describe this specialized enclosure not for any commercial reasons but because it is a unique design of some general interest. There is quite a strong feeling among many acoustic engineers that the reproducing system should have no resonant properties at all. It is argued that resonances are tricky things to deal with, and the safest way out is to prevent them happening in the first place. This has always been my belief, which led me to designing speakers that had no audible bass resonance, even if the consequences were a reduction in sensitivity through the need for very free cone suspension.

I knew that a hole in the wall was as near a perfect flat baffle as we can ever get, but very few can manage this happy state of affairs. Putting the speaker in a closed lined box simulates an infinite baffle, but the enclosed air resonates. If the whole of the space inside is filled with sound

absorbing material to eliminate the air resonance, the freedom of suspension of the speaker will be impaired owing to the stiffness of the air compliance.

The inert non-resonant device I finally produced I called a "Boffle," an abbreviation of box baffle. A cross-section is given in Fig. 24. It is quite unlike any other form of enclosure, for it is an acoustic filter. In electrical filters we have inductance, capacity, and resistance; in mechanical filters (and acoustics is a form of mechanics) the elements are masses, springs, and friction. In the "Boffle" the sound waves from the back of the speaker hit the second screen (the first is merely an anti-reflection device); if it were not perforated the screen would be unduly stressed, so part of the pressure passes through to the third screen, and so on. The diagram shows two graded filter stages, but except in deep cabinets, one filter with up to 8 screens is all that is necessary. The semi-porous screens of carpet felt act as masses, their slight elasticity and the air pockets between the screens as springs, and their acoustical semi-transparency as friction. The back must not be rigidly closed, and all that emerges from the rear is a very low-pitched "grumble" which has no harmful effect on the speaker output. Wrapping the felt around the wooden frames of the screens is an essential feature of the device. The screens are rather a tight fit in the box and the felt is slightly compressed as the screens are slid into place. Every part of each side is therefore properly damped against nodes and resonances, and thinner wood can be used for the box than is necessary for any other form of enclosure.

The "Boffle" has been described for home constructors (*"Radio-Electronics,"* February, 1956) with interesting consequences. Designed for my own speakers, I did not suppose it would be much favored for housing speakers that normally require a reflex enclosure for neutralizing the bass resonance of the speaker. It turns out, however, that owners of more conventional speakers than mine have made it up and like it very much indeed. They say that the "Boffle" gives very clean and clearcut reproduction having noticeable "presence." This is due to the almost complete suppression of cabinet and air-column resonances. With these removed, the bass resonant frequency of the speaker is not unduly noticeable. These experiences suggest that the "non-resonant school" has some justification for thinking that way.

Closed Box Baffles

The closed box "infinite" baffle differs from the hole-in-wall infinite baffle, for in the former the air is trapped and in the latter it is free. This has a profound effect on the reproduction. The closed box is a resonator, frequently called a type of Helmholtz resonator, although the distinguished physicist did not invent it, but he did analyze its properties. The air within the box resonates at a frequency determined by the volume, and the sharpness of the resonant peak depends on the reflective power of the internal surfaces of the box. Moreover, about 25% of 3rd harmonic of the fundamental resonant frequency is generated when the air is activated by the speaker diaphragm. In addition, for reasons given in an earlier part of this series, reflections from the sides of the box create standing waves. All three phenomena cause distortion and must be eliminated as far as possible. The sharpness of resonance is flattened by lining the box with sound absorbing material; if there is sufficient thickness of lining the 3rd harmonic will be suppressed, as will standing waves at all but low frequencies. The basic physical properties of a closed box are, therefore, that it must be very strongly constructed (since the bass is not wholly absorbed) and lined with a substantial thickness of acoustically absorbent material.

Under these conditions it will be found that interaction of the bass resonance of the speaker and the air resonance of the closed space results in an effective raising of the bass resonant frequency of the speaker. The larger the speaker cone the larger must be the box, and as a rough working guide it can be taken that an 8-inch speaker requires 5 cubic feet of cabinet volume, a 12-inch 14 cubic feet, and a 15-inch 20 cubic feet. The normal speaker bass resonance should be as low as possible, which implies free suspension, and, contrary to what might be expected, the larger the cone the "free-er" must be the suspension. A large cone moves more air than a small one, and the air trapped behind the cone is what causes the rise in frequency, hence, the need for larger boxes with large speakers. If, therefore, you wish to use a small closed box, a small speaker must be used with it to avoid an undue rise in resonant frequency, but the small speaker of conventional design is not very effective at low frequencies. This dilemma can be avoided by providing some form of air leak in the cabinet.

Vented Box Baffles

Robbins and Joseph have devised an enclosure which is stated to be a modified Helmholtz resonator, and is shown simplified in Fig. 25. The box is not substantially larger than the speaker itself, but a form of air duct is provided by the space between the small baffle carrying the speaker and the front of the box. It is claimed that this reduces the sharpness of the resonance of the air within the box, producing a two-peak curve comparable to that of a reflex housing. If the speaker is intended to reproduce the whole frequency range, then, as pointed out in Part 1 of this series, the slot should be vertical to secure horizontal dispersion of the high frequencies. Some models of the enclosure have a slot at the bottom, suggesting that no attempt is made to reproduce the highs, which makes the unit simply a woofer. Obviously the performance of the whole assembly must depend on the size of the box, the size and bass resonant frequency of the speaker, the thickness of the air duct, and the size of the slot. A comprehensive mathematical analysis of these critical dimensions has not been published.

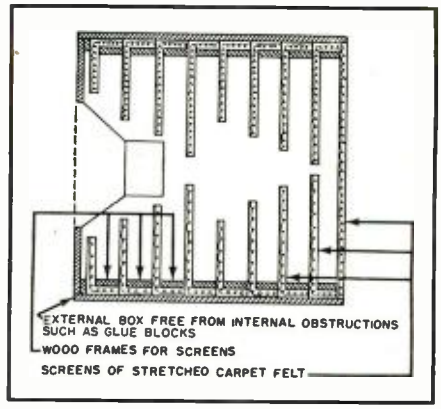


Fig. 24. Cross-section of Hartley "Boffle."

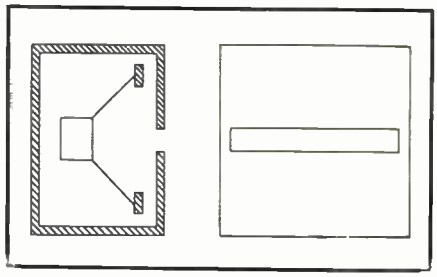


Fig. 25. Section and front of R-J box baffle.

A different type of vented enclosure is the acoustic labyrinth, shown in section in Fig. 26A. This is virtually an air column loading the back of the speaker diaphragm, in contrast to a horn which loads the front. The operation differs from that of the horn, for whereas a horn gives correct loading over the whole frequency range (if big enough) the labyrinth can only act as an efficient load at its resonant frequency. The dimensions should be such that the effective length of the air column (taken along the center line) is one quarter of the wavelength of the bass resonant frequency of the speaker. The wavelength, of course, equals the speed of sound (1129 ft. per sec.) divided by the frequency in cycles-per-second. Under these conditions the air column resonance will neutralize the bass resonance of the speaker. The whole of the interior surfaces must be covered with sound absorbing material to prevent reflections as far as possible. This will cause considerable attenuation of the high frequencies from the rear of the speaker. A tweeter may be necessary to maintain over-all balance.

Acoustic Phase Inverter

The most popular vented enclosure is that usually called the bass reflex, due originally to A. L. Thuras (U. S.

(*Continued on page* 156)

A 2-Meter Grounded-Grid Preamp

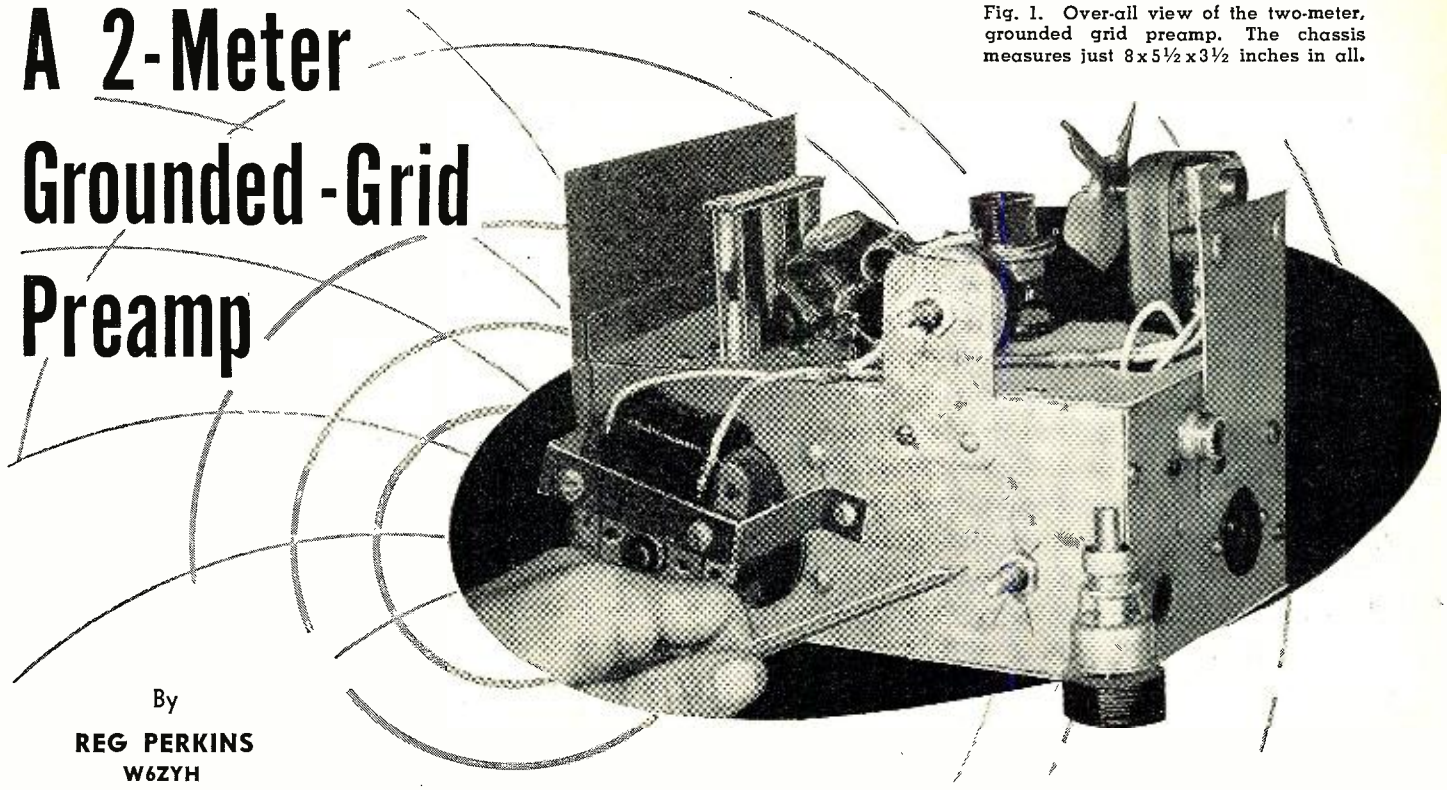


Fig. 1. Over-all view of the two-meter, grounded grid preamp. The chassis measures just 8 x 5½ x 3½ inches in all.

By
REG PERKINS
W6ZYH

Construction details on a broadband, air-cooled unit which uses two 2C39A surplus tubes for stable two-meter operation.

THE device to be described in this article is not meant to be the ultimate in 2 meter r.f. stages by any means, but if you like to tinker and experiment, here's something to sink your soldering iron into. Just think, it might make a good bookend to hold up those old radio magazines, too.

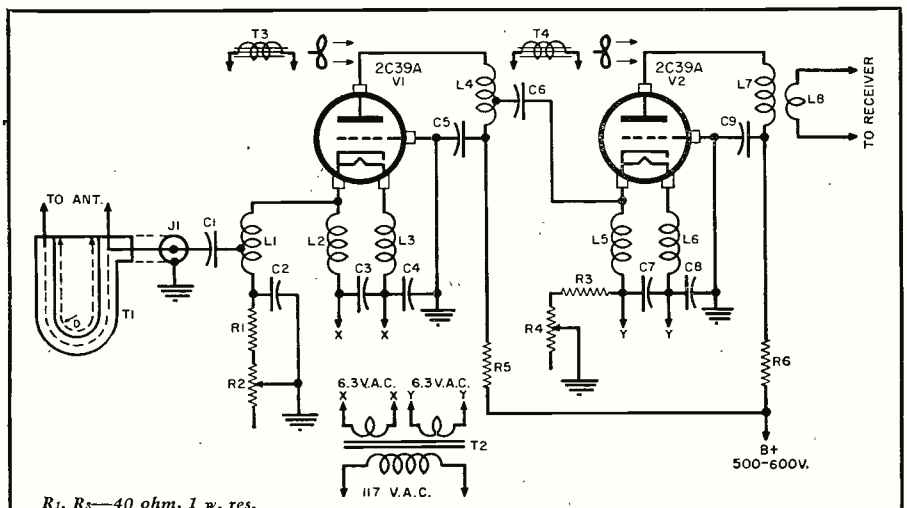
With everyone bringing out his pet circuits of cascodes and cascades, here's another to add to the long list; the author's entry is a broadband grounded-grid r.f. stage, air cooled, which uses transmitting tubes in a receiving circuit.

Before getting into the soldering iron and screwdriver department, a brief explanation of this air-cooled monster is in order. The tube chosen was the 2C39A because it offers some intriguing features. Now don't do a back-flip out of your chair; it's true these tubes are expensive new but there are surplus tubes on the market from many sources.

The interesting features of this tube might help you forget its price. Consulting a manufacturer's data sheet for the 2C39A or a radio handbook you will see that the average *mu* is 100 and the transconductance is around 22,000 μmhos. This is a good point in anybody's book. Under actual test conditions the transconductance runs as high as 25,000 to 30,000 μmhos in some cases. The tube is a "natural" for grounded-grid service because of its unique construction. Some of you 420 mc. operators might keep in mind that the 2C39A is ideally suited for use on that band, at low voltage applications, for receiver front ends.

Another startling feature is the power supply. If you have access to one of your local power company substations, you're all set. Not being able to arrange such facilities, the author used the old-fashioned method the power company supplies and my old GF-11 power supply which gave me about 600 volts d.c. In operation each tube pulls 35 to 90 ma., depending on where you set the variable cathode resistors. Consulting the data sheet again you will see that the 2C39A develops its high transconductance at a plate voltage of 600 volts d.c and 70 ma. and that the tube must be air cooled. If you can sneak the rig into the family refrigerator, you might accomplish something. You could try confiscating the family vacuum cleaner for cooling but that is probably out, unless you only want to clean up the

Fig. 2. Complete schematic of preamp. The coils are hand wound. Refer to article.



R1, R3—40 ohm, 1 w. res.
R2, R4—75 ohm, 25 w. pot (Ohmite Model H)
R5, R6—20 ohm, 1 w. res.
C1, C2, C3, C4, C5, C6, C7, C8, C9—.003 μfd., 600 v. mica capacitor
L1—4 t. #12 en., ½" i.d., ⅞" long, tapped 2½ t. from ground end
L2, L3, L5, L6—16 t. #16 en., closewound, 5/16" i. d.
L4—6 t. #12 en., ½" i.d., 1¼" long, tapped 1½ t. from ground end
L7—6 t. #12 en., ½" i.d., 1½" long
L8—3 t. #14 bare copper wire with plastic insulation
J1—Male and female coax connector
T1—Balun trans. 4:1 ratio (D (length in ft.) = 492/f (mc.) × .66)
T2—Fil. trans., 6.3 v. @ 1 amp., 6.3 v. @ 1 amp. (Single sec. 6.3 v. @ 2 amps. can be used)
T3, T4—Small 117 v. a.c. fan (Barcol Motors Model DYAB)
V1, V2—2C39A tube

ham shack floor. The author finally settled for two small 117 volt a.c. fans, which can be purchased at most local radio houses.

A few of you are probably shaking your head and muttering: "Why spend all that money on tubes and look at the power requirements." Yes, it's true it pulls enough current to run a good sized transmitter on 2 meters but most ham shacks usually have one or two universal power supplies that can be used and if you inquire at enough surplus houses a pair of tubes can be bought fairly cheap.

Now that all the readers have been scared off, let's continue. The unit described here is presented without any fancy claims of signal-to-noise ratio, db gain, or umteen pages of mathematics. The circuit is a basic grounded-grid adapted for use with the 2C39A. Each tube is very effectively shielded from the other by operating one tube upside down and by a shield between the two tubes. The tubes are highly stable in operation and there is no sign of oscillation with either tight or loose coupling.

The entire r.f. stage was constructed and tuned to the middle of the 2-meter band with only a grid dip meter and no adjustments were found necessary when the unit was put into operation. If no grid dip meter is available, very little adjustment will be needed if the circuit of Fig. 2 is followed.

You will notice that there are no means for tuning either tube. The preamp was made broadband so that it wouldn't be necessary to twiddle dials all night on those weak ones.

For those who like the feel of at least being able to control this monster, two variable cathode potentiometers were provided to adjust the plate current and the gain on weak signals.

The balun transformer shown in Fig. 2 (T_1) should be used for best results when using a balanced feedline; otherwise, a loss in gain will result. The tap on L_1, shown in Fig. 2, indicates that C_1 is connected at 2½ turns from the cold end. A slight reduction in gain will be noticed on an "S" meter if the tap is moved back 1 turn. The tap on L_4 offered the same results when C_6 was moved 1 turn. The coupling of L_7 and L_8 should be as

(*Continued on page* 162)

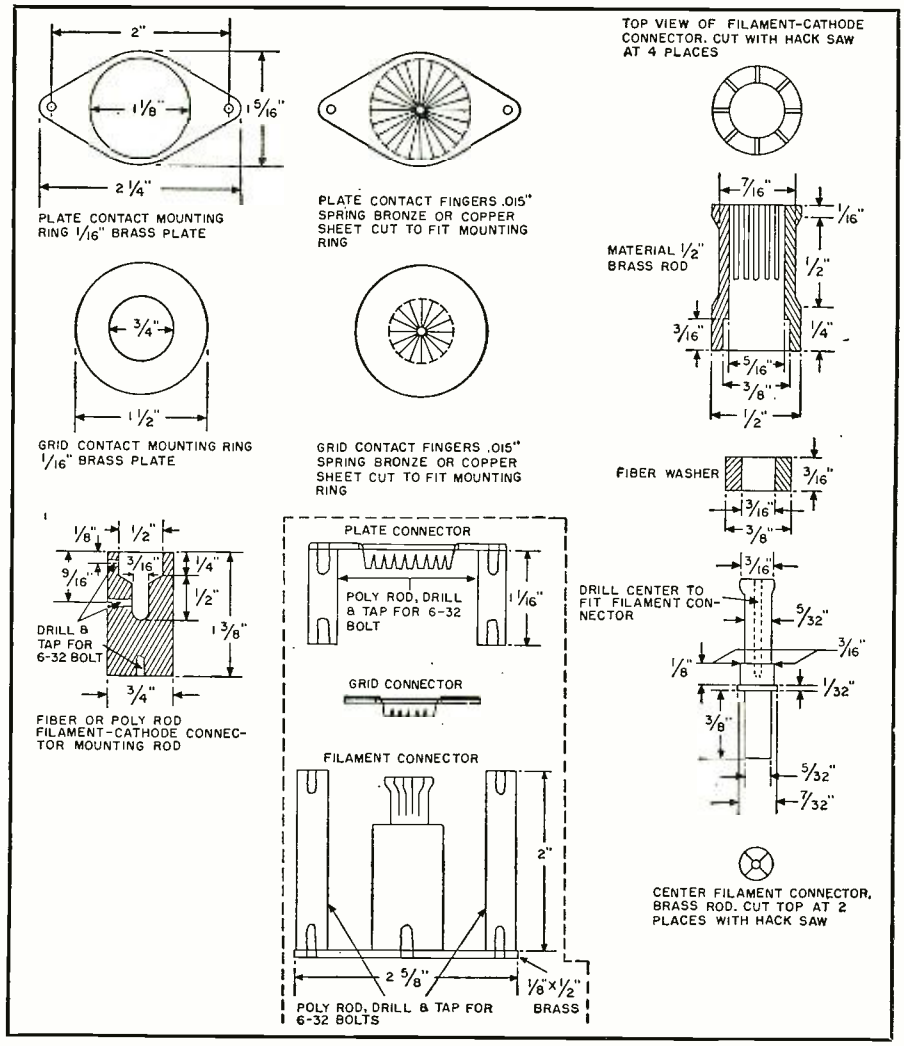
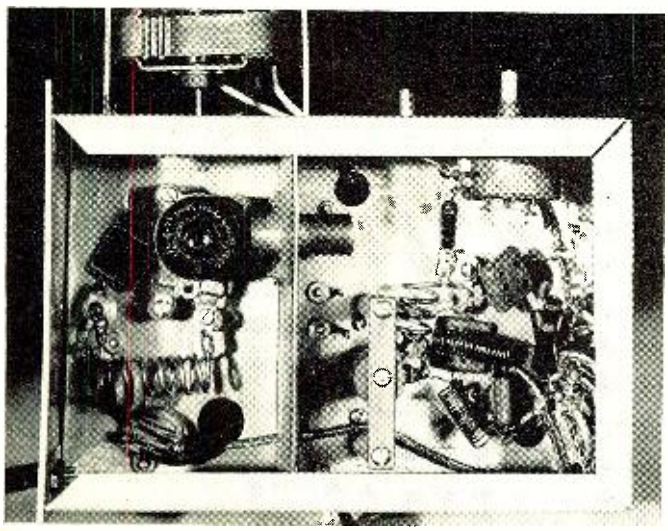
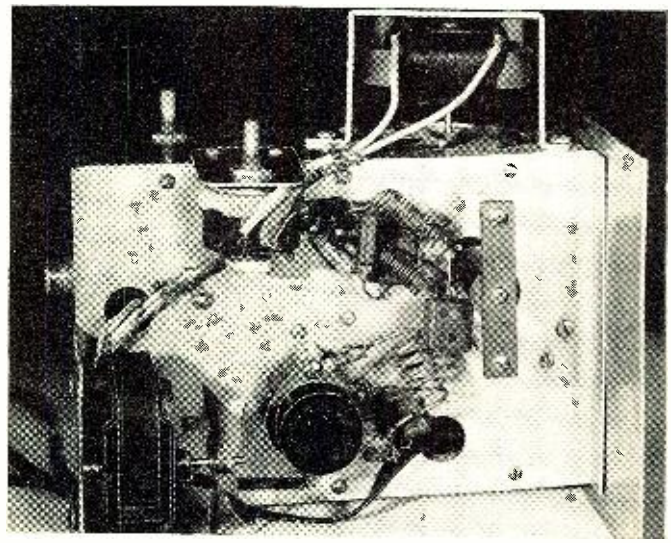


Fig. 3. Mechanical details of the tube mounting and contact fingers.

Fig. 4. (Left). Bottom view of the preamplifier showing V_2 on the left. L_7 and L_8 are shown at the bottom left. The shield separating V_1 and V_2 shows a section of copper tubing protruding through the shield. This was added after the unit was built and is used with a high-pressure blower. L_1 and C_1 are visible at right of shield. The coaxial connector is input from the antenna.

Fig. 5. (Right). Top view showing L_1 connected to the plate contact ring of V_1. The r.f. chokes, L_5 and L_6, are shown at the top right of the photograph with R_3 and R_4 to the left of the r.f. chokes. The twin-lead is the output to the receiver.





By J. P. NEIL

A Special Purpose Transistor Preamp

Fig. 1. Over-all view of the author's transistorized amplifier. It is housed in a 3" x 3½" x 2⅛" interlocking cabinet.

Details on a single-stage unit which can be used as an audio preamp, in Geiger counters, or photoelectric cells.

A VIBRATION study problem on oil seals at the *National Motor Bearing Co., Inc.* of Redwood City, California, required development of a special audio amplifier. For a number of reasons it was decided that a transistor amplifier would be most suitable. The basic requirements were: low-frequency response to less than 10 cps; high-impedance input and output, consistent with a high voltage gain; and a minimum of or, if possible, no distortion.

Although the practical application in this case is of interest only to a limited number of readers, there are many other uses for such a unit. This amplifier is particularly applicable as a preamplifier for crystal microphones or crystal pickups which feed into a subsequent high-impedance stage or, as in the author's case, directly into an oscilloscope for wave and distortion analysis.

Other possible applications include Geiger counters or scintillometers; water, gas, and air pipe locators; high-impedance bridge circuit amplifiers for instrumentation purposes; computers; police investigation devices; and photoelectric cell amplifiers, to name a few.

Development of Unit

The fact that even the best high-fidelity transformers are limited in their very-low-frequency responses is well known. Transistor transformers are no exception, in fact, are very poor in this regard, as it soon transpired. A number of such circuits were tried with various components, but found quite inadequate below about 80 cps.

Resistance coupling was next attempted with the idea of using a high-impedance grounded-collector stage followed by a grounded-emitter output stage. This combination produced very low gain, in fact, about that equal to the inherent noise level. A single grounded-collector stage gave less than unity gain as a voltage amplifier, hence this system was abandoned.

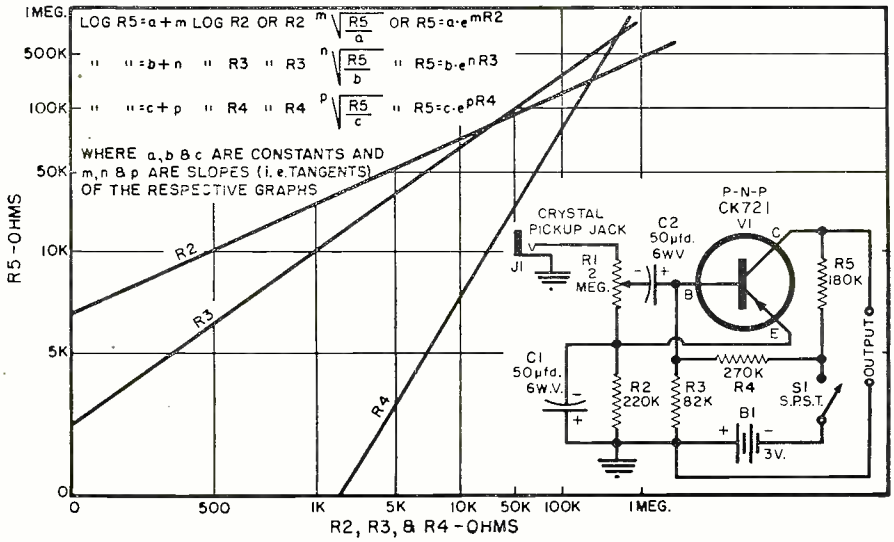
At this point it was decided to try checking the characteristics of an *RC*-coupled grounded-emitter stage. It was soon apparent that this might prove satisfactory if the input signal voltage is limited to a relatively low value, in order to avoid distortion, irrespective of frequency. Optimum voltage gain is, of necessity, intimately associated with high-impedance circuits (*i.e.*, low current) in any amplifier. A program for determining optimum component values under simulated operating conditions was undertaken. This consisted of first holding a particular resistance constant while varying all others, and second, adjusting all simultaneously in small increments or decrements. It was found that more than .02 volt input would saturate the CK721 and that at less than about .0005 volt the signal-to-noise ratio was poor. As a compromise, an input voltage of .001 volt from a crystal vibration pickup was used during the following tests. The pickup was excited by a headphone in turn driven by a signal generator over a range of 10 cps to 10 kc.

The graphs of Fig. 2 demonstrate the relations which existed to a first approximation and with an estimated accuracy of not more than two significant figures. Component values noted on the various curves are those listed for the circuit shown in the inset.

For those who may be interested in industrial transistor research and application developments or perhaps as a college thesis problem, it may be worth noting that the graphs of Fig. 2 appear to be exponential (or logarithmic) in form. That is to say, they take the general form of $R_5 = k \times e^{qx}$ or $R_5 = k \times x^q$ (or $\log R_5 = \log k + q \log x$) where $x = R_2$, R_3, or R_4 as the case may be. As a general guide it should be noted that (a) with R_3 and R_4 fixed, R_5 increases as R_2 increases; (b) with

(*Continued on page* 138)

Fig. 2. Curves for the CK721 transistor when used as a voltage amplifier (maximum sensitivity) with RC-coupling and schematic of the finalized amplifier circuit.



1957 RCA Color Sets

A $500 color TV set and 9 other models plus complete service contracts may make this the first big color year.

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

Mr. David Sarnoff, Chairman of the Board, RCA, shown here presenting a $500 "Aldrich" color TV with 21" tube.

AN INDICATION that 1957 may be a big year for color TV can be seen in the fact that the new line of *RCA* color sets includes a total of ten different models, grouped into three basic series, "Special," "Super," and "Deluxe."

All *RCA* color receivers use the 21-inch round, three-gun, shadow-mask type color picture tube with a viewing area of 254 square inches. They are all automatically usable for either color or monochrome broadcasts and while the basic models feature a v.h.f. tuner, a u.h.f. tuner is optional in areas where both types of reception are available. The inclusion of the u.h.f. tuner is indicated if the receiver model number is followed by the letter "U."

Lowest priced of the *RCA* sets is the "Special" series which actually contains only the "Aldrich," Model 21CS-781, with a nationally advertised list price of $495. This is a table model available in mahogany or limed oak with a matching stand provided at extra cost. The "Super" series is the medium-priced line with three sets from $550 for the "Stanwyck" consolette to the "Dartmouth" consolette at $650. For the higher-priced market, a total of six models are offered ranging from the "Whitby" open console priced at $695 to the "Wingate" at $850. The latter is a colonial style full-door console and is made of maple and French walnut veneers and solids.

All *RCA* color receivers are now being shipped with the picture tube in place and should, in theory, be very simple to install. In practice there are several problems which are likely to crop up and *RCA* discourages the average customer from installing the receiver himself. One of the problems is the misadjustment of various color controls which may occur in transit. Another is the frequent limitation which an apparently good antenna shows when a color receiver is connected to it. Ghosts, smearing, and limited bandwidth or detuning are sometimes tolerable in black-and-white sets but are quite objectionable when color transmissions are received.

Still another problem is the occasional magnetization of certain components of the receiver due to transportation. This occurs when any ferric metal is moved across the magnetic lines of the earth, and may result in color impurities and/or poor convergence. A special demagnetizing coil is used to remove this defect.

Service

The *RCA Service Company* offers several plans for the installation and service of color sets. For installation alone their regular charge is $25. This applies in cases where a usable antenna already exists and where no special couplers or divider networks are required. Installation of the receiver and final adjustments on both color and monochrome transmission only are included in this price.

All components in the color set are guaranteed for 90 days. The color picture tube is guaranteed for a full year like new black-and-white picture tubes. In addition, most dealers recommend that one of three *RCA Service Co.* service contract plans be taken at the time a color set is purchased. One plan provides installation to an existing antenna and a full year of unlimited service at a cost of $99.50. This contract includes both labor and materials for any defect or trouble that might occur within the first year. The black-and-white set 1-year service contract with this company costs $59.

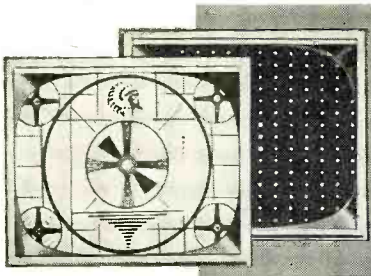
Optimistic customers may feel that the first three months are the most critical and for them, *RCA* offers a 90-day service policy which also includes installation to an existing antenna and unlimited service for the period stated. This 90-day policy costs $39.95.

Still another plan provides installation, 90-day service, and one year parts guarantee. The price of this contract is $69.50 with a flat charge of $7.50 for each service call after the 90-day period.

All of the preceding service and installation charges are based on the presence of a usable antenna. Installing a roof or window antenna in the New York metropolitan area, for example, costs a flat $35. Special installations requiring more elaborate equipment naturally run higher.

Recent experiences of many TV service technicians seem to indicate that antennas which have been up for five years or more should be replaced when a color TV set is installed. The mechanical mounting as well as electrical connections are often so badly corroded that the replacement might

(*Continued on page* 124)



A Flying Spot Scanner for the TV Technician

This inexpensive flying-spot scanner is a unique test instrument for black-and-white and color TV servicing.

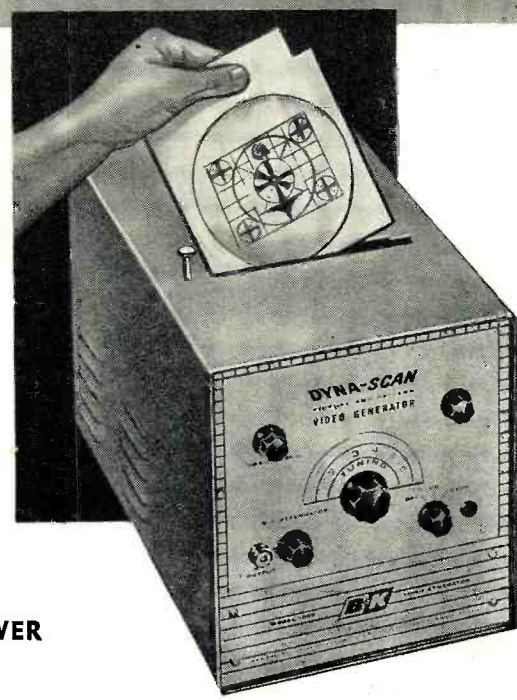


Fig. 1. Indian-head pattern slide being inserted into the "Dyna-Scan" picture and pattern video generator. When attached to a TV receiver, this pattern appears on the picture tube. A dot pattern slide or photo is reproduced on a TV set in same manner.

By **MILTON S. KIVER**

A FLYING-SPOT scanner is probably one of the most versatile pieces of video equipment that has yet been produced. In essence it is a camera which reproduces still pictures and these can take almost any form imaginable. For example, suppose it is desired to check the over-all frequency response of the video section of a television receiver. To do this, a conventional test pattern slide is inserted into the scanner, and the scanner signal is then applied to the television receiver. The appearance of the pattern on the picture-tube screen shows exactly how the receiver is performing.

This is but one use; there are actually many more; for example, testing the shading and contrast capability of a receiver and its vertical and horizontal linearity, special video amplifier checks, and static and dynamic convergence in color receivers, among others. There are, in addition, non-servicing applications of this device because this is a miniature video transmitter capable of lending itself to paging systems at conventions and to the advertising of special sales and other merchandise on any number of receivers hooked into a common master antenna system.

Until recently, flying-spot scanners were more or less restricted to broadcast stations because of their high cost. Within the last few months, however, an economical scanner has been developed and placed on the market by *B & K Mfg. Co.*, Chicago, Ill. Shown in Fig. 1, this scanner is not only useful in the service shop but, because of its light weight and compactness, it can be taken into the customer's home, if desired. Thus it widens the scope of the technician's portable test equipment and permits more extensive checking than was heretofore possible.

The heart of this instrument is a specially designed 5-inch cathode-ray tube which provides the flying spot of light that scans any slide placed in front of it. Whatever light passes through the slide reaches a light sensitive phototube and then produces an output current which is proportional to the intensity of the received light. These current fluctuations pass through a load resistor and the video signal is born.

The cathode-ray, or "scanner," tube used in the "Dyna-Scan" Model 1000 picture and pattern generator is specially designed to match the spectral response of the photomultiplier pickup tube. The phosphor behind the faceplate of the tube stops emitting light almost immediately after the electron stream ceases its bombardment; this allows very fine vertical lines to be reproduced without distortion.

The dot of light produced by the scanner starts at the top of the faceplate, sweeps across to one side, is blanked while it returns to the starting side (retraces), sweeps across to the second side, is blanked while it returns to the starting side (retraces), etc., until it finally reaches the bottom of the screen. It is then blanked and returned to the top of the screen. If a slide with the letter "A" is placed over the face of the scanner tube, the dot of light and photomultiplier tube translates the entire pattern, spot by spot, into a video signal.

It will be appreciated that the current initially developed in the phototube by the arriving light rays is exceedingly minute. This current, however, is subject to a process of internal multiplication within the phototube so that it is amplified approximately 1 million times as it leaves the tube and develops the corresponding video signal across the load resistor. This process of internal multiplication is achieved by a series of plates, called dynodes, which are coated with a substance which emits several electrons for each impinging electron. Thus, when the electrons on the phototube cathode are activated by the scanner light beams, they leave the cathode

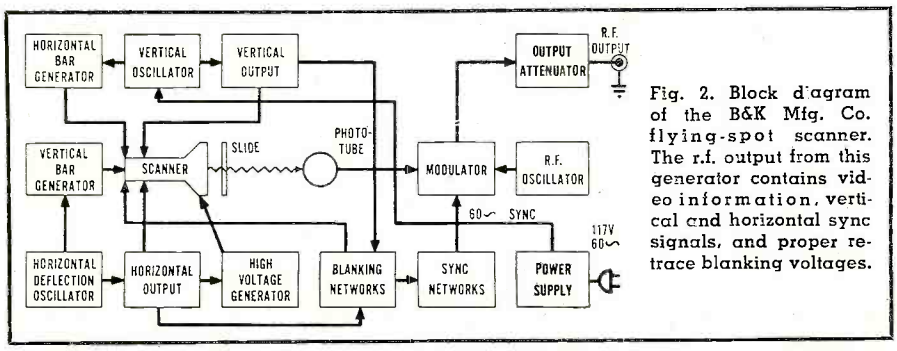


Fig. 2. Block diagram of the B&K Mfg. Co. flying-spot scanner. The r.f. output from this generator contains video information, vertical and horizontal sync signals, and proper retrace blanking voltages.

and are attracted to the first dynode by a positive voltage. For each electron striking this dynode, two or more electrons are emitted by it. The current provided by this first dynode is larger than the original cathode current and amplification has occurred. The electron stream from the first dynode is attracted to the second dynode by a higher positive voltage, where further amplification takes place. The electrons from the second dynode are, in turn, attracted to the third dynode. This process continues to dynodes four, five, six, seven, eight, and nine. Finally, a very large electron stream from the ninth dynode is fed to the plate where it is on the order of 1 million times larger than it was when it left the cathode.

From this point on, the action of the video signal is straightforward. It is fed to the grid of a modulator tube where it is mixed with the r.f. carrier generated in a Hartley oscillator. See Fig. 2. Thereafter, the amplitude-modulated r.f. is coupled to the output terminal *via* an r.f. attenuator. From here it can be fed to a single receiver over a 75-ohm coaxial cable, or to an entire system of receivers by means of a signal distribution system.

The attenuation provided by the r.f. attenuation network is sufficiently effective to permit reducing the output to a point where the displayed picture falls into the "snowy" region. This is useful for checking the sensitivity of receivers designed to operate in fringe areas.

In addition to video information, horizontal and vertical synchronizing pulses are transmitted also with the r.f. carrier to assure proper picture display without vertical flop-over and horizontal slippage. These pulses are coupled to the grid of the modulator stage and are derived from the horizontal and vertical sections of the instrument. In the horizontal system, control of the operating frequency is achieved by selecting the proper component values plus permitting a sufficiently wide range of control so that a

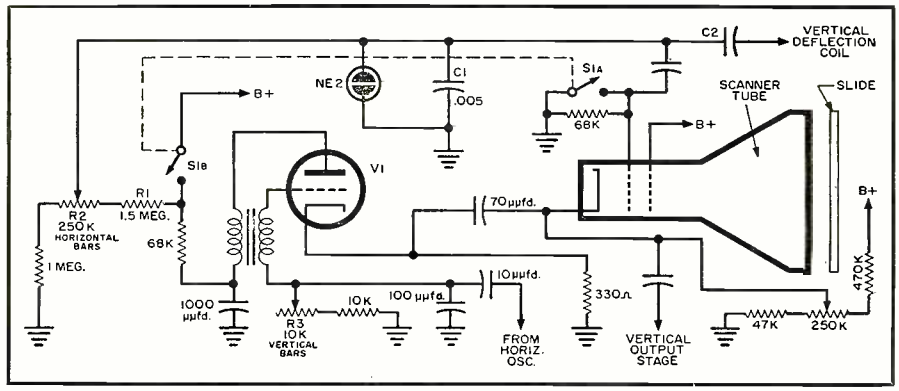


Fig. 3. Schematic diagram of that part of the scanner used for internal crosshatch.

television receiver can be locked in securely. In the vertical system, the 60-cycle power line frequency is employed as the chief controlling factor.

Another useful servicing feature of this instrument is the ability to develop an internal crosshatch pattern when the technician desires to check the horizontal and vertical linearity of the scanner sweeps. The device therefore can be internally calibrated for accurate linearity.

The manner in which this crosshatch pattern is developed is both unique and simple. When S_{1A} is open and S_{1B} is closed, Fig. 3, the NE-2 horizontal bar generator blanks out certain complete horizontal traces during the vertical sweep of the scanner. This occurs because the NE-2 effectively grounds the grid of the scanner when it fires. This action results in no horizontal line on the scanner tube raster. As soon as C_1 discharges to a certain value, NE-2 ceases to conduct, and it will not conduct again until C_1 charges to its firing point through R_1 and R_2. During the time C_1 is recharging, the scanner raster emits light. The frequency with which the NE-2 fires, and thus the number of horizontal bars, is determined by the setting of the horizontal bars control, R_2, which varies the charging time of C_1. The repetition rate of the horizontal bar generator is always some multiple of the vertical oscillator frequency. A synchronizing pulse from the vertical output stage is coupled to the horizontal bar generator through C_2 to insure stable horizontal bars.

Switch sections S_{1A} and S_{1B} are part of the front-panel "Off-On-Bars" switch. S_{1B} is closed and S_{1A} is opened when this switch is in the "Bars" position. The horizontal bar control, R_2, is on the chassis and is adjusted internally.

Vertical bars are generated by blanking small portions of each horizontal trace. Blanking pulses for this purpose are supplied by vertical bar generator V_1, which is a blocking oscillator that operates at some multiple of the horizontal oscillator frequency. Since the operating frequency of a blocking oscillator is determined by the RC time constant in its grid circuit, varying potentiometer R_3 changes the operating frequency. Thus, R_3 is used as the vertical bars control (adjusted internally) to vary the number of vertical bars. Pulses from the vertical bar generator are coupled from the cathode of V_1 to the cathode of the scanner tube. Since "B+" is connected to V_1 only when S_{1B} is closed ("Bars" position), the vertical bar generator operates only when the "Off-On-Bars" switch is at "Bars."

(*Continued on page* 110)

Fig. 4. White dot slide furnished with flying-spot scanner.

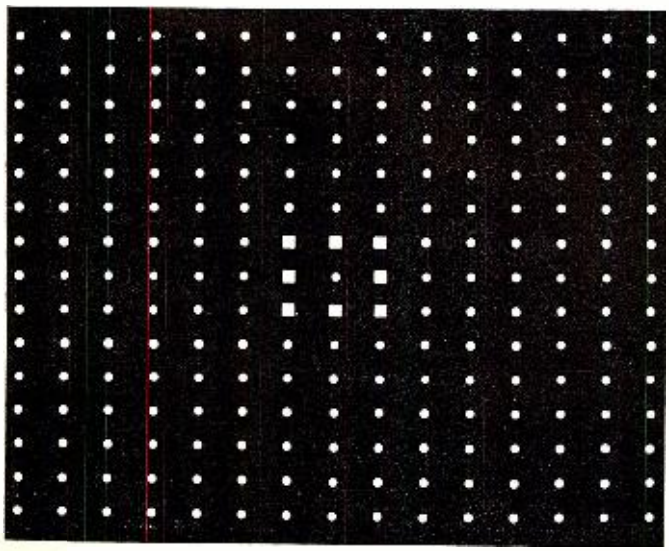
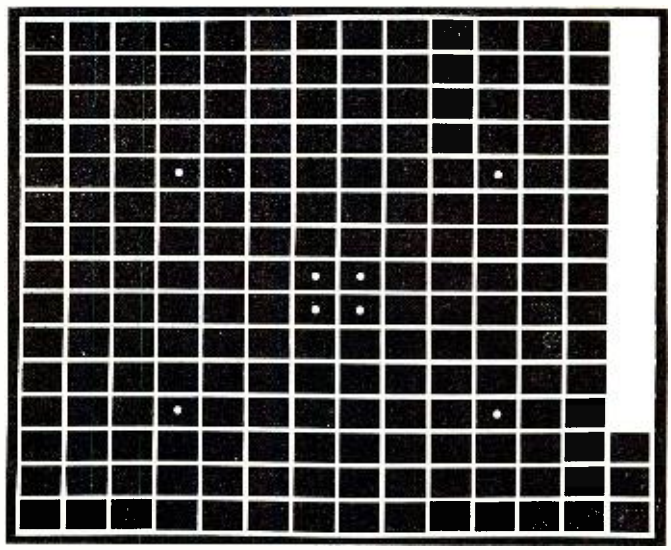
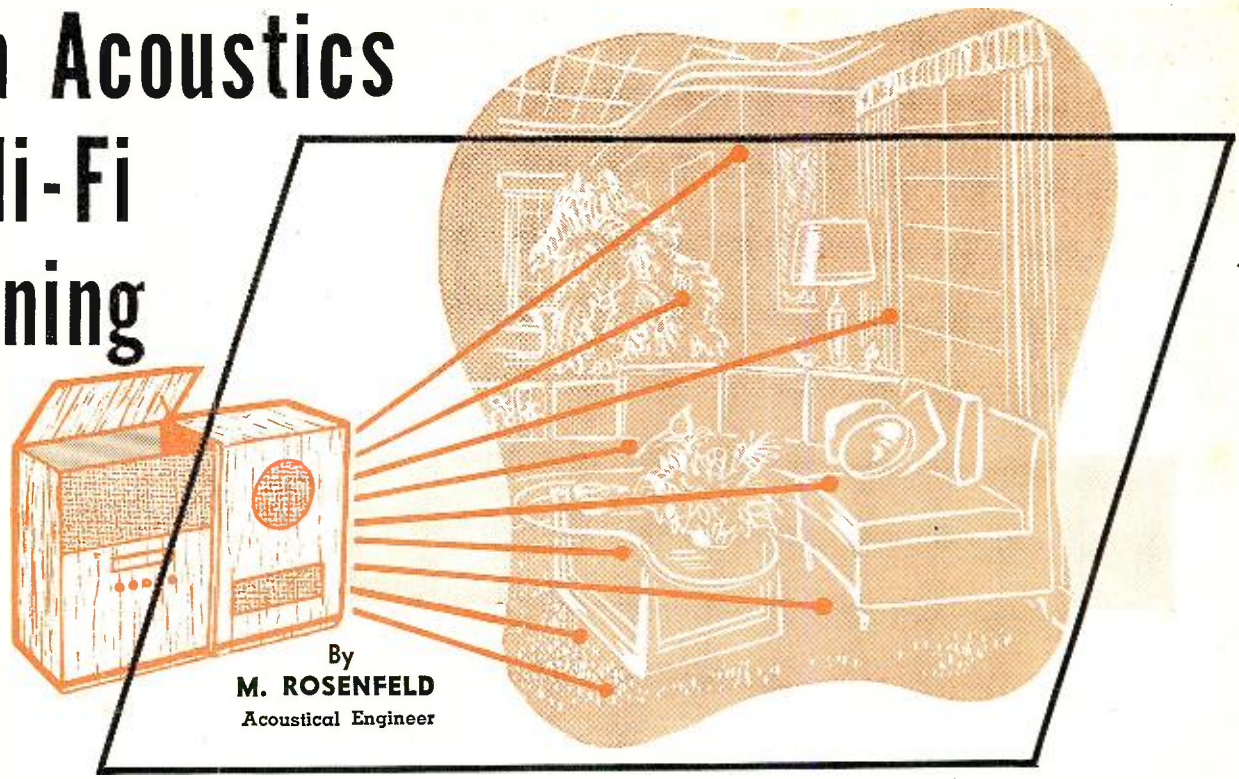


Fig. 5. White line crosshatch pattern "Dyna-Scan" slide.



Room Acoustics for Hi-Fi Listening



By
M. ROSENFELD
Acoustical Engineer

Add "presence" to the reproduction of music in your home by following these simple rules for improving acoustics.

WHILE a hi-fi enthusiast may have spent considerable time, thought, and money in acquiring the components of his system, probably very little effort has gone into consideration of the acoustical characteristics of the room where the music is to be heard. Acoustical conditions change the character of each note as heard by the listener such as its duration and intensity. Acoustic conditions also determine the distribution of sound throughout the room and the amount of power required from the sound source. By proper control of these conditions, the illusion of "presence" can be obtained as explained later in the article. Designers of auditoriums, sound studios, lecture halls, etc., recognize this, whereas the average hi-fi enthusiast has little knowledge of the subject. Dealers in high-fidelity equipment should also be aware of the acoustic conditions in their showrooms in order to display their merchandise to best advantage. Very frequently, the same equipment will sound different in one's own living room than in the showroom because of differing acoustic conditions.

This article will give the reader an appreciation of the factors that influence the acoustics of a room. In addition, a simple formula will be presented that will enable the reader to calculate the reverberation qualities of his own listening room and ascertain whether satisfactory acoustic conditions exist.

"Live" and "Dead" Rooms

The acoustical engineer often speaks of a room as being "live" or "dead," which refers to the amount of echo (also called reverberation) present. An example of a "live" room is a museum gallery where the floors and walls are concrete or marble. When one talks or takes a step in such a room, the sound waves are reflected from the walls, floor, and ceiling, bouncing around the room, echoing and re-echoing, persisting for a relatively long time. In contrast, if one walks or talks in an acoustically treated theater or studio, there is little echo and sounds persist only for a very short time. These are known as "dead" rooms. When a person is talking in such a room, it sounds as if he were outdoors, where there are no sound wave reflections. A person's ears are generally accustomed to listening to music and speech indoors where a certain amount of reverberation is present. Music and speech sound different outdoors because of the absence of this reverberation.

Reverberation Time

The difference between a "live" room and a "dead" room is the difference in the time it takes for a sound to die out in such rooms. The walls, ceiling, floor, and other objects in a room all absorb energy from sound waves striking them. If the amount of absorption is large, as in an acoustically treated theater, sounds will die out rapidly. If absorption is small, as in a marble museum gallery, sound waves will echo back and forth a number of times before their energy is finally absorbed. Therefore, a sound will require a longer time to die out.

Acoustical engineers measure the "liveness" or "deadness" of a room by its reverberation time. Reverberation time is defined as the amount of time it takes for the energy of a sound wave to decrease to one millionth of its original value in the room. This definition is based on the fact that for the average person, this is the time it takes a sound of average intensity to decay to inaudibility in the room. A highly reverberant or "live" room would have a reverberation time of about 4 or more seconds, while the reverberation time of a "dead" room would be about 0.3 second or less. One can note the difference between the reverberation time of various rooms by simply clapping hands and noting how long it takes for a sound to die out. With a little practice, a rough comparison of the reverberation times of different rooms may be obtained.

Effect of Reverberation

In addition to the primary source of sound in a room such as a person, orchestra, or loudspeaker, reverberation (in other words, echoing) introduces secondary sounds which modify the characteristics of the direct sound. As far as speech is concerned, reverberation reinforces the primary source of sound so that less loudness from the person talking is needed. However, if the reverberation time of the room is too long, overlapping of syllables occurs, because the reflected sound interferes with that coming directly from the person talking. This causes syllables to become indistinct, speech to become garbled and the intelligibility of the speech suffers.

In music, reverberation in the room is also an important factor to consider and its effect depends upon the type

of music. For example, if dance music having short clipped notes is played in a room or hall having a long reverberation time, reflected sound will interfere with notes directly from the orchestra, causing unpleasant listening. On the other hand, an organ oratorio played in such a hall with a long reverberation time is enhanced. Reverberation in a room also tends to distribute sound more evenly throughout the room, which is an important factor to consider if a large audience is present. In addition, less power is required from an orchestra or loudspeaker for a given amount of loudness when the reverberation time of a room is larger.

Optimum Reverberation Time

In rooms used for unamplified speech, such as lecture halls, classrooms, and auditoriums, there is an optimum reverberation time. The compromise is between a long reverberation time giving higher volume and better sound distribution over the audience and a short reverberation time giving less overlapping of syllables and greater intelligibility of the spoken words. The optimum reverberation time for unamplified speech has been found, by experience, to be about 1 second, more or less, depending on the room volume.

In rooms used for unamplified music, such as concert halls and recording studios, satisfactory acoustical conditions are subjective and a matter of individual preference. The preferred reverberation time is, to some extent, a matter of musical taste which depends on the composition, the conductor's interpretation, the musicians, and the listener. Measurements of the reverberation time of the leading concert halls in Europe and the USA, judged to be acoustically satisfactory by musical authorities, have been made. These measurements indicate that satisfactory acoustical conditions result when the reverberation times range from approximately 1 to 2.5 seconds, depending on the room volume and the type of music. Acceptable limits for both speech and music as a function of room volume are shown in Fig. 1.

Reverberation Time for Hi-Fi

Factors such as loudness and uniformity of sound distribution can be readily controlled in rooms where speech and music are reproduced by amplifier and loudspeaker systems such as in motion picture theaters, auditoriums with p.a. systems, and one's own living room. Therefore, such factors need hardly enter into a determination of optimum reverberation time for these rooms.

The effective reverberation heard by the listener in such rooms will be a combination of that of the studio where the speech or music originated and the room where the speech or music is heard. The listening room should not add to the reverberation of the music emanating from the studio, so the listening room's reverberation time should be relatively short. However, if the listening room is excessively deadened, then most of the sound heard will be that coming directly from the loudspeaker, which is too directional to sound natural. It will sound as if one were listening to the loudspeaker out-of-doors where no objects, such as walls or ceiling, are present to reflect sound waves. A suitable reverberation time for a listening room is approximately 0.3 to 0.6 second.

The reverberation time of the listening room can, to a great extent, give the listener the illusion of "presence." For example, if an announcer is speaking in a studio having a very short reverberation time, the listener in an ordinary room has the impression that the announcer is present in the listening room since the reverberation of the listening room will be predominant. However, if the studio has a considerably longer reverberation time than the listening room, the listener has the impression that he is actually in the studio. To meet the requirements of different program material, many studios have variable reverberation time characteristics obtained by the use of removable acoustical wall panelling. Interesting musical effects can be obtained by the use of "echo" chambers and electrical devices which artificially introduce reverberation into a musical composition.

The following examples illustrate how the reverberation times of the studio and the listening room combine. If a studio has a reverberation time of 0.3 second and that of the listening room is 0.4 second, the resultant reverberation heard by the listener will be about 0.6 second, an increase of about 100% over that of the studio. If the studio has a reverberation time of 1.5 seconds and that of the listening room 0.4 second, the resultant reverberation will be about 1.65 seconds, an increase of about 10% over the studio. These figures illustrate that since the optimum reverberation time for music studios is about 1 to 2.5 seconds, a listening room reverberation time of about 0.3 to 0.6 second will have little influence upon the reverberation qualities of the original music.

In modern motion picture theaters, the designers have purposely made the reverberation times low (0.6 second or less) permitting the originating sound studios to introduce the desired reverberation time. For a cathedral setting, the reverberation time introduced by the originating studio is made long. For an outdoor setting, it is made short or zero. It should be noted that once reverberation has been introduced into the recording, it cannot be removed at the listening room, but can only be made greater.

For hi-fi listening, it is desirable that the studio where the music was originally recorded or played contribute the major part of the reverberation introduced. Therefore, the listening room should have a reverberation time of 0.6 second or less, since its effect on the reverberation qualities of the music will then be negligible. (*Continued on page* 159)

Varnished wood	.07	Curtains and draperies (heavy)	.50
Parquet or hardwood flooring	.07	Cotton curtains	.20
Heavy carpeting or rugs	.40	Concrete or brick	.02
Thin carpeting or rugs	.20	Upholstered areas	.50
Linoleum	.02		
Plastered wall or ceiling	.03	ABSORPTION OF COMMON OBJECTS (in Sabine Units)	
Plywood wall	.10	Person	5.0
Wooden doors	.10	Wood chair	.3
Marble surfaces	.02	Small wood table	.3
Wallpaper	.04	Sofa, upholstered	8 to 16.0
Glass window panes	.10	Chair, upholstered	4.0
Open window	1.00		

Table 1. Absorption coefficients of common materials and home objects (in Sabine units)

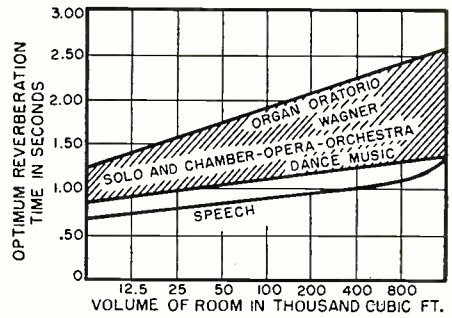


Fig. 1. Optimum reverberation time for recording studios and concert halls for music and for unamplified speech. See text.

Table 3. The absorption of the various parts of a household listening room, with the normal complement of furniture.

Ceiling (plastered)	16′ x 12′ x .03	5.76
Floor (heavy carpeting)	16′ x 12′ x .40	76.80
Walls (2 plastered)	16′ x 9′ x 2 x .03	8.64
Walls (2 plastered)	12′ x 9′ x 2 x .03	6.40
Heavy drapes over windows (Windows not included since they are covered and not a factor)	2′ x 5′ x 2 x .50	10.00
Wooden door (1)	3′ x 7′ x .10	2.10
Sofa (medium size)		12.00
Upholstered chairs (2)	4 x 2	8.00
End tables (2)	.3 x 2	.60
Three persons in room	5.0 x 3	15.00
Total absorption = A =		145.30 Sabine units.

Table 2. Absorption of various parts of an empty listening room.

Ceiling (plastered)	16′ x 12′ x .03	5.76
Floor (parquet)	16′ x 12′ x .07	13.44
Walls (2 plastered)	16′ x 9′ x 2 x .03	8.64
Walls (2 plastered)	12′ x 9′ x 2 x .03	6.40
Window panes (2)	2′ x 5′ x 2 x .10	2.00
Wooden door (1)	3′ x 7′ x .10	2.10
One person in room		5.00
Total absorption = A =		43.34 Sabine units.

Probing with a V.O.M.

You can use the v.o.m. more widely now in repairing TV, radios, and appliances, with the new probes available.

By
ROBERT G. MIDDLETON
Technical Consultant, Futuramic Co.

THE volt-ohm-milliammeter is the most widely used instrument in radio and TV servicing. Sales figures show that even the vacuum-tube voltmeter runs a distant second place to the popular v.o.m. Two of the reasons for this preference are that the v.o.m. is simple in construction and it requires no source of external power.

Recognizing the widespread preference for the v.o.m. throughout the service trade (including industrial maintenance and refrigeration, air conditioning, and appliance servicing), manufacturers make available accessory probes for the v.o.m. These probes extend the field of usefulness of the meter and permit the operator to get the most from it.

Among the various v.o.m. probes which are available, the signal-tracer probe has proved very popular within the past year. The signal-tracer probe is a special detector unit adapted to the characteristics of conventional v.o.m.'s, and permits checking of signal voltages in the local oscillator, i.f., picture detector, video amplifier, horizontal oscillator, sweep, damper, and flyback circuits. Tests of signal voltages can also be made in the sync, intercarrier sound, and audio frequency sections of a TV receiver.

The output from the probe is applied to the d.c. input of the v.o.m., and the probe is used in place of the conventional test leads for the instrument. A test of local oscillator operation is made by applying the probe to a "floating" tube shield over the oscillator-mixer tube, as shown in Fig. 1. The v.o.m. is operated on the lowest d.c. range; no reading indicates a dead oscillator. More voltage will be obtained on low channels, when the oscillator is working, than on channels 7 to 13, with a reading from 1.5 to 2 volts for normal operation.

Fig. 2 shows how the sweep output signal is checked. The probe tip is merely held alongside of the glass envelope of the horizontal output tube. (Never touch the probe to the plate cap of the tube, or the probe will be burned out.) This capacitive coupling to the plate of the horizontal output tube gives a reading of about 1 volt when the horizontal output signal is up to par. The ground lead of the probe must be connected to the chassis in all such tests.

Test adapters for tube sockets are useful to make checks of the horizontal oscillator, i.f., and sync signals. Fig. 3 shows a test adapter plugged into a tube socket, and the tube in the adapter. This allows signal checks under dynamic conditions of operation. An indication of about ½ volt at the input of the picture detector, for example, shows that the r.f. and i.f. systems are OK. Of course, the receiver must be tuned to a TV station to make i.f. tests.

When such test adapters are not available, the tube can be pulled, and a check of signal level can be made at the socket grid terminal by inserting the probe tip. For example, grid drive to the horizontal output tube will read about 20 volts in this test, if the horizontal oscillator is working properly, and supplying drive signal to the horizontal output tube. Drive to the horizontal yoke can be checked as illustrated in Fig. 4, by attaching a clip to the probe tip, and clipping the probe input to the insulation of the lead to the yoke winding.

The value of such tests is apparent,

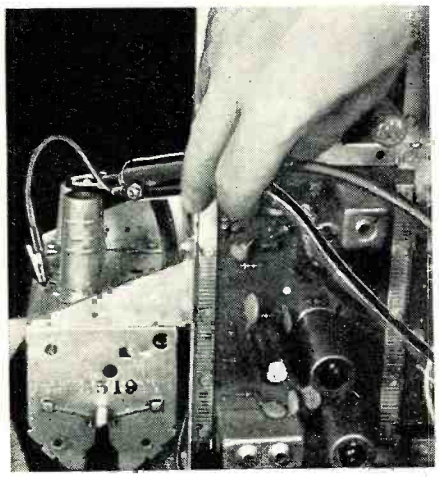


Fig. 1. Touching a signal tracing probe to the "floating" tube shield of the mixer-oscillator tube of a TV set will indicate if the local oscillator is working.

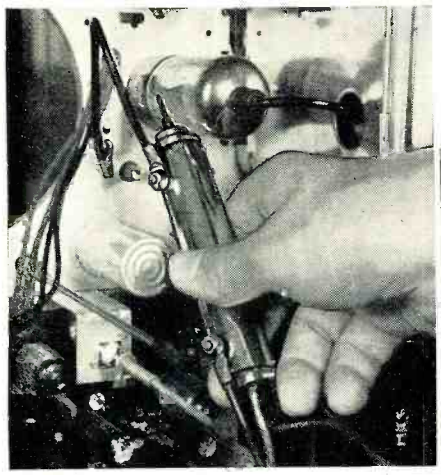


Fig. 2. The horizontal sweep output may be checked by touching a signal tracing probe to the outside of the output tube.

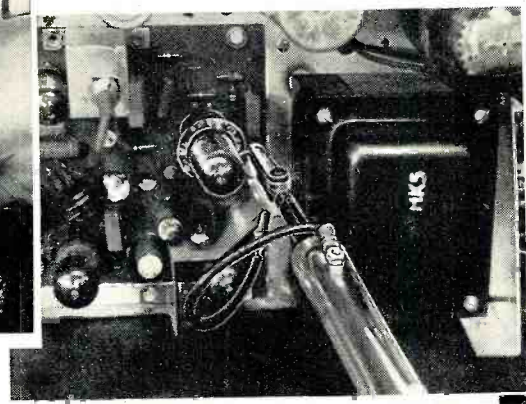


Fig. 3. Using a tube socket test adapter, as shown here, allows dynamic checks to be made above the chassis with a v.o.m.

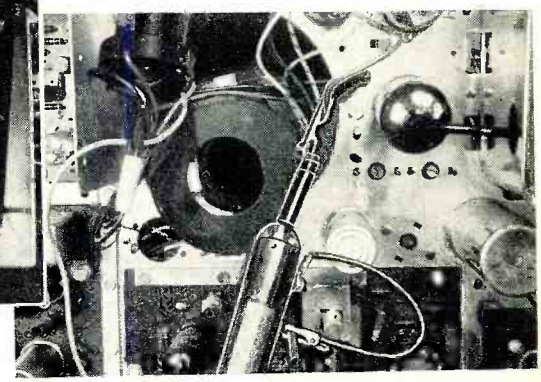


Fig. 4. To check the signal to the deflection yoke, slip a clip over the probe tip and connect it to the insulation of the lead(s) going to the yoke.

because a TV chassis is often pulled only to discover that the effort was wasted due to the fact that the fault was external, such as a defect in the yoke, or a faulty picture tube. Video signal drive to the picture tube can be checked easily by inserting the probe tip into the cathode (or grid terminal) of the picture tube socket. Again, the TV set must be receiving a TV station signal to make this test.

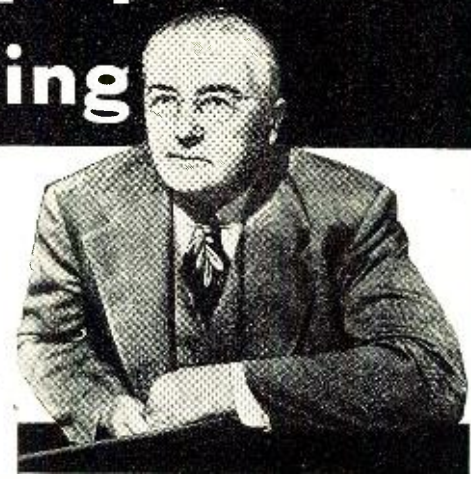
Other v.o.m. probes contribute greatly to the utility of the meter. A typical high-resistance probe converts the R x 10,000 ohms range of a v.o.m. to an R x 100,000 ohms range, and permits measurement of resistance values up to 200 megohms instead of the usual 20 megohms. Such a probe can be used to measure insulation resistance between socket terminals and insulation resistance between the primary and secondary of a vertical oscillator transformer.

A high-resistance probe is as useful in air conditioning and refrigeration service as in radio and TV work. For example, such a probe is used to test the motor compressor assembly of hermetically sealed units for internal grounds. The term "ground" is often misunderstood by the layman, who may confuse "ground" with short circuit. As a matter of fact, leakage resistance in the motor assembly up to 100 megohms can result in unpleasant shock or "tingle" to the housewife during humid weather, or when the floor is damp. The cabinet must be "floating" electrically, so that no potential difference will exist between it and ground during operation. Likewise, leakage resistance can be localized with the high-resistance probe to the wiring system external to the motor compressor assembly. Insulation resistance between the external wiring and the cabinet must also be in excess of 100 megohms.

There are other types of accessory probes for the v.o.m. to further extend its fields of usefulness. Among these are the polarity-reversing probe, which provides fingertip control of meter polarity. The probe makes it unnecessary to reverse the test leads at the meter, or to reverse the test clips when making checks of grid bias voltages, sync voltages, cathode voltages, etc.

Another useful accessory probe is the range-splitter probe, which provides an additional 500-volt range on popular kit-type and factory-built v.o.m.'s, so that plate supply, screen, and "B+" voltages can be measured on a 500-volt range, instead of a 250-volt range. Some popular types of v.o.m.'s provide a 250- or 300-volt range, and a 1000- or 1200-volt range, so that voltage values between 250 (or 300) and 500 volts must otherwise be measured on the 1000-volt (or 1200-volt) scale. The range-splitter probe thus provides added operating convenience. A slide switch in the probe housing permits fingertip control of the conventional ranges, or selection of the new 500-volt range. —30—

Test Equipment and Servicing



By **RAY R. SIMPSON**

The author, founder of Simpson Electric Co., Chicago, is celebrating his 50th year in the electronic instruments field. He began his career in 1906 when he went to work for the old Jewell Electric Co., a firm he later headed. In 1934 he organized the firm which bears his name. Today, Simpson Electric Co., with Ray Simpson as chairman of the board, has three plants — in Chicago, Aurora, Ill.; and Lac du Flambeau, Wis. — and is one of the largest manufacturers of panel meters and radio-TV test equipment.

Predictions as to the increase in the test equipment and servicing industries with the rise of color TV.

COLOR television will bring new techniques and the necessity to learn them, new testing instruments, and new plant investment.

To get an idea of just how soon a radical new development like color television can make its way into almost every American home we need only take a backward glance at the servicing industry. Since 1920, it has worn seven league boots as standard equipment to keep up with the entertainment demands of our people. The man who serviced dad's two-tube radio set in 1920 owned about $25 worth of testing equipment. His electronic education, picked up in his "ham" days, was good enough for the day, but he still spent roughly four hours on the average service job. Today, the average black-and-white TV service job takes only a half hour, but the practical engineer who is the modern service technician owns or uses at least $1500 worth of test equipment.

Another indication of growth is found in my own division of the industry, designing and manufacturing the test equipment. In 1920, our entire industry yearly sales amounted only to $50,000, while today, five of the largest manufacturers combined do a $25,000,000 yearly business. Based on growth figures of only the past few years, I believe supplying the 100,000 service technicians in the United States with specialized testers to meet the challenge of color television is going to be a bigger than $50,000,000 industry by 1960, a two-fold increase in four years.

Concretely, the need for new equipment to service a new dimension, color, will mean the production of 25,000 tube testers, 50,000 oscilloscopes, and 100,000 specialized colorscopes, color-bar generators, and variable dot generators—names which will become as much a part of servicing jargon as tube tester or v.o.m.

The biggest service tool in the service kit of 1920 was a voltmeter used to measure the output of the batteries used to power the old radio sets. It cost about $10. The advent of de Forest's vacuum tube added simple tube testers to the kit, and by the mid-thirties, the conscientious service technician carried a signal generator in his field case to make alignment tests of the larger console radios of the period.

Radios, of course, became less complicated, but television introduced video, synchronizing, and sweep circuits, and problems of proper picture adjustment. The electronic instrument field met the service technician's black-and-white TV needs with advanced sweep generators, signal generators, marker generators, oscilloscopes, and high voltage probes, as well as by refining the conventional meters and making them more sensitive. With the experience gained with these instruments and TV circuitry, the service technician should be able to keep the color sets operating. But he'll need new testers and the ability to use them to do it. His own increased plant expense will, of course, be reflected in the prices he charges for color servicing, but I believe the public will accept this just as they will accept and are accepting the much higher set costs of color television.

In addition to producing new instruments, many companies in our field are distributing educational literature on color servicing and a few are conducting nationwide service technician meetings where color servicing with the new instruments is explained and demonstrated.

I've indicated a pretty optimistic growth picture for the service technician and my own industry, because I can't see how we can do anything but grow. Each new electronic development will have its counterpart in new ways of measuring, controlling, and servicing that development. —30—

Unionized Service Shops

By **WILLIAM LEONARD**

Why have radio and TV service shops in San Francisco signed a contract with the electrical workers union?

AFTER numerous fruitless and frustrating attempts to enlist the help of other industry elements in some program that would cure the ills of the independent electronic service industry in their cities, associations in Chicago and San Francisco have turned to labor unions as providing a possible solution to their problems. The San Francisco TV Service Guild recently signed a contract with Local 202 of the International Brotherhood of Electrical Workers. This contract, or labor-management agreement, merely provides for wages and working conditions; however, more than this is expected from the union. Some of the aims of the shops which have joined the union are municipal licensing and the elimination of cut-rate service operators. These goals the union will seek to attain.

The philosophy of union officials in working with independent service businesses was summed up by Edward John Bird, business manager of the Radio and Television Engineers Local 202 of the I.B.E.W.

"As business manager of a local union representing approximately a thousand television servicemen in this area, one would think that my interest would stop there, namely in the financial welfare of the people I represent. However, this is not so. I have as much, if not a greater interest in the economic status of the industry as a whole and the financial success of the individual employer whether he be big or small.

"The reasons, of course, are obvious. No employer can long endure if on the one hand he has to afford his technicians the economic rewards their individual and collective skills entitle them to, while on the other hand he is beset by every kind of unscrupulous and unfair competition from every conceivable angle.

"Accordingly, we have dedicated ourselves to rid this area of the 'gimmick boys,' and 'fly-by-nighters,' and their ilk and will use every fair and legitimate measure to do so. We have approached every association in the eight Bay Area Counties and asked their cooperation in this endeavor. To say the least, the response, though at first on the slow side, is now assuming snowball proportions. As a union, we are very encouraged and grateful for the confidence afforded us by the various city and county associations and will leave no stone unturned to merit that confidence. Together we have a big job to do, but rest assured we will do it."

Many of the service dealers on the West Coast and elsewhere seem to feel that there are three main reasons why a healthy business climate does not exist for their profession. The first reason is that the parts distributors from whom they buy replacement tubes and parts, in many cases, also sell directly to the consumer at the same prices as to the service dealer. The service dealers point out that once the customer has bought a part or tube at the net price, he objects to paying a service technician the list price for a part that has to be replaced.

Another contributing factor in the opinion of many service dealers is the unrealistic price structure on replacement parts and tubes. The maintenance of list prices that allow for discounts which are much higher than for other similar products has led, they feel, to distrust on the part of the consumer. The average markup from net to list prices for TV receiving tubes, for example, is about 100%. Because of this, many service dealers are able to charge less than a realistic service charge for a call because they will make up the amount on parts profits. This, service dealers feel, has hindered the acceptance of realistic service charges by the public.

Ethical service dealers point out that the third big reason why the service industry is not a healthy one is because of the existence of unethical "sharp" operators. Often, these operators sell a set owner more tubes than the set really needs to return it to proper operation. This he does by misadjusting the tube tester he uses so that good tubes will read bad. The extra tubes he sells this way more than makes up in profit for the low cost of the service call that he usually advertises. To these activities should be added those of the gyp operator whose sole aim is to pull sets for major overhaul jobs in the shop at exorbitant prices.

Members of the San Francisco Guild believe that unionization will help them overcome these problems.

Union Contract

The contract signed by the San Francisco TV Service Guild and Local 202 of the I.B.E.W. provides for a $2.65½ minimum hourly wage for technicians. They also receive time and one-half for overtime past 40 hours per week. The contract makes shop owners members of the Union. The forty-two shops holding membership in the Guild signed the contract and the immediate objective is to bring an additional forty shops in the city into the Union.

Although the provisions are not specified in the contract, the Union has agreed to throw its full weight against part-timers and cut-rate shops. They plan a cooperative management-union drive to bring about city and county licensing of technicians and the passage of key zoning ordinances.

To relieve the shortage of trained technicians, the Guild and the Union are setting up an apprenticeship education program for the purpose of creating a new corps of qualified technicians. Under committee guidance, apprentices entering the trade will be sent to city vocational schools two nights per week for four years. Upon graduation, they will receive journeyman certificates. Also planned under joint management-union sponsorship is a "finishing school" program for journeyman technicians to get them ready for color.

Although other Bay Area associations have expressed an interest in the management-union type of contract, Union officials do not plan to expand their organizational efforts until the major goals have been reached in San Francisco.

In the opinion of Guild officers, if the objectives of their contract with the Union are effectuated, they will be able to meet the growing competition of manufacturer-sponsored centralized service successfully and keep the control of consumer service in the hands of efficiently managed independent service businesses. They do not feel that the contract will provide an umbrella for the inefficient service shop however ethical its operations may be. But they are of the opinion that given a clean business atmosphere in which to operate, the independently owned and managed service shops will provide the most efficient service at fair prices. —30—

The "Corona Loudspeaker"

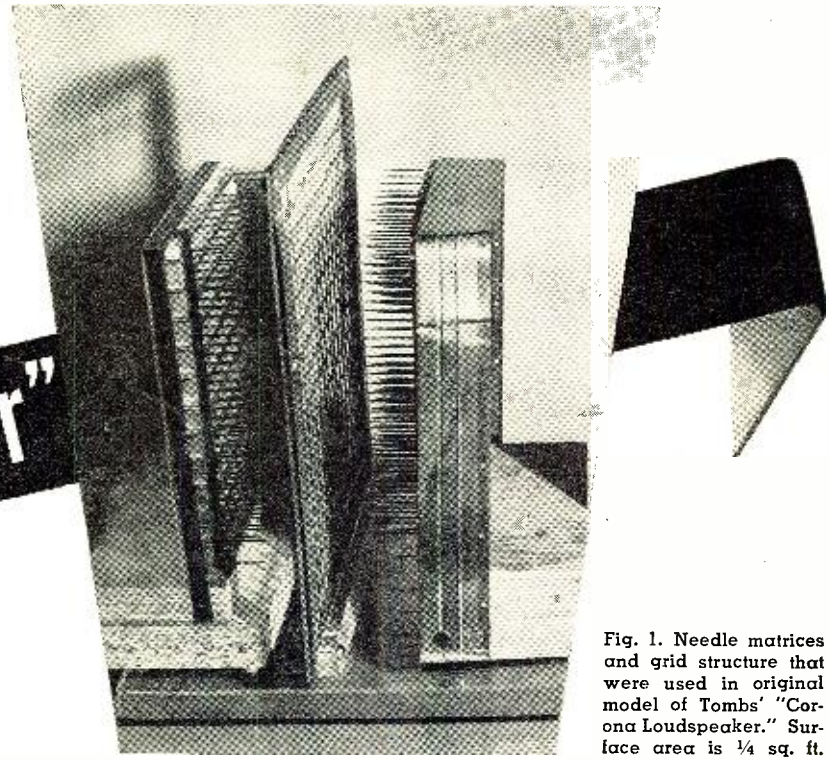


Fig. 1. Needle matrices and grid structure that were used in original model of Tombs' "Corona Loudspeaker." Surface area is ¼ sq. ft.

By
GERALD SHIRLEY
President, Televex Co.

Details on a novel experimental design which employs a modulated wind, due to corona discharge, to produce sound.

A LOUDSPEAKER which converts electrical energy directly into sound without any moving parts, and which reproduces the entire audio spectrum, has long been a dream of audio engineers and loudspeaker designers. The demonstration of a prototype of such a speaker in England (where it was invented) and recently before the New York Section of the Audio Engineering Society indicates that the dream may finally become a reality. The inventor of the "Corona Loudspeaker," so named because it is based on the corona-wind phenomenon, is Dr. David M. Tombs, a New Zealand born engineer who was formerly Senior Lecturer in Telecommunications at the Imperial College of Science and Technology of London University, and now director of the research department of *Hoover Ltd.*

Patent applications have been filed on the "Corona Loudspeaker," and exclusive rights for North America have been assigned to the *Televex Co.*

It has been known for many years that corona, a byproduct of high voltage, is accompanied by a movement of air away from the discharge point. TV service technicians and experimenters have, on occasion, been made aware of this effect when working in or near the high voltage sections of TV receivers. Reasoning that any source of wind might also be a potential source of sound, since sound is, after all, a sort of a.c. wind, Dr. Tombs constructed special apparatus in order to study the phenomenon more closely and to find a method of modulating the corona winds. A convenient method of observing the direction, strength, and pattern of the winds was found by injecting smoke into the corona field.

Starting with a pair of electrodes, one of which was sharply pointed and the other blunt, it was found that a corona wind moves away from the sharp point only. The next step was to mount a smooth ring coaxially around the sharp electrode, in the expectation that it might be made to act as a grid to control the corona current, and hence the corona wind. The inventor found that with a grid potential of "the same order of voltage as the sharp electrode" there is a position of the grid with respect to the tip of the sharp electrode "at which comparatively small changes of the grid potential produce a maximum effect on the intensity of the corona wind . . ." This is shown diagrammatically in Fig. 2A.

The "plate characteristics" of this corona triode were plotted for various geometries and voltages. (By various geometries is meant that the relative distances between electrodes and grid were varied, as well as the diameter of the grid itself.) The resulting family of curves bears a striking resemblance to those of certain vacuum-tube triodes.

In this application the electronic amplification (a voltage gain of about three) is "thrown away" since we are interested only in the byproduct, namely, the acoustic output. This output can be described as modulated d.c. That is, there is both sound and a steady, background, uni-directional wind.

Dr. Tombs next experimented with two sharply pointed opposed elec-

(*Continued on page* 124)

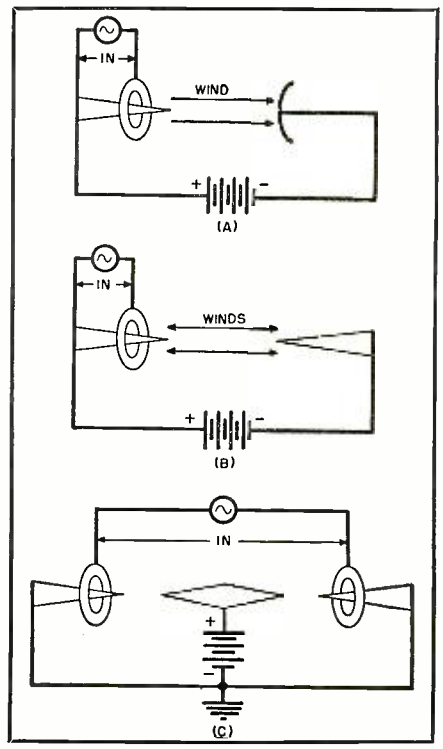


Fig. 2. (A) Simplest form of "Corona" triode speaker which produces steady "background" wind. (B) Advanced form in which winds are balanced on no signal. (C) A push-pull version of the original "Corona Loudspeaker."

Transistorized "Transmitter"

By **JOSEPH CHERNOF**

The transistorized "transmitter" with the antenna mounted on a sun helmet. This is an optional method of mounting the antenna which gives added range. Normally, antenna is mounted on stand-offs.

Construction details on a compact, low-power unit for use as wireless mike, wireless intercom, or like applications.

AFTER absorbing a number of articles on transistor receiver construction, etc., the writer has watched with great interest for some information on the use of transistors in r.f. transmission applications. To date, there has been very little information on this subject available, so the writer, with considerable trepidation, set out to investigate the situation. The results have been very interesting. Surprisingly enough, the transistor is at its most efficient when used as an r.f. oscillator and modulation poses no great problem. The unit to be described is quite simple and is intended more as an indication of the possibilities of the transistor in transmitter work than as a finished product.

This transmitter is shown schematically in Fig. 1. Total current drain for the unit amounts to 1.4 milliamperes with the microphone keyed and is only a few microamperes when not being keyed. This latter current represents the leakage across the back biased collector-base junction with zero emitter current.

The transmitter tunes from approximately 1.3 mc. to 2.0 mc. using the components shown. The r.f. output is greatest at the low end of the band. An ordinary carbon microphone is used for modulation purposes. A whip antenna, fabricated from a four-foot length of brass welding rod, gives about a ¼-mile range with the antenna attached to the unit and somewhat more with the antenna raised to head level by being attached to a hat as shown in the photograph at the top of this page. Use of a reasonably long antenna would probably extend the range of transmission well beyond the limits set up by the FCC for phono oscillators and other units radiating in the broadcast band.

The upper frequency limit of the transmitter is dependent on the type of transistor used. There are a number of units available commercially which will oscillate at frequencies well above 5 mc.; however, the writer limited his work to the most inexpensive units available. The final choice was a *Texas Instruments* TI-300, which has the advantage of being quite low in price. This transistor is of the *p-n-p* type.

Transistors oscillate with great ease so there was no difficulty in developing an oscillator circuit. The circuit finally chosen was that of the grounded-base amplifier with feedback. This is a better circuit for r.f. oscillators than the more conventional grounded-emitter amplifier since it has much the superior frequency response. Also, there is no phase shift between input and output current in the grounded-base amplifier so that all that is necessary to sustain oscillation is to feed back a portion of the output signal to the input through a coupling capacitor. The waveform obtained is excellent and stability is fairly good.

Referring to the schematic diagram, the "tank" circuit consists of a *Miller* "High-Q Ferrite" antenna coil. The adjustable ferrite tuning core on this coil covers a very wide frequency range without need for an additional tuning capacitor. A portion of the signal developed across the tank circuit is fed back to the emitter through C_1. Increasing the value of C_1 will drop the lower tuning limit of the unit down considerably with a corresponding decrease in the upper frequency limit. Since the antenna length available for portable use was limited, it was decided to settle for the highest possible operating frequencies.

Emitter current is supplied from a standard penlite cell through the microphone, a 1.5 millihenry r.f. choke, and a 1000 ohm pot which serves as modulation control. This is fairly simple to adjust with the aid of a nearby receiver, being set for the best compromise between loudness and distortion. Modulation is accomplished through variation of emitter current through the carbon mike. There is also a secondary effect due to the resistance of the mike being part of the r.f. feedback network. Since this effect gives both amplitude and frequency modulation, it has been minimized as much as possible through the r.f. choke and decoupling capacitor, but there is still enough of an effect left to give a little frequency modulation. Using a shielded cable for the mike lead also helps to reduce this. The FM effect is not too objectionable and is probably average for most modulated oscillator circuits.

The mike is a standard T-17, usually

available on the surplus market. Almost any carbon mike would be a satisfactory substitute here.

Collector power is supplied from an *Eveready* Model 413 miniature 30-volt battery. Manufacturer's specs limit the TI-300 transistor to a maximum collector voltage of 22½ volts, but the writer has put many hours on several of these units at 30 volts with no adverse effects. In any application where that last yard of range is not too important, a 22½-volt battery would be satisfactory. An ordinary toggle switch serves as the "on-off" control although a miniature slide-type switch would have been a better choice.

The antenna connection is taken directly off the top of the tank coil, which means that antenna length has a very noticeable effect on tuning. As one would imagine, the longer the antenna, the lower the frequency for a given tuning adjustment.

The entire unit fits very nicely into a miniature *LMB* box chassis, 4 x 2 x 1½ inches in size. The antenna may either be mounted directly on the case with miniature stand-off insulators or may be located elsewhere. As seen in one of the photographs, the chassis was held in the writer's hand and the antenna was mounted with stand-off insulators on his sun helmet. The entire unit could probably have been built in the sun helmet without too much trouble. Battery life should be excellent, since the only appreciable current drain will occur when actually talking into the mike. Audio fidelity is not outstanding, being equivalent or slightly worse than telephone quality, so the unit is not recommended as a phono oscillator.

It was found that the upper frequency range of the transmitter could be extended by replacing the TI-300 with an i.f. transistor such as the TI-2N146. For this higher frequency operation, the value of C_1 should be reduced by at least a factor of two. It should be noted that the 2N146, in common with most r.f. and i.f. units, is an *n-p-n* transistor and therefore cannot be directly substituted in this circuit. It is first necessary to reverse the polarities of both the emitter and collector batteries, B_1 and B_2, to avoid damaging the transistor. It would also be a good idea to replace the 30-volt battery with a 22½ volt unit as the manufacturer's specs on the 2N146 quote a 20-volt maximum.

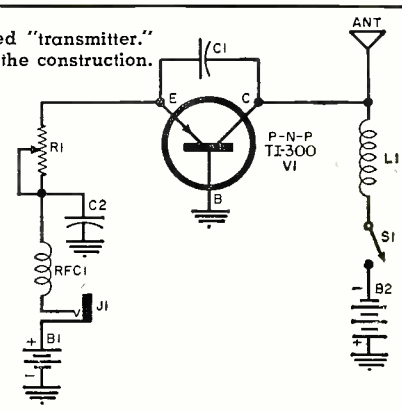
As can be seen in the construction photographs of the transmitter, B_1 and B_2 have their leads soldered directly to the battery terminals. This is the cheapest and easiest method but makes battery replacement a little difficult. It is suggested that one of the miniature battery holders, such as the *Austin-Craft,* be used to permit easy battery replacement. Solder connections are then made to the eyelets on the holders.

Regarding the use of other low cost *p-n-p* transistors in the circuit, unfortunately these were not available for checking. However, judging from results obtained to date in working with transistor circuits, probably any type of *p-n-p* transistor of comparable characteristics would operate in the circuit.

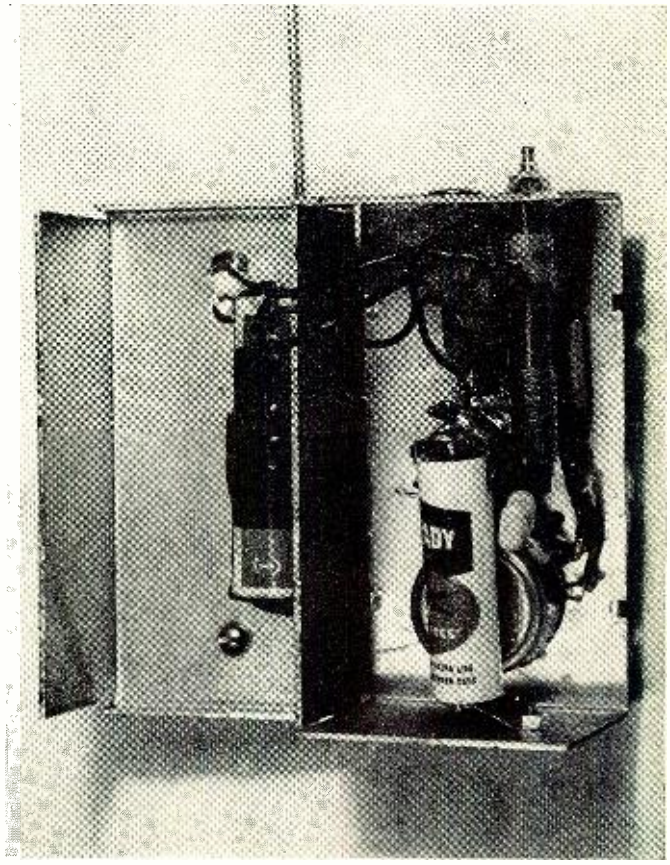
Some of the uses found for the unit, over and above the obvious broadcasting through home or car radios as a gag, have been as a part of a two-way setup for uranium prospecting in the local mountains, which ties in with a very broad application for a low-cost wireless intercom system for home or field use. This unit should also be excellent for Civil Defense use during emergencies where regular *Conelrad* broadcasting facilities are tied up with high priority messages as an alternate means of communication between local groups. As far as ham use is concerned, with better stability built into the circuits and higher frequency transistors, use of transistorized transmitters on the ham bands should not be too far off. —30—

Fig. 1. Complete schematic of transistorized "transmitter." Standard miniature components are used in the construction.

R_1—1000 ohm pot
C_1—270 μμfd., 200 v. silver mica capacitor (El-Menco or equiv.)
C_2—.25 mfd., 6 v. miniature capacitor (Sangamo Type EHT or equiv.)
RFC_1—1.5 mhy. r.f. choke (Miller #4664 or equiv.)
L_1—Antenna coil (Miller "High-Q Ferrite" #6300 or equiv.)
J_1—Microphone jack
S_1—S.p.s.t. toggle switch
B_1—1½ volt penlite cell
B_2—30 volt miniature "B" battery (Eveready #413 or equiv. See text)
V_1—"p-n-p" junction transistor (Texas Instruments Type TI-300. See text)

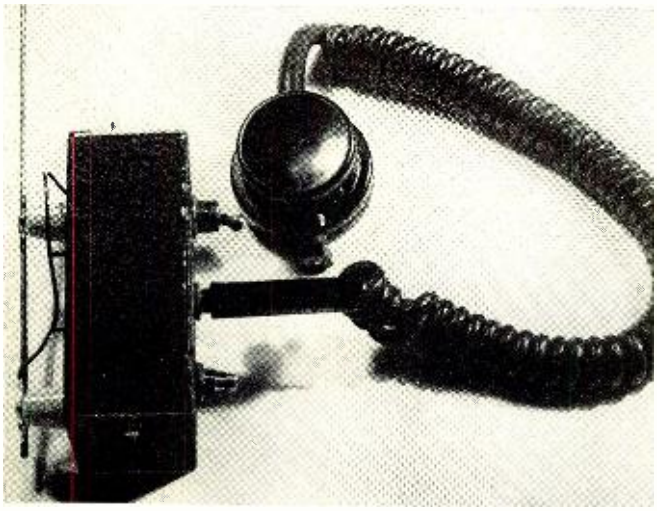


Internal view of unit. Circuit is built into a 4" x 2" x 1½" box chassis but could be built into sun helmet or other case.



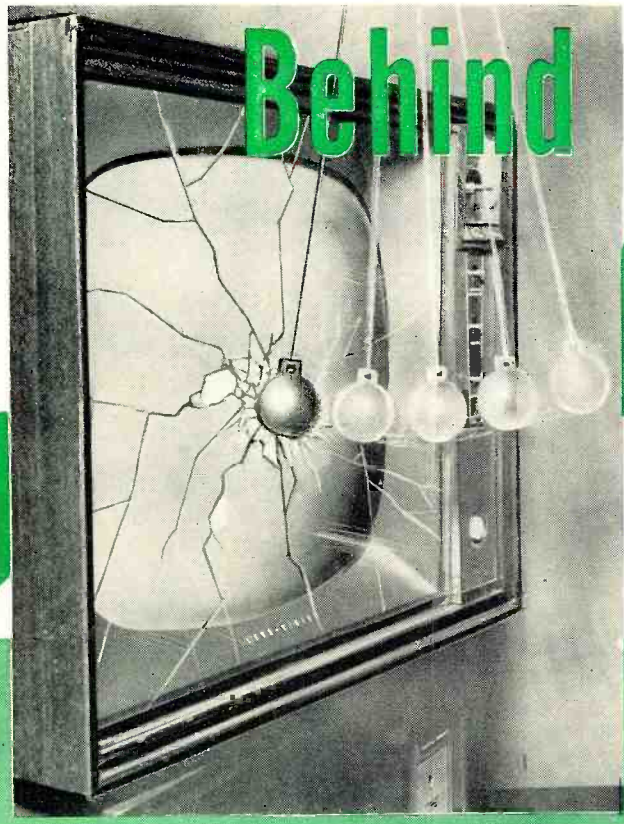
★

Over-all view of the "transmitter." In this case, antenna is mounted on case with stand-offs. Mike is a surplus T-17 unit.



Behind the UL Label

By
JACK NAJORK
Field Service Representative
General Electric Company



This is an Underwriters Laboratories test of the safety glass on a TV receiver. If the glass flies out toward the viewer as a result of being hit by a 1¼ lb. steel ball, it is unsafe.

Do you know how a TV manufacturer protects you as a viewer or service technician from implosion, shock, and fire hazards? Don't defeat the built-in safeties.

Fig. 1. This "guillotine" drops a weight upon the picture tube through a hole in cabinet. This causes the CRT to implode.

THE TV technician carefully slid the chassis of a 21" TV set out of the cabinet and placed it on his bench. The complaint was "no picture" and the technician's preliminary checks had revealed that there was no high voltage. Substitution of tubes had not corrected the trouble, so the set had been taken into the shop.

One of the first things the technician noticed as he eyed the chassis was that all the tube shields were wired down so that he wouldn't lose them, he thought. But the real reason was more important than that.

The chassis pulled by the technician may have resembled the one shown in Fig. 2. This is a "hot" chassis, that is, one side of the a.c. line is connected directly to it. The chassis is well insulated from the cabinet, which in this case is metal, but what would happen if one of those metal tube shields fell off in shipment and lodged between the "hot" chassis and cabinet? The resulting short circuit could give the set user a serious shock if he happened to be standing on, say, a grounded heat register as he touched the receiver after turning it on.

The use of captive tube shields is just one small detail in an exhaustive series of precautions taken by the TV set manufacturer to insure that his product will not constitute a hazard in the hands of the user and his family. The watchman, who makes certain that the manufacturer doesn't overlook a point or perhaps try to save a penny or two is the *Underwriters' Laboratories, Inc.*

Founded in 1894, *UL* is a nonprofit organization sponsored by the National Board of Fire Underwriters. It is operated solely as a service and maintains complete facilities for testing TV receivers (as well as many other products) in New York, Chicago, and Santa Clara, California. A set manufacturer who desires to have his receiver "listed" with *UL* must first submit a sample of the set to one of these three testing stations. If the sample is approved, *UL* representatives then visit the manufacturer's plant at the beginning of production to insure conformity with the sample. Furthermore, if changes are made in the mechanical or electrical design of the receiver during production, the revised version must be re-examined.

In the television field, *UL* is concerned with three basic hazards:

1. Picture tube implosion
2. Electrical shock
3. Fire

Before any TV receiver is granted *UL* listing it must comply with *UL* published standards for TV sets. Notice that *UL* listing does not guarantee product performance such as a perfect picture, super-fringe performance, or non-slip sync; the *UL* engineers who perform the many inspections are rather indifferent to these characteristics. Their basic concern is the user's safety.

Although TV receivers can be marketed without *UL* listing, most manufacturers seek *UL* approval for some good reasons. A *UL* listing is accepted throughout the country as evidence of adequate protection against hazard; without it, the manufacturer must obtain approval of local authorities in certain areas. Also, the display of the *UL* label generally increases public acceptance of a product.

The TV technician has an important responsibility relative to all this. He must see to it that the many user safeguards designed and built into the set at substantial additional cost are not defeated, intentionally or otherwise, as the result of a service call or shop repair job.

Let's look at some of the many tests made by *UL* to help protect the user.

One of the first and most important tests which a new model must pass is picture tube implosion. The monstrous device shown in Fig. 1 is similar to the machine used by *UL* to implode picture tubes in TV receivers. This implosion test is made on all new models to test cabinet and safety glass strength and thus reasonably safeguard the user from the possibility of serious injury from projected glass fragments should the picture tube implode.

The test is made by boring a hole in the cabinet top directly above the rim of the picture tube. The implosion machine is then used to drive a one-inch steel bar through this opening against the rim of the picture tube with an impact of approximately 100 foot-pounds. This produces a "good" implosion, which means that the folks in the laboratory next door are apt to reach out and steady themselves when they feel the shock. The terrific impact of an implosion of this type usually demolishes the interior of the receiver as can be seen in Fig. 3.

UL requirements specify that on a test of this nature no material shall be violently expelled from the receiver enclosure, provided that the method of implosion does not impair the physical strength of the enclosure itself. Obviously, the safety glass must be securely mounted if it is to contain the full force of a 21" tube implosion. (A safety glass that has been removed for cleaning and replaced insecurely, either by the customer or service technician, constitutes an implosion hazard of the first degree. Precaution #1 therefore: *When replacing safety glass make absolutely certain that all retaining hardware is replaced.* One bolt may suffice to hold the glass in place —all are needed to withstand the tremendous blast of an implosion, otherwise the manufacturer wouldn't have spent the money to include them.)

The removable back on the set also comes in for some scrutiny on this test, particularly if the receiver is one of the smaller portable models that can be parked in the middle of the room rather than against the wall. The back must also be designed to withstand the force of the implosion and, here again, if the manufacturer uses eight screws for securing purposes where two would apparently do, the reason should now be clear.

Once the implosion test is passed, a second sample receiver is brought into use for further electrical and fire hazard inspections. Before proceeding into details of these other inspections, it might be appropriate at this time to point out the assumptions made by *UL* which have a direct bearing on the nature of the inspections.

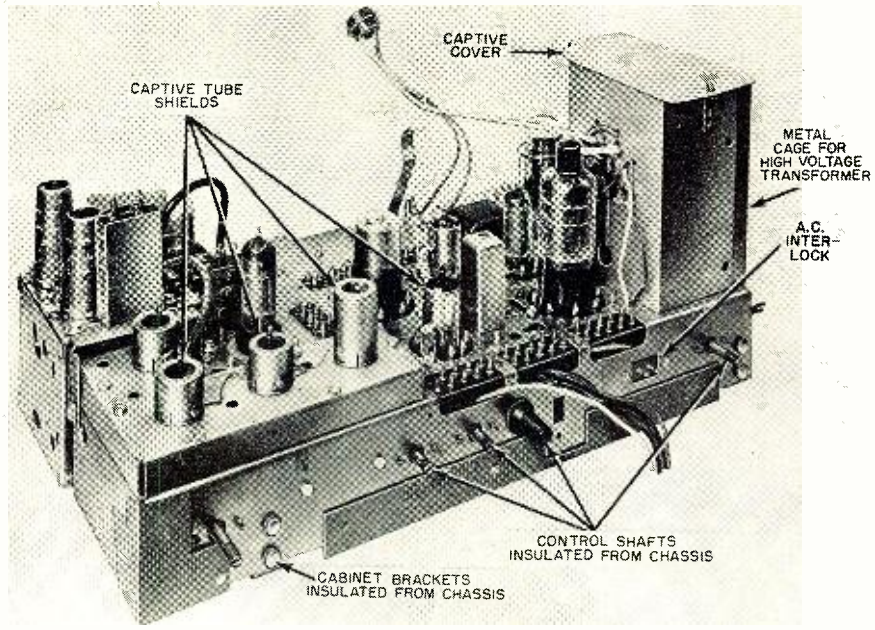
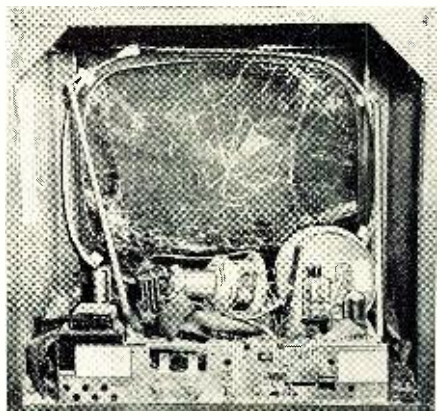


Fig. 2. Chassis of a TV set which uses a selenium rectifier low-voltage supply. This chassis is "hot" and as a result, the control shafts are insulated from it.

UL assumes that the replacement of tubes and some types of fuses is a customer operation. This goes back to the days of radio when the customer took the tubes out of his radio and had them tested at the nearest repair shop. Admittedly, this practice is not widespread with TV, but the assumption remains. All adjustments with respect to focus, picture centering, and framing are considered customer adjustments, even though the back must be removed to perform some of these adjustments. Here again, the practice is not universal, but it is considered within the realm of possibility. Still another vital assumption is that the receiver will be subject to the unpredictable actions of children and must therefore be reasonably safe against inquiring little fingers.

It now remains for the engineers to design a receiver which has satisfactory picture and sound qualities and is also safe in the hands of the consumer.

Fig. 3. Rear view of a TV receiver showing the interior after the picture tube has imploded. Note how CRT glass has scattered, but safety glass has not.



Perhaps the first *UL* required safeguard relative to the foregoing assumptions is a precautionary label on the back of the receiver which states in bold letters that the set is equipped with an electrical interlock to prevent dangerous electrical shock. Warning is given not to tamper with this device or to attempt to defeat its purpose. Despite this label, many technicians have probably come across TV sets operating in the home with "cheater" cord in use and the back cover entirely missing. A receiver in this condition is an open death trap if there are small children in the home. Several needless deaths due to this practice have been recorded. Technicians are urged to correct this situation when they come across it.

With the a.c. interlock on the back operating properly, the user is exposed to no shock hazard in removing and replacing small tubes. Closely allied with tube changing is fuse replacement and here the *UL* has a somewhat different philosophy.

Until recently, *UL* did not permit an *essential* fuse to be user-serviceable because the types of fuse receptacles available could be bridged or otherwise defeated with a piece of wire, metal foil, etc. Any user-accessible fuse, therefore, which was incorporated by the manufacturer, was shorted out of the circuit during the *UL* test and the equipment was then required to meet test requirements in this condition. Within the past year, however, a practically foolproof fuse and fuseholder have been devised and *UL* has given recognition to their use within definitely established limits. Fuses are now considered either "user serviceable" or "non-serviceable."

A "user serviceable" fuse must be clearly visible when the back of the

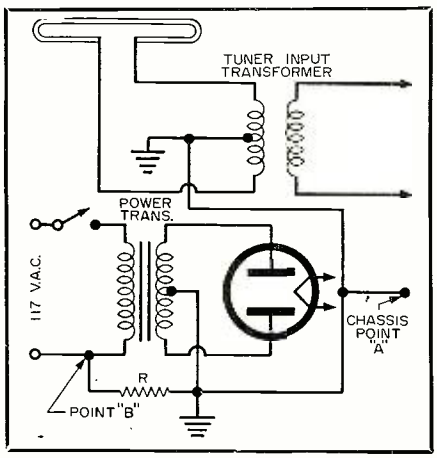


Fig. 4. Simplified low-voltage power supply and signal input circuits of a TV set showing the resistor from one side of the a.c. line to ground.

receiver is removed or the interior of the receiver is otherwise exposed and it must be labeled with data on the type and rating of a suitable replacement. A fuse in this category must also be mounted so that the user cannot defeat its purpose, that is, both terminals of the fuse cannot be exposed to invite a temporary repair with a piece of baling wire or metal foil.

A "non-serviceable" fuse, on the other hand, must be concealed from the user either by a cover of some sort (which cannot be removed without hand tools) or by wiring the fuse into the chassis at a point where it is not visible when the interior of the receiver is exposed. This type of fuse can be wired into the primary a.c. circuits or the high-voltage circuits, or both. Generally, it is desirable from a cost and design standpoint to wire in the high-voltage fuse as a "non-serviceable" type because extension of damper or other horizontal circuit wiring to enable convenient positioning of the fuse can produce undesirable feedback effects to other sections of the receiver.

Fire Hazards

As might be expected, the high-voltage transformer is generally considered the number one fire hazard and the *UL* test, therefore, requires that this component withstand, without breakdown, a voltage in excess of twice the peak operating voltage. Failure to pass this test requires that the transformer be enclosed in a metal container so that the flame of a breakdown arc cannot be propagated. If a cover or access plate is provided on the enclosure for service reasons, it must be made captive, that is, secured to the chassis so it cannot be completely removed or forgotten. A clip, chain, or hinge is usually provided to fulfill this requirement. (Precaution #2: *Be sure the high voltage compartment is securely "buttoned-up" after servicing this section of the receiver.*)

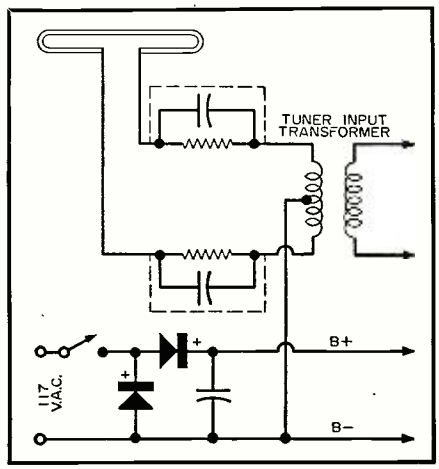
If the receiver is unusually compact, which appears to be the current trend, heat generated by the larger tubes in confined areas is considerable and it is for this reason that some wooden cabinets have sections of the interior lined with metal foil or asbestos. One common installation precaution which should not be ignored is to make sure ventilation openings on the bottom and sides of the cabinet are not covered with adjacent books, magazines, knick-knacks, etc. Aside from contributing to possible fire hazard, the higher temperatures resulting from restricted vents can shorten the life of tubes and components.

The more inquisitive technician may have wondered why a high-value resistor is wired from the primary side of a transformer-type power supply to chassis ground, as shown in Fig. 4. This resistor provides a d.c. leakage path from chassis to earth ground by way of the power lines and thus prevents the possibility of a dangerous voltage build-up on the chassis and accessible metal parts. How can this voltage build up? The simplified diagram of Fig. 4 illustrates one source of high voltage—the antenna system.

It is well known that electrical storms can induce high potentials in exposed wiring such as antenna lead-ins, and with the usual antenna input circuit, this voltage will appear on the chassis of the receiver, point "A" in Fig. 4. When this happens, point "A" can be thousands of volts in potential above point "B" which represents earth ground *via* the power lines. Without resistor *R* to provide a leakage path, this potential could break down the insulation of the power transformer and thereby develop a dangerous short circuit between the a.c. line and chassis.

The same condition can also develop if the service technician discharges high-voltage circuits to an external earth ground rather than to chassis. This is the reason for the warning label prominently displayed on the receiver chassis which states: *Warning: Discharging high voltages to earth ground produces a shock hazard between chassis and earth ground. High voltage should be discharged to chassis only.*

Fig. 5. Bridging the signal input filters in this circuit made the antenna "hot."



In the case of a "hot" chassis receiver, similar precautions must be taken when discharging high-voltage circuits. Discharge must be made only to "B—" and not to isolated metal parts such as cabinet, controls, brackets, etc. These isolated metal parts are generally insulated from "B—," hence, discharging high voltage to them can break down the insulation and result in a direct short circuit between "B—" and these exposed parts.

Occasionally a technician can unwittingly modify a circuit into a crackerjack of a lethal machine in the belief he is improving things. An example of this was found by the author several years ago in a fringe area where all sorts of stunts were being tried in an effort to improve reception. Shown in Fig. 5 is the basic antenna circuit of a receiver which used a transformerless power supply. The centertap of the antenna input transformer connects to "B—," as does one side of the a.c. line. The technician removed the *RC* networks at the input to the tuner and connected the lead-in directly to the antenna input transformer as shown in dotted lines in Fig. 5. In so doing, he unknowingly connected the antenna circuit directly to one side of the a.c. line. Depending on line cord polarity, the antenna and lead-in would be either at ground potential or 117 volts a.c. above ground with virtually unlimited amperage behind it. Fortunately, the antenna at this installation was properly grounded so the only casualty was a burned-up antenna input coil.

To thwart small children, *UL* requires that cabinet openings in close proximity to hazardous circuits in the chassis be blocked. Some openings can remain unblocked if they are small enough and sufficient clearance exists between them and the danger points. Leakage current tests are made between all exposed metal parts and earth ground with the set in operation. Maximum allowable leakage current is five milliamperes. Thus, should a knob be pulled off, contact with the exposed shaft will draw off no greater current, even if the customer happened to be standing on, say, a wet basement floor as he tuned the receiver. This test also accounts for the insulated shaft couplings sometimes found on certain types of chassis. Woe to the unthinking technician who replaces a broken insulated shaft couling with a solid metal bushing because it looks like the easy way out. Precaution #3: *Do not improvise mechanical repairs without first considering the potential hazards such work can create.*

The main purpose of this article has been to inform the service technician on some of the apparently "silly" practices TV manufacturers follow in designing and building receivers. If the information presented here can prevent one needless casualty, then the effort involved in its preparation will have been well worthwhile. —30—

A Portable Audio Amplifier System

By
RICHARD T. BUESING
Comm. Sec., Tech. Prod. Dept.
General Electric Company

Matching preamp with operating controls is shown at the left, with the associated power amplifier unit at the right.

Can be operated from 6- or 12-volt battery supply or from a.c. line. Power amplifier and matching preamp provide a 10-watt audio output with low distortion.

THE literature is replete with designs for amplifiers and preamplifiers whose main application is for living room use. However, there are many instances when the audio enthusiast is called upon to furnish an amplifier for parties, mobile public-address work, and special events. He seldom relishes the task of dismantling the living room amplifier, providing suitable enclosures, and rigging up the requisite power supplies. It is for such applications that the author has designed a "universal" system that is convenient for such uses besides serving as a high quality entertainment or public-address amplifier for the home.

Design Specifications

The first consideration was the rated-power output of the amplifier. If the required acoustic power is known, the electrical power may be found from the relationship:

Electrical Power = Acoustic Power/Speaker Efficiency.

It is unfortunate that the two expressions on the right side of the equation are not easily established. Let us, therefore, make certain preliminary assumptions which will lead to expected power requirements. The average orchestral intensity level has been found[1] to be approximately 75 db above 10^{-16} watt per square centimeter where 0 db is taken as the level of the weakest 1000 cps tone that can be heard by a normal ear in a silent room. Peak orchestral intensities up to 110 db have been measured with bass-drum-solo intensities reaching approximately 113 db.

The acoustic power required to produce a level of 75 db depends upon the volume and reverberation time of the room in which it is to be heard. Mitchell[2] has prepared data from which acoustic power may be determined if the room dimensions and characteristics of the reflecting surfaces within the room are known. For a room 30′ x 20′ x 10′ (such as a game room), the acoustic power needed is on the order of 10^{-5} watts. Assuming a speaker efficiency of 5%, the electrical power is found to be $10^{-5}/(5 \times 10^{-2}) = 0.0002$ watt. If the peak intensity of 115 db is to be reproduced, 2 watts of electrical power will be needed; and, with a 6 db margin, an amplifier with 8 watts of electrical power will be sufficient. Since it is customary to rate amplifiers in this power region in multiples of 5, the amplifier to be described was designed for 10 watts output.

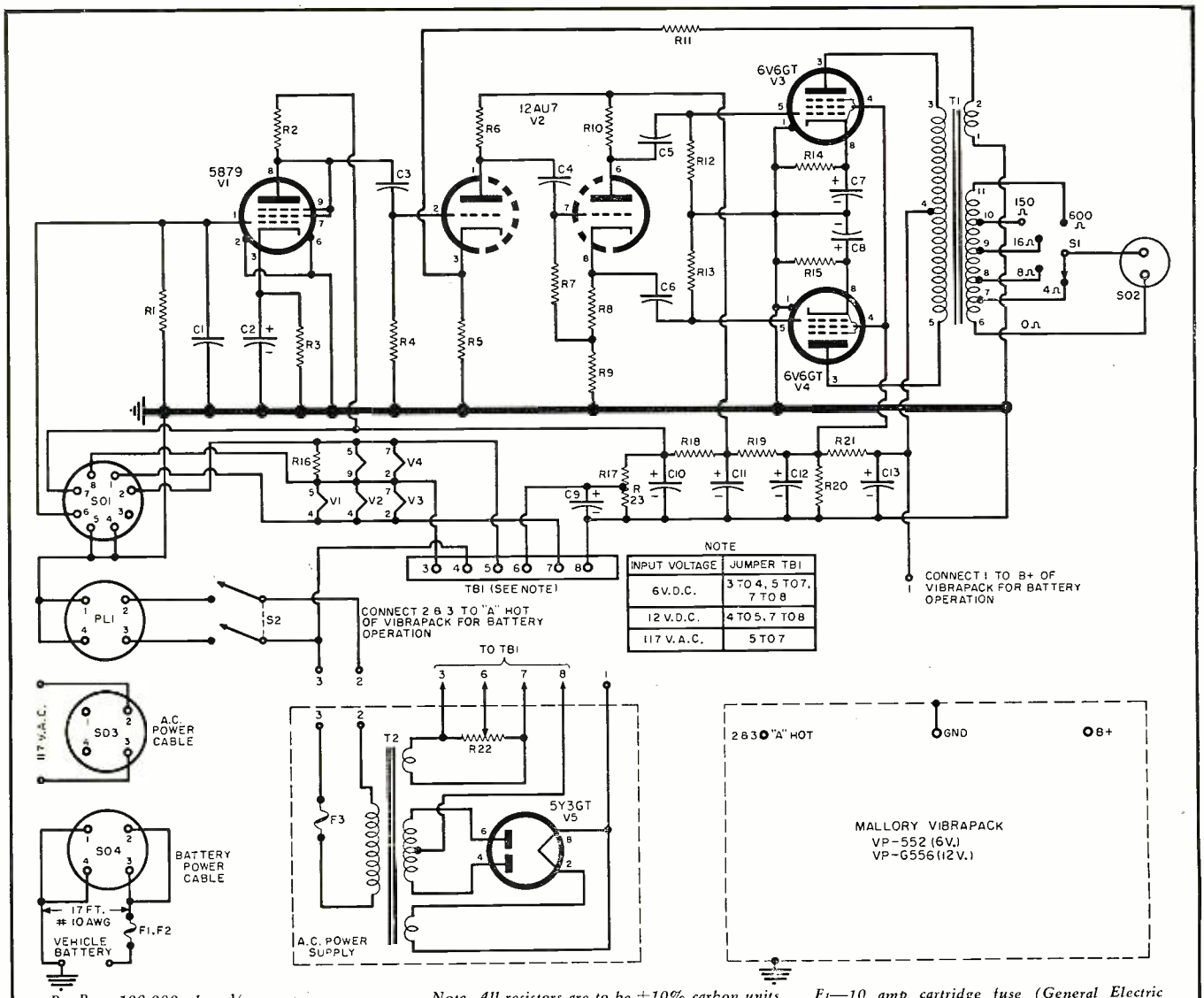
It is recognized that outdoor public-address work means that the intensity level will vary inversely as the square of the distance from the source, thus demanding more power for large areas. With re-entrant horns or compound-diffraction projectors, conversion efficiencies of 30% to 40% may be expected as compared to the 5% more typical of cone speakers, thus helping to compensate for the added power required.

It was decided, at the outset, that no compromise in performance would be tolerated in order to achieve a compact and economical design. Since the best ears can perceive frequencies from 16 to 22,000 cps at intensities near the threshold of pain, there is no reason to exceed this bandwidth and very little reason to attempt to equal it. It was decided to hold to broadcast practice and design the main amplifier with a frequency response of 30 to 15,000 cps ±1 db from a 1000 cps reference.

Bandwidth and power output specifications, in themselves, are relatively easy to meet until a distortion specification at rated power output is set. With a total harmonic distortion on the order of 1%, few critical listeners are offended, thus 1% over the 30 to 15,000 cps band was chosen as the design specification. The intermodulation distortion compared to 1% harmonic distortion is approximately 4%. It is extremely important, in any amplifier design, not to be content with measuring the single-frequency distortion at the output. Internal feedback and non-linearities may cause cancellations that yield meaningless results when only the output is measured. It can be shown philosophically and demonstrated experimentally that two stages whose harmonic distortions are 3% may result in a measured distortion of, say, 1% at the output. The r.m.s. of the individual stage distortion, however, indicates the true performance of the amplifier. This is the reason for measuring the intermodulation, which takes into account the sum and difference products of each stage.

Finally, it was desired that the hum and noise level at the output of the main amplifier be at least 70 db below rated output.

In the preamplifier, it was deemed desirable to include four controls: "Loudness/Volume," "Treble," "Bass,"



R_1, R_{17}—100,000 ohm, ½ w. res.
R_2—68,000 ohm, ½ w. res.
R_3—2200 ohm, ½ w. res.
R_4, R_{12}, R_{18}—470,000 ohm, ½ w. res.
R_5—3600 ohm, ½ w. res.
R_6—56,000 ohm, ½ w. res.
R_7—1 megohm, ½ w. res.
R_8—2000 ohm, ½ w. res.
R_9, R_{11}—22,000 ohm, ½ w. res.
R_{10}—24,000 ohm, ½ w. res.
R_{14}, R_{15}—390 ohm, 2 w. res.
R_{16}—43 ohm, 2 w. res.
R_{18}—10,000 ohm, ½ w. res.
R_{19}—2000 ohm, 1 w. res.
R_{20}—20,000 ohm, 20 w. wirewound res.
R_{21}—2000 ohm, 2 w. res.
R_{22}—100 ohm, 2 w. pot
R_{23}—30,000 ohm, ½ w. res.

Note. All resistors are to be ±10% carbon units except as indicated.
C_1—100 μμfd. mica capacitor
C_2—40 μfd., 25 v. elec. capacitor
C_3, C_4, C_5, C_6—.047 μfd., 200 v. capacitor
C_7, C_8—40/40 μfd., 25 v. elec. capacitor
C_9—50 μfd., 50 v. elec. capacitor
C_{10}, C_{11}, C_{12}, C_{13}—20/20/20/20 μfd., 450 v. elec. capacitor
SO_1—8-contact female receptacle (Amphenol Type 79-PO8F)
SO_2—2-contact microphone connector (Amphenol Type 80MC2F1)
SO_3, SO_4—4-contact female receptacle (Amphenol Type 79-PO4F)
PL_1—4-contact male receptacle (Amphenol Type 79-PO4M)
TB_1—Terminal board (Jones ¾W-164-5)

F_1—10 amp cartridge fuse (General Electric "Silverend," for 6-volt operation)
F_2—7 amp cartridge fuse (General Electric "Silverend," for 12-volt operation)
F_3—2 amp fuse (3AG type)
S_1—S.p. 4-pos. rotary switch
S_2—D.p.s.t. 10 amp switch
T_1—Output trans. 10,000 ohms c.t. to 600/150/16/8/4 ohm (Chicago PSC-150 or PCO-150, same specs except for case)
T_2—Power trans. 350-0-350 v. @ 200 ma.; 6.3 v. c.t. @ 6 amps.; 5 v. @ 3 amps. (Thordarson T-22R07 or equiv.)
Vibrapack—Vibrator (Mallory VP-552 for 6-volt operation and VP-G556 for 12-volt operation)
V_1—5879 tube
V_2—12AU7 tube
V_3, V_4—6V6GT tube
V_5—5Y3GT tube

Complete schematic diagram of the power amplifier and rectifier circuit portions of the portable high-quality audio system.

and microphone "Mixer." Provision for equalization of the "New Orthophonic," AES, LP, and European 78 recording curves was made, but only the "New Orthophonic" equalization was incorporated.

With the current controversy over loudness controls, it was decided that a "universal" amplifier should have provision for operating the front panel control either as a loudness or volume control, hence the circuit to be described.

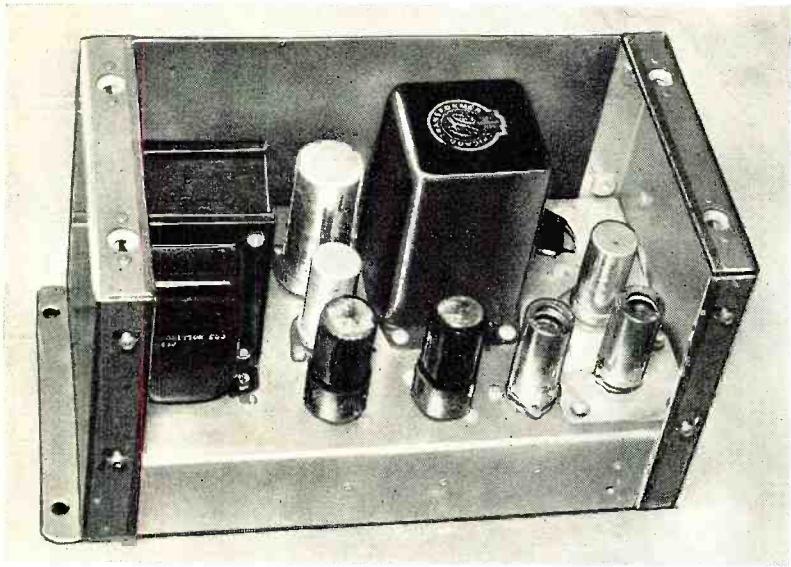
The treble control was designed for either boost or droop, the mid-position being flat. This allows "shading" the equalization more closely for differences in room acoustics, playback level, and other recording curves. The bass control was designed for boost only, since bass droop is used so seldom. When bass droop is desired, the operation of the loudness control as a volume control removes the Fletcher-Munson compensation and gives the illusion of bass droop.

Microphone mixer controls are generally of multi-element or multi-stage design and were not felt to be sufficiently economical of space to warrant their use in this application. A new and novel mixer-fader circuit (Patent Applied For) was developed for this use.

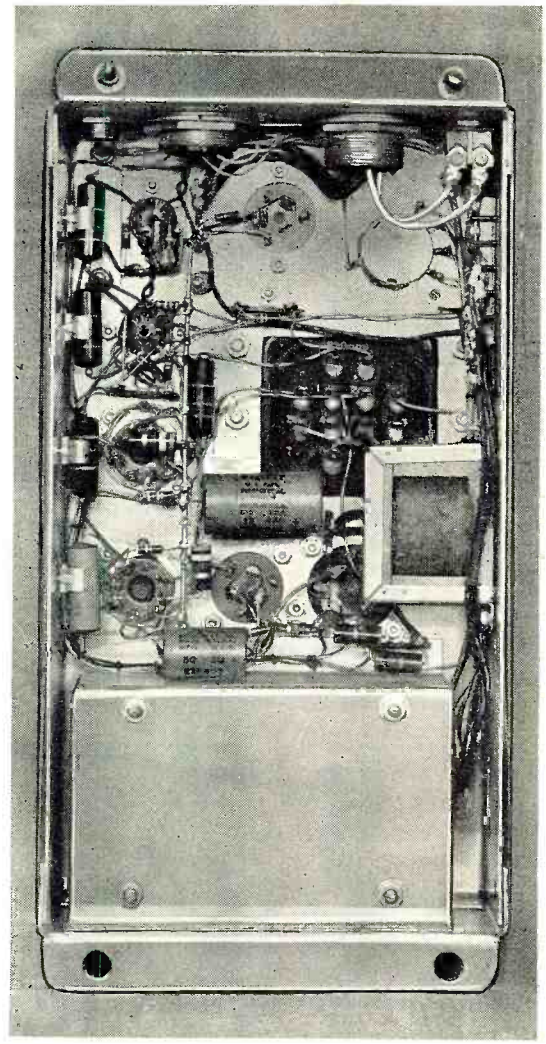
Again in the preamplifier, it was the designer's purpose to provide a circuit with negligible distortion, 1.0% harmonic distortion being considered tolerable. Hum and noise 70 db below full output was the accepted goal.

In order to meet the requirements set forth in the first paragraph, it was mandatory that both amplifier and preamplifier be capable of being operated from primary sources of 117 volts a.c., 6 volts d.c., or 12 volts d.c.

The following step was to determine an acceptable packaging arrange-



↑ Top view of the power amplifier with top and side panels removed. The audio output transformer can be clearly seen near the center of the chassis, while the power transformer is at the left. The four amplifier tubes, the electrolytic filter capacitors, and impedance selector switch are also visible on the chassis.



Underside of the power amplifier unit. Note the use of the ground bus immediately to the right of the line of four tube sockets for the amplifier tubes. All components are rigidly mounted so that the vibration to which a portable unit of this type may be subjected does not cause any serious problems. →

ment. Ease of service and portability were of paramount importance. For minimum chassis currents and induced hum into the low-level stages, two separate chassis for the main amplifier and preamplifier were chosen, thus also giving flexibility in mounting and operating the units. For vehicular use, the main amplifier could easily be trunk mounted; and, for home or party use it would be advantageous to have only the preamplifier at the operating position.

The Output Stage

Once the power output of an amplifier has been determined, the next step in the design is to select the output stage. A push-pull arrangement was chosen so that even-order harmonics would be cancelled, there would be no d.c. saturation in the core of the output transformer, and two small tubes of modest power requirements could be used rather than one large tube. Among the tubes that could have been used are the 6V6, 6L6, 807, 6146, etc. The available data for the 6V6 in the tube manuals show that 14 watts at 3.5% harmonic distortion may be expected with plate and screen voltages of 285 volts and zero signal plate current of 70 ma. It is true that each of the other tubes could produce the same power output at less distortion but with greater input power requirements. Since it is seldom wise to send a man to do a boy's job (he may be expensive to feed), 6V6GT's were selected. Bear in mind that the 14 watts are referred to the primary, thus allowing an output transformer whose efficiency is 70% or greater.

The circuitry which evolved with the use of the push-pull stage is relatively simple and straightforward; certain fundamentals being important and having been adhered to in this design. Since high G_m tubes operating at high currents always draw some grid current and since this current is generally not a linear function of grid voltage, hence causing distortion and limiting power, the grid resistors were kept to as low a value as possible, consistent with minimum loading on the phase inverter. The cathodes were biased with separate resistors rather than a single resistor of half the value. This arrangement tends to equalize the plate currents when two tubes, whose characteristics are slightly different, are used. These resistor values were carefully chosen to yield minimum distortion when the output stage was loaded *via* the output transformer to be described and when driven by the phase inverter—*before the feedback loop was closed*. This latter point is an important one which is often overlooked. In designing a feedback amplifier, the safest avenue to follow is to design the best possible amplifier without feedback and then apply just enough feedback to meet the design specifications. It is generally much wiser to apply 10 db of feedback to reduce 3% distortion to 1% than to apply 20 db to reduce 10% to 1%.

A bleeder in the screen circuit was used to improve regulation. (Note that the constant plate current curves shown for beam power tubes assume constant screen voltage.)

The Output Transformer

After the output stage is selected, a device to couple it to the load must be selected. With a push-pull stage, a transformer is the logical choice, but a decision about the method of applying feedback must be made before the transformer can be specified. Among the more practical and popular methods of forming the feedback loop are: feedback from the plate of the output stage, from the load winding, and from a tertiary winding.

If feedback is taken from the plate of the output stage, the points to which the feedback can be applied are fixed by the number of stages. Also, the load presented by the feedback loop to the output stage must be very large with respect to the load resistance referred to the primary. Furthermore, the output stage "B+" must be very well filtered since it can be shown that as the feedback increases, the hum in the output will approximate the power-supply ripple.

Feedback, in any case, follows the relationship: $e_{out}/e_{in} = A/1\text{-}AB$
where: e_{out} = output voltage
e_{in} = input voltage
A = forward gain of the amplifier without feedback
B = portion of the output signal applied as feedback

The term "A B" is a complex variable and must never equal $1+ j0$ if the amplifier is to be stable. Thus, the limiting conditions for the design of the feedback amplifier are (*a*) all of the coupling networks in the "A B"

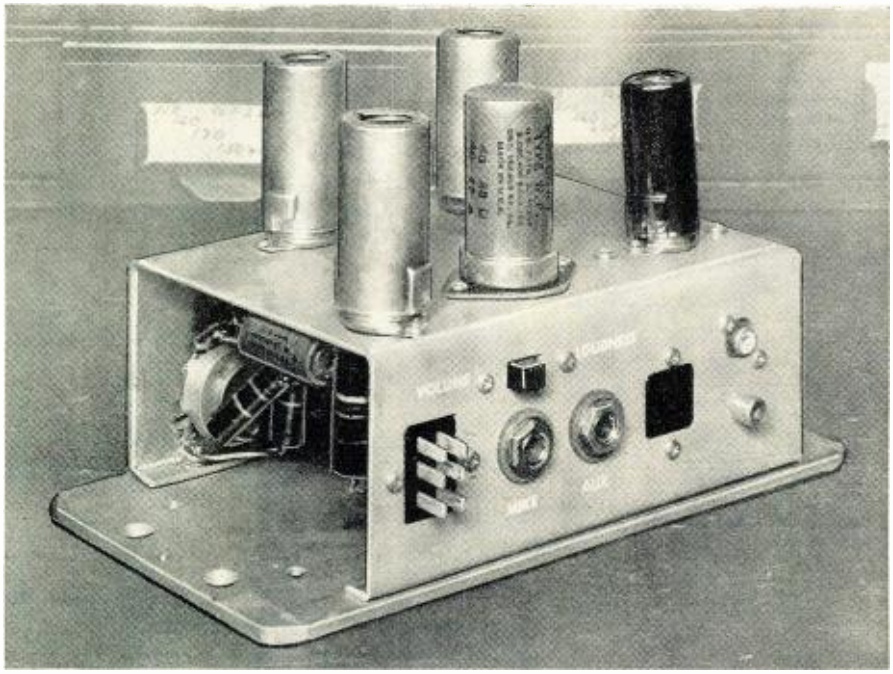


Photo of preamplifier unit with top cover removed. Rear panel is toward reader.

circuit are of the minimum phase-shift type, (*b*) all of the amplifying elements in themselves unilateral, and (*c*) all of the circuit parameters possess a value independent of time. Condition (*a*) implies a formal relationship between the amplitude transmission characteristic and the phase-shift of output relative to input of the network. Practically, the phase-amplitude characteristic must be controlled one octave above and below the signal-channel passband for every 10 db of feedback, plus an octave for margin.

When the feedback is taken from the load-winding of the output transformer, rather stringent requirements are placed on the transformer. If the passband of the forward amplifier is 30 to 15,000 cps, the phase-amplitude characteristic of the feedback loop must be controlled from 4 cps to 120 kc.

In order that the load winding be required to pass only the signal frequencies, tertiary feedback was selected. Thus the signal circuit is sampled and the distortion products appearing in the transformer are fed back. Also, the hum voltage appearing at the output is reduced by a constant factor as the feedback is increased.

Transformer Design

The output transformer specifications must be quite rigid since it must be considered as another circuit parameter. The following are the more important items to be specified.

1. Since the transformer can deliver only about two-thirds of the available volt-amperes to the load, the reactance of the primary inductance at the lowest frequency to be amplified must be approximately twice the primary load impedance.

2. The leakage inductance of the primary to tertiary must be low in order not to load the primary; and, the tertiary surge impedance must be much smaller than the tertiary load. The first resonance of the tertiary must be at or above the highest frequency in the feedback loop.

3. The turns ratio of tertiary to primary must be as close to "B" as possible.

4. The electrostatic coupling between windings must be kept to a minimum. Operating one side of the tertiary at ground potential is an important step in this regard.

The *Chicago Transformer* PSC-150 or PCO-150 (see parts list), although designed for p.a. work, has been found very satisfactory for use in this "universal" amplifier.

Phase Inverter-Voltage Amps

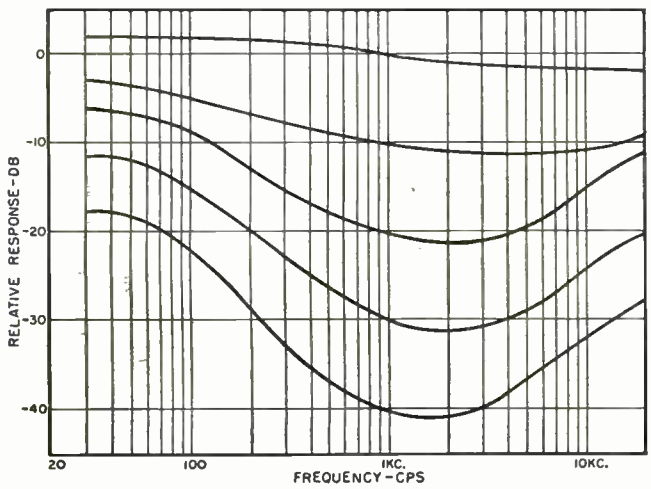
The output stage was fed from a split-load phase inverter despite the fact that the plate and cathode circuits are at different impedance levels, thus offering the possibility of different amplitude-frequency characteristics between plate and cathode circuits. These differences are distinct and measurable but are, for all practical purposes, undistinguishable even to critical listeners.

Feedback was applied to the cathode of the second voltage amplifier. A 5879 was triode-connected to serve as a low-noise first voltage amplifier and completed the tube complement for the main amplifier. The input required for 10 watts output was chosen as 0.5 volt r.m.s.

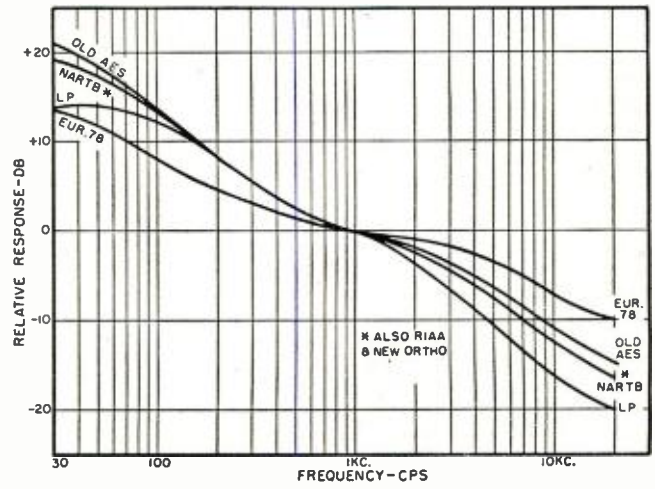
All ground connections were made to a ground bus connected to chassis ground only at the input. As a further precaution against hum, the heaters were biased at +50 volts d.c. to minimize heater-to-cathode leakage. The bias was applied to the arm of a 100-ohm potentiometer across the twisted pair used to feed the heaters. Adjusting this potentiometer for minimum hum enables one to reduce the output from 10 to 20 db over an unbiased arrangement.

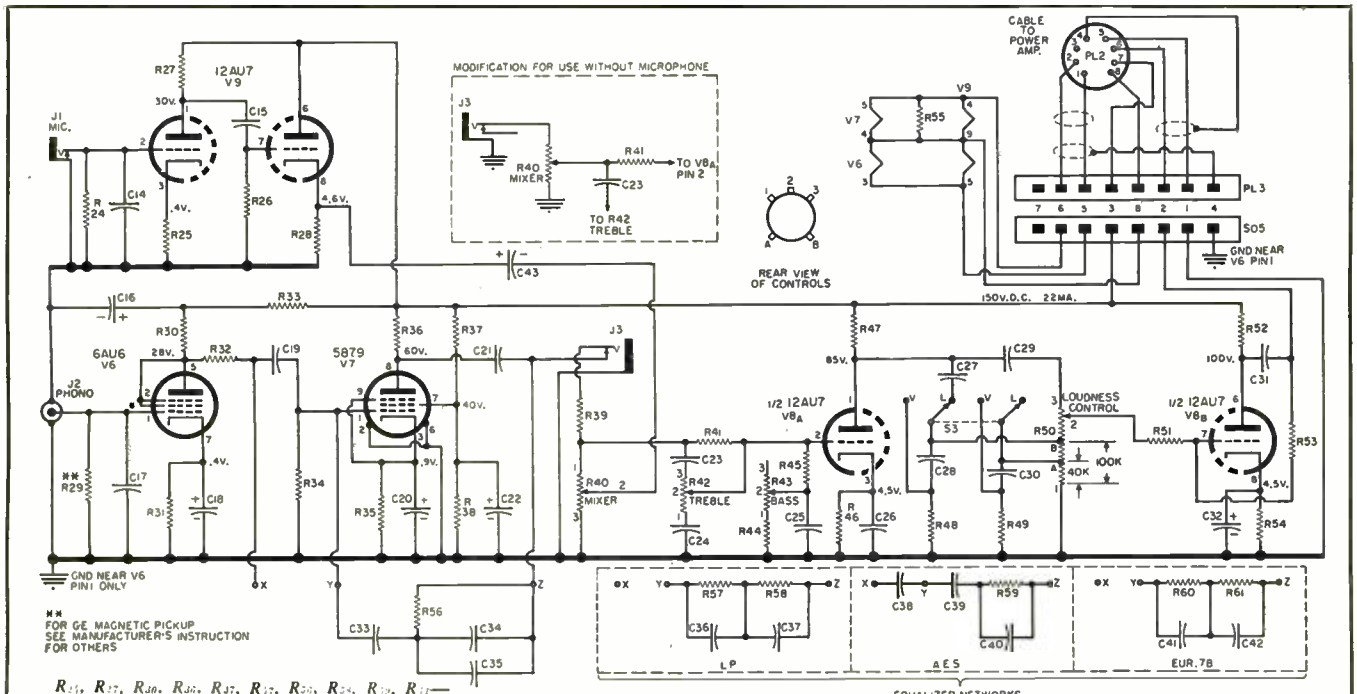
Both a.c. and d.c. power supplies were needed as indicated on the amplifier schematic. A d.p.s.t. "on-off" switch energizes either type of power supply, depending upon the input cable used. Other connections to adapt the amplifier for a.c. or d.c. use are made to terminal board TB_1. It is important

Preamp ouput from "Aux" input at various loudness settings.



Preamp output from "Phono" input at various equalizations.





R_{24}, R_{27}, R_{30}, R_{32}, R_{37}, R_{42}, R_{45}, R_{48}, R_{51}—100,000 ohm, ½ w. res.
R_{25}—470 ohm, ½ w. res.
R_{26}, R_{39}, R_{41}, R_{54}—220,000 ohm, ½ w. res.
R_{28}, R_{52}—1000 ohm, ½ w. res.
R_{29}, R_{38}, R_{43}, R_{53}—47,000 ohm, ½ w. res.
R_{31}—330 ohm, ½ w. res.
R_{33}—27,000 ohm, ½ w. res.
R_{34}, R_{35}—470,000 ohm, ½ w. res.
R_{36}—680 ohm, ½ w. res.
R_{40}, R_{44}—500,000 ohm log taper pot
R_{46}—1 megohm log taper pot
R_{47}, R_{49}, R_{57}—15,000 ohm, ½ w. res.
R_{50}—6200 ohm, ½ w. res.
R_{50}—250,000 ohm log taper pot
R_{55}—3600 ohm, ½ w. res.
R_{56}—43 ohm, 2 w. res.
R_{57}, R_{60}—1 megohm, ½ w. res.

Note: All resistors are to be ±10% carbon units except as indicated

C_{11}, C_{17}—100 μμfd. mica capacitor
C_{13}, C_{21}—.01 μfd., 200 v. capacitor
C_{16}—20 μfd., 250 v. elec. capacitor
C_{18}, C_{20}—50/50 μfd., 25 v. elec. capacitor
C_{19}—.22 μfd., 200 v. capacitor
C_{23}, C_{31}—.047 μfd., 200 v. capacitor
C_{22}—5 μfd., 150 v. elec. capacitor
C_{25}—470 μμfd. mica capacitor
C_{27}, C_{28}—.0022 μfd., 200 v. capacitor
C_{29}—.01 μfd. ceramic capacitor
C_{32}—270 μμfd. mica capacitor
C_{38}, C_{39}—.022 μfd. mica capacitor
C_{39}—.15 μfd., 200 v. capacitor
C_{42}, C_{43}—25 μfd., 25 v. elec. capacitor
C_{44}, C_{45}—.0033 μfd., 200 v. capacitor

EQUALIZER NETWORKS

C_{33}—510 μμfd. mica capacitor
C_{35}—150 μμfd. mica capacitor
C_{37}—.001 μfd., 200 v. capacitor
C_{38}—.1 μfd., 200 v. capacitor
C_{39}—.0047 μfd., 200 v. capacitor
C_{40}—560 μμfd. mica capacitor
C_{42}—330 μμfd. mica capacitor
J_1, J_2—Microphone jack
J_2—Phono connector
PL_2—8-contact male receptacle (Amphenol Type 79-PO8M)
PL_3—Female 8-point plug (Jones type)
SO_3—Male 8-point connector (Jones type)
S_1—D.p.d.t. slide switch
V_6—6AU6 tube
V_7—5879 tube
V_8, V_9—12AU7 tube

Complete schematic diagram of the preamplifier-equalizer unit of the portable high-quality audio system.

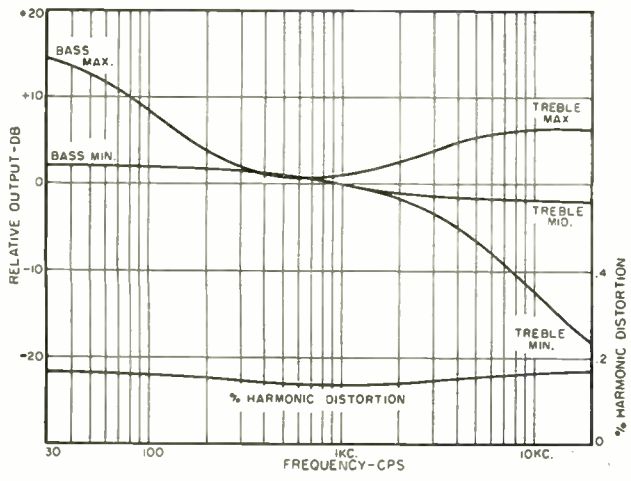
to note that the cables for mobile use are AWG No. 10 for both the "A" hot and ground returns. The fuse block and fuse must have low d.c. resistance to eliminate excessive voltage drops between the battery and power supply.

Preamp-Equalizer Stages

The input stage (V_6) for the preamplifier was designed around a triode-connected 6AU6. Several tubes are suitable as low-level amplifiers, but the 6AU6 shows little variation from tube to tube and the noise level referred to the first grid is consistently in the range from 5 to 7 microvolts. The second stage, V_7, was designed as a feedback-type equalizer. It is common to provide high-frequency equalization by varying the load on the magnetic pickup; and the low frequencies are often equalized by placing combinations of RC networks in shunt with one of the low-level stages. The author prefers to take advantage of the distortion-reducing and gain-stabilizing properties of feedback equalization, hence the plate-to-grid feedback shown around V_7. Resistor R_{32} from the plate of V_6 was included to isolate the feedback loop from variation in the plate resistance of V_6. The compensating network comprising C_{33}, C_{34}, C_{35}, and R_{36} is for the "New Orthophonic" curve and provides equal-

(*Continued on page* 144)

Preamp tone control ranges and harmonic distortion.



Frequency response and harmonic distortion of power amplifier.

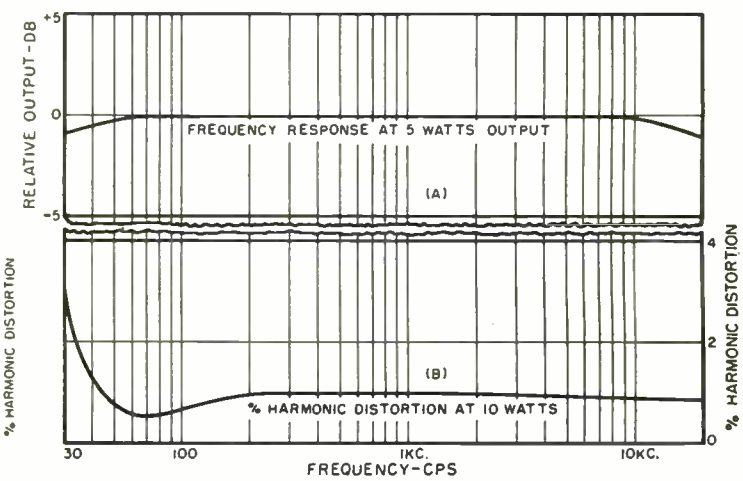


Fig 1. Zenith "Space Command" remote control unit may be used from a room other than the one in which the TV set is, as shown here. A microphone at the top center of the receiver intercepts the ultrasonic control waves.

Ultrasonic Remote Control

By
JOHN G. SPRACKLEN and **PETER C. J. DESMARES**
Research Dept., Zenith Radio Corp.

An ultrasonic television control for the home—turns the set on and off, changes stations, and mutes sound without use of wires, batteries, light, or radio waves.

THE *Zenith* "Space Command" tuning system is a remote control device for a TV receiver which enables the viewer to change channels, mute the sound when desired, and turn the set on or off. These operations are performed from anywhere in the room without connecting wires by a small remote control device held by the viewer. The control box does not require tubes, transistors, or batteries.

Practical and novel use is made of ultrasonics as a medium for conveying control information from the control box to the TV receiver. Ultrasonics is particularly well adapted to meet the requirement that walls must confine the signals so that no interference can be caused to a similar receiver in an adjoining apartment. The ultrasonic microphone and selective circuits of the amplifier in the TV set readily distinguish between the desired control signals and all sorts of noises which are usually present around the home, including the audio output from the speaker of the TV set.

Of particular interest is the method by which ultrasonic waves are generated in the control box. Four aluminum rods, about 2½ inches in length, are mounted on a bracket. When a key is pressed, a spring is compressed, then suddenly released and a little hammer strikes the end of one of the aluminum rods. This excites the rod which then vibrates at its resonant frequency, near 40 kc. The length of each rod determines its natural frequency; the four rods differ slightly in length from each other.

To produce the same sound energy electrically would require ten to one hundred milliwatts, depending on the efficiency of the transducer. At an average viewer-to-set distance, the energy can be detected for about one second.

The ultrasonic microphone in the TV set is of the condenser type. A strip of aluminized "Mylar" film, .0005" thick, is stretched across a frame at a distance of .004" from a metal plate. The mechanical stiffness of the air gap is mechanically resonant with the mass of the film at about 40 kc. The microphone is mounted on the upper edge of the picture tube escutcheon as shown in Fig. 1 and connected to the amplifier input by a shielded cable.

Fig. 2 is a complete schematic of the model 400 "Space Command" receiver. The microphone is polarized with 190 volts d.c. through resistor R_1. The signals from the microphone are amplified many times by a 40 kc. high-gain amplifier consisting of the 6CB6, V_1, and the pentode section of the 6AU8, V_{2A}. High sensitivity is needed as the control box must be capable of operating the set from anywhere within even a large living room. The triode section of V_{2B} operates as a tripler and drives the 6BN6 limiter at 120 kc.

Tripling was found highly desirable for the discriminator circuits following the limiter for reasons of circuit "Q" and coil size. It also reduces the amplification required at the fundamental key frequency, decreasing the possibility of spurious regeneration.

The 6BN6 limiter, V_3, supplies a constant amplitude signal to the frequency discriminator circuits which are similar to those used in conventional FM receivers. The output from each discriminator is split to provide two opposite output control voltages. This permits the operation of two control channels from each discriminator, so that two discriminators provide for four channels. L_1 and L_3 are the primary coils and L_2 and L_4 are the secondary coils of the two discriminator transformers. These are tuned to center frequencies of 122.25 kc. for the higher channels and 114.75 kc. for the lower channels. The 6AL5's, V_4 and V_5, complete the discriminator circuits.

A simpler version of this unit, the model "200," is made which uses just one discriminator circuit centered at 122.25 kc., providing two channels, one for turret tuning and the other for sound muting. In this model the tripling is done in the 6BN6 limiter; the triode section of the 6AU8 is used as a 40 kc. amplifier rather than a tripler. Since this model does not provide an "off-on" function, considerable economy is realized by utilizing the power from the main video chassis.

The frequency separation between the peaks of each discriminator is 3 kc. The natural frequencies of the aluminum rods are so selected that, after tripling, each coincides with a discriminator peak. Assignments are shown in Table 1.

The diode loads are effectively in series across output points "A" and "B" for one discriminator and "C" and "D" for the other. R_2, R_3, R_4, and R_5 are returned to a negative bias source from the cathode side of each diode load. This divides the combined output of the diodes with respect to the bias point "E." Thus, whenever "A" goes positive, "B" goes negative with respect to "E" by an equal amount; the same applies to points "C" and "D." In this manner, push-pull output is obtained from each discriminator. To illustrate the operation, assume that the "tune right" rod is struck; the resulting signal falls on the upper peak of the upper discriminator. Point "A" goes positive, removing the negative bias from the lower section of tube V_5 and operating the "CW" relay. If "tune left" had been struck instead, point "B" would go positive, energizing the lower section of tube V_5 and the "CCW" relay.

Because this device is essentially an FM receiver, voltages produced across the diode loads by random noise or by any interference having symmetrical distribution about the center frequency cancel out. Asymmetrical interference produces an output at the discriminators, but no matter how strong the interfering input signal may be, the discriminator output can never exceed the legitimate output obtained with the control box, and it can reach this level only if the interfering signal is exactly on the right frequency.

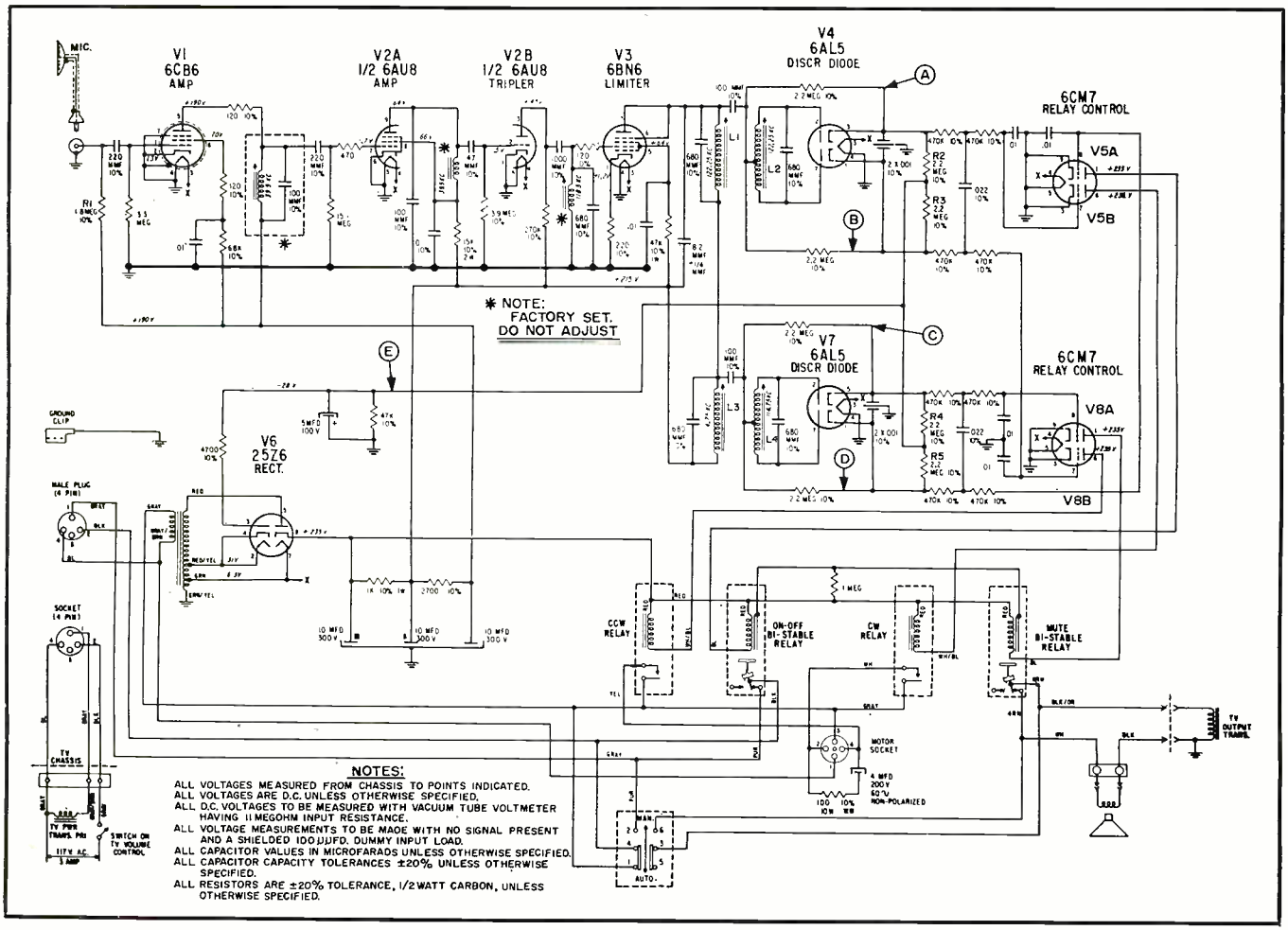
FUNCTION	KEY FREQ.	DISCRIMINATOR PEAK FREQUENCY
4-CHANNEL MODEL "400"		
ON-OFF	37.75KC.	113.25KC.
MUTE	38.75KC.	116.25KC.
TUNE LEFT	40.25KC.	120.75KC.
TUNE RIGHT	41.25KC.	123.75KC.
2-CHANNEL MODEL "200"		
MUTE	40.25KC.	120.75KC.
TUNE RIGHT	41.25KC.	123.75KC.

Table 1. Frequency of the signal transmitted by each key on the "Space Command" unit (for both models 200 and 400) and the corresponding discriminator signal.

Without a signal applied, the negative bias supply keeps the triodes biased beyond cut-off. The bias voltage is so large that 60% of the peak output of the discriminator is required to operate the relays. Each discriminator output is connected to the corresponding triodes through an integrating network with a time constant of about 30 milliseconds. Most noise

(*Continued on page* 161)

Fig. 2. Complete schematic diagram of the "Space Command" receiver model 400. All of this circuitry is contained in the TV set.



Applications of Small High-Voltage Selenium Rectifiers

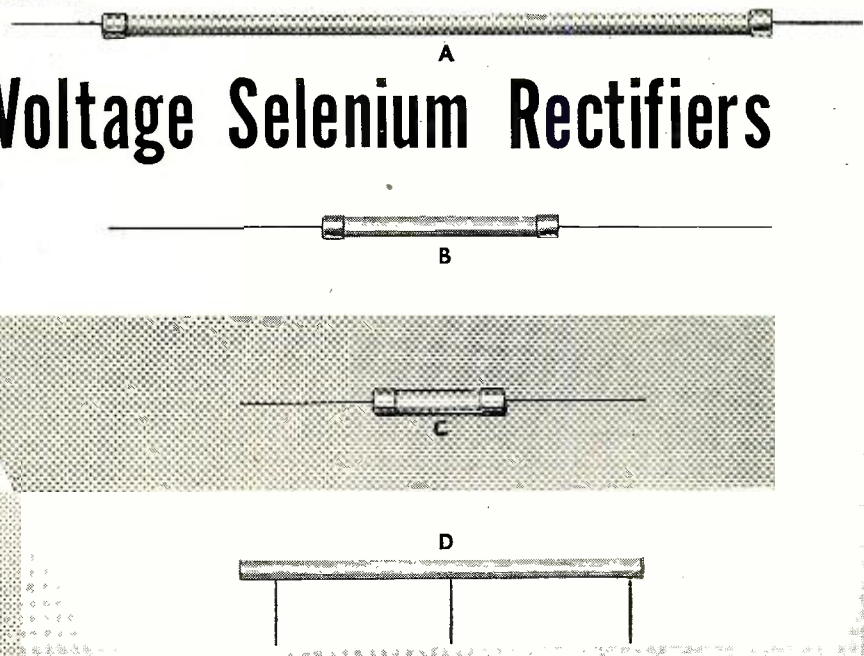


Fig. 1. Four of International Rectifier's high-voltage selenium rectifiers. (A) The type U200HFP, (B) the type U75HFP, (C) a type U50HFP, and (D) a type U50DP unit.

By
JOHN VICKREY
International Rectifier Corporation

Details on several popular and practical circuits which afford tubeless rectification for special applications.

CARTRIDGE-TYPE selenium rectifiers have brought simplicity and compactness to the design of high-voltage supplies. Tubeless operation results in freedom from warm-up time filament circuit complications, reduced heat radiation, increased ruggedness, unlimited life, and reduction of space requirements.

International Rectifier Corporation's high-voltage, cartridge-type selenium rectifiers are obtainable with ratings up to 9.9 kilovolts r.m.s. input for single units. These single rectifiers may be employed in conventional and special voltage doubler, tripler, and quadrupler circuits, as well as in simple half-wave and full-wave circuits. Polyphase operation is also possible, as with lower-voltage rectifiers. Besides half-wave units, standard cartridges are available in full-wave center tap, voltage doubler, and single-phase bridge types.

Typical applications of these rectifiers include insulation test equipment, capacitor breakdown testers, magnetic amplifiers, bias supplies, oscilloscope high-voltage d.c. supplies, television high-voltage supplies, radiation detecting instruments (Geiger and scintillation counters), electrostatic dust and smoke precipitation, electrostatic spray painting, photoflash high-voltage supplies, photomultiplier tube supply, arc suppression in contact protection circuits, and many similar uses.

The accompanying illustrations show practical circuits for several small-sized devices employing selenium rectifiers to obtain high d.c. voltages. The simplicity of these devices, resulting from tubeless rectification, is evident. While each circuit is intended for a specified application, other uses will suggest themselves.

Portable High-Voltage Supply

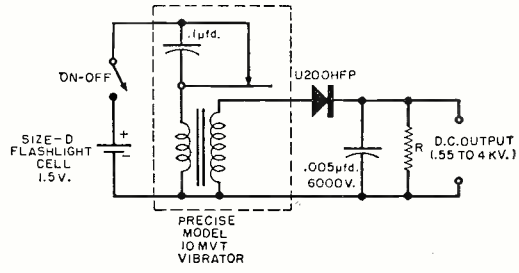
Fig. 2A shows the circuit of a midget, low-current, high-voltage supply. Operated from a single Size-D 1½-volt flashlight cell, this unit is completely portable and self-contained.

The high a.c. voltage is supplied by a small vibrator transformer, Model 10MVT (*Precise Measurements Company,* Brooklyn 23, New York). This component is completely encapsulated and requires only four connections, two to the battery circuit and two to the rectifier-output circuit. The interruption frequency is approximately 250 cps.

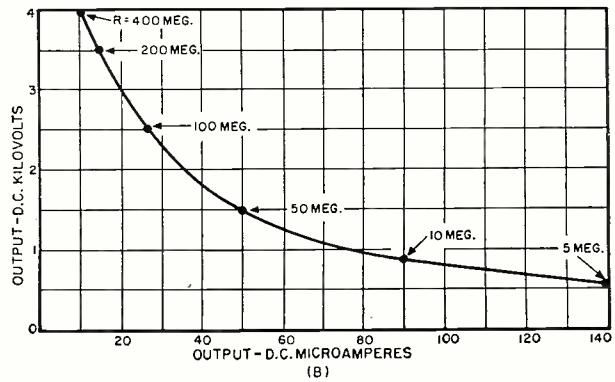
The rectifier is an *International Rectifier* Type U200HFP. This unit, shown in Fig. 1A, is 7¼" long and ¼" diameter. Its peak inverse voltage rating is 9600 volts.

The maximum d.c. output voltage is 4 kv. Maximum output current, not coincident with maximum voltage, is

Fig. 2. (A) Schematic diagram of a midget, low-current, high-voltage supply which is completely portable and self-contained. It operates from a 1½ volt flashlight cell. (B) A current versus voltage plot for various values of load resistance, R.



(A)



(B)

140 microamperes. Fig. 2B is a current *vs* voltage plot for various values of load resistance, R.

The vibrator is relatively noiseless acoustically. Very little trouble has been experienced with electrical hash from the contacts. If hash is observed in a particular installation, however, it can be eliminated or minimized by means of a 0.005 to 0.01 microfarad buffer capacitor shunting the high-voltage secondary winding.

At the low values of current drain indicated in Fig. 2B, the 0.005 μfd. output capacitor will furnish sufficient filter action.

The high-voltage supply may be built into other equipment, such as radiation detectors, vacuum system leak detectors, dielectric breakdown testers, etc.

Geiger Counter Supplies

Vibrator Type: The circuit shown in Fig. 3 will supply –900 volts of regulated d.c. to a 1B85, or equivalent, Geiger tube and plus 80 volts at 0.2 ma. to one or two amplifier tubes in the counter circuit.

As in the preceding circuit, initial driving power is derived from a single 1½ volt Size-D flashlight cell. The cell operates a Model 10MVT miniature vibrator transformer, previously described. This feature provides simplicity and compactness, as well as economy and convenience of battery replacement.

Two Type U50HFP (Fig. 1C) selenium rectifiers are employed. The first, SR_1, is "reverse-connected" to supply a negative potential of 900 volts to polarize the 1B85 Geiger tube. The second, SR_2, is "forward-connected" to supply the positive plate and screen voltage to the amplifier tube, or tubes.

The high voltage is stabilized at —900 volts by a miniature gaseous regulator tube (*Victoreen* Type 5841). The smoothing action of this tube and of the R_2C_2 network filters the high voltage effectively. The loading effect of the ½ megohm resistor, R_1, and leakage in the electrolytic filter capacitor, C_1, reduce the positive output voltage to 80 volts. Sufficiently good regulation of the 80 volts by the combined load is obtained. Capacitor C_1 seems to provide adequate low-voltage filtering, since no serious humming or buzzing is discernible in a sensitive Geiger counter containing this power supply.

In addition to operating the vibrator, the 1½ volt cell can also heat the filaments of the amplifier tubes in the counter circuit.

Transistor Type: In Fig. 4, a transistor takes the place of the vibrator in the primary circuit of a battery-operated step-up transformer. The transistor functions as a low-frequency oscillator with clipped-peak waveform. The high a.c. voltage is presented to a selenium voltage doubler circuit consisting of two Type U75HFP, (Fig. 1B) rectifiers and the 0.002 μfd. capacitors, C_3 and C_4. This circuit is adapted from the original arrangement by Chambers and Coleman.[1]

The d.c. output is 2000 volts at 20 microamperes. This is adequate for a sensitive scintillation counter. The high turns-ratio midget transformer, T_1, is a special component, Type TC-673 (*Cam-Co Engineering Company*, Culver City, California). The transistor oscillator is powered by a medium-sized 22½ volt "B"-battery (*Burgess* Z30NX, or equivalent). The low d.c. drain of 7½ to 10 milliamperes insures long battery life.

Efficient voltage doubling in the full-wave circuit is afforded by the two rectifier cartridges. However, a dual rectifier unit, like the *International Rectifier* Type U50DP, (Fig. 1D) may be used, if desired. For small over-all size, the electrolytic capacitors, C_1 and C_2, may be of the subminiature tantalum variety.

In adjusting the unit, the following steps should be observed. (1) With switch S_1 open, set rheostat R_1 to its maximum resistance. (2) Connect a high-resistance d.c. voltmeter (20,000 ohms-per-volt or higher) to the d.c. output terminals and close switch S_1. (3) Adjust rheostat R_2 for maximum voltage. (4) Lock R_2 in this position and do not subsequently disturb its setting. Make all later output voltage adjustments with rheostat R_1.

This transistor oscillator is stable and is a good starter if the R_1 and R_2 adjustments have been made correctly. With the d.c. voltmeter connected to the d.c. output terminals, the starting action may be checked by throwing switch S_1 rapidly back and forth several times. The voltage should rise and fall quickly in response, within the limitations set by the meter damping.

Beside its specific use as the high-voltage d.c. supply for Geiger and scintillation counters, this unit may be employed in other applications requiring a totally quiet, battery-operated, portable source of 2 kv. or less. Such uses include photomultiplier tube supply, voltmeter calibration, klystron electrode supply, portable oscilloscope supply, etc.

Variable-Voltage Supply

Fig. 5 shows the circuit of a general-purpose, adjustable-output, low-current, high-voltage supply which may be made as small as some test meters. The d.c. output voltage is 0 to 2000 volts at a maximum current of 3 ma.

In this arrangement, the a.c. input voltage to the transformer may be varied by means of a *Superior Electric* Type 10 "Powerstat." A *General Radio* 200B "Variac" also may be used for this purpose. A full-wave voltage doubler is operated from the high-voltage secondary of the transformer. The doubler consists of a Type U50DP doubler type high-voltage selenium cartridge and the two 0.5 μfd., 2000 volt capacitors.

Any convenient transformer having a 1000 volt r.m.s. secondary may be used. For convenience and economy, the entire secondary winding of a small replacement type transformer may be employed, neglecting the center tap of this winding.

At the low values of current drain specified, storage action of the two 0.5 μfd. capacitors and the full-wave operation of the rectifier unit will smooth the d.c. output well enough to permit use of the high-voltage output for the calibration of d.c. voltmeters, polarization of cathode-ray and photomultiplier tubes, dielectric studies, radiation detector operation, and polarizing capacitors. However, additional filter circuitry may be added externally or internally for discriminating applications.

A continuously variable supply of this type will find sundry uses in the laboratory and shop. A prosaic application is the flash-burning of particles from between the plates of variable capacitors.

(*Continued on page* 190)

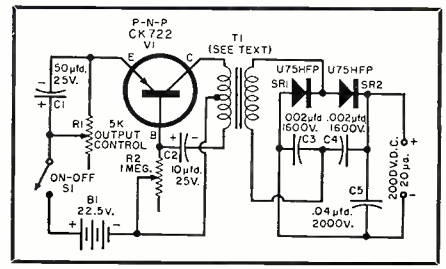


Fig. 4. Transistorized high-voltage supply for Geiger and scintillation counters.

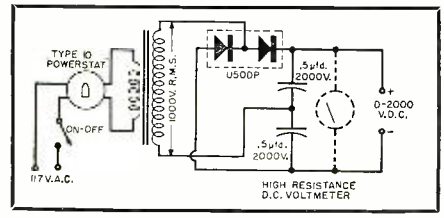
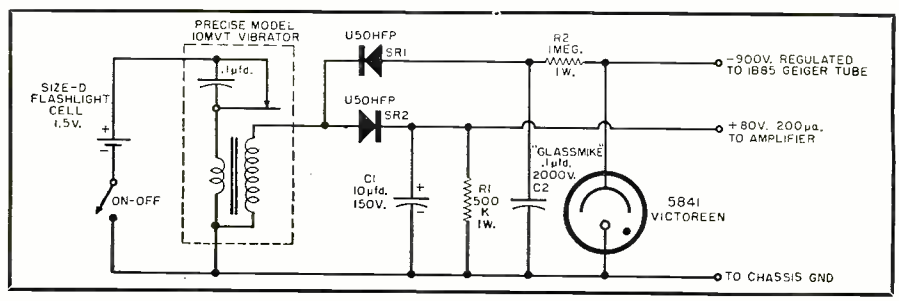
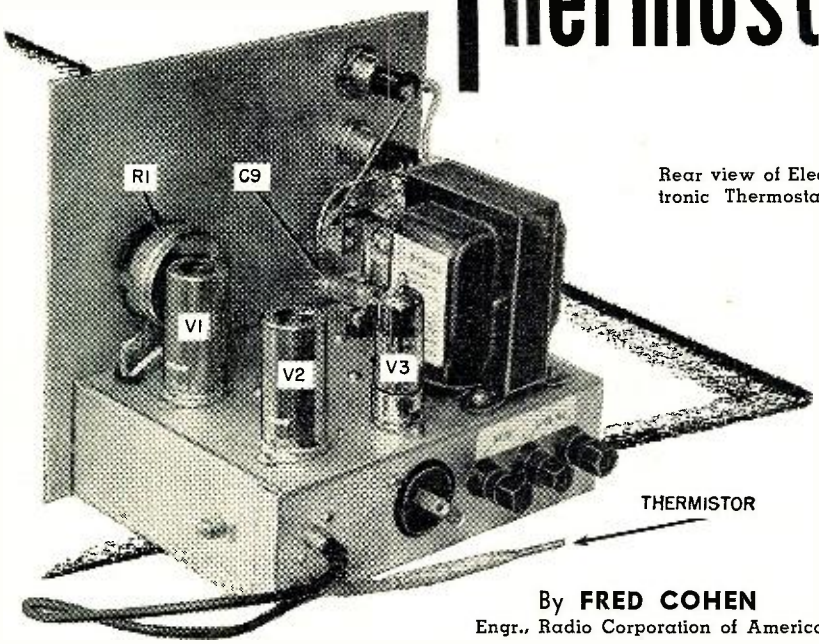


Fig. 5. A general-purpose, variable, high-voltage, low-current type power supply.

Fig. 3. Vibrator-type power supply for a Geiger counter. It furnishes 900 volts.



An Electronic Thermostat



Rear view of Electronic Thermostat.

By **FRED COHEN**
Engr., Radio Corporation of America

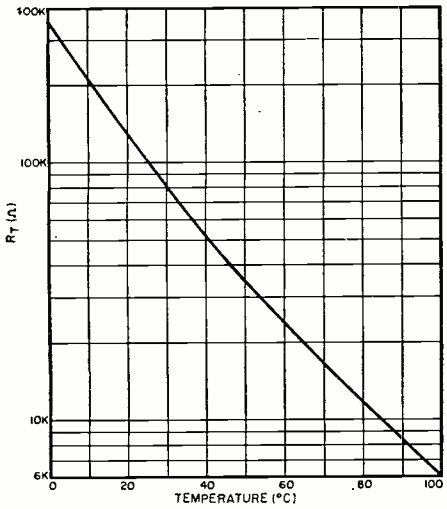
Construction details on a unit which provides control over range of 0 to 97 degrees C (32 to 207 degrees F).

THIS article describes the design and construction of an electronic temperature controller. Although basic in construction, the unit is quite versatile and serves to demonstrate some fundamental points of instrument design. The device is described for the benefit of the home experimenter and is not a product which *RCA* plans to market.

The unit illustrated has a range of 0 to 97 degrees C (32 to 207 degrees F) and may be used in such applications as controlling a laboratory oven or a dark room water heater. The instrument has the advantages of a wide control range and its ability to control a process from a remote location, since only the sensing element need be in contact with the controlled process.

The operation of the device is quite simple. Temperature is detected by the sensing element which, in this case, is a thermistor, or temperature sensitive resistance. The sensing element and its associated circuitry are known as the measuring circuit. It is the function of the measuring circuit to produce an error signal whenever the temperature of the controlled process differs from the temperature set point. The error signal is stepped up by three stages of voltage amplification and then applied to the grid of the power tube which drives the control relay.

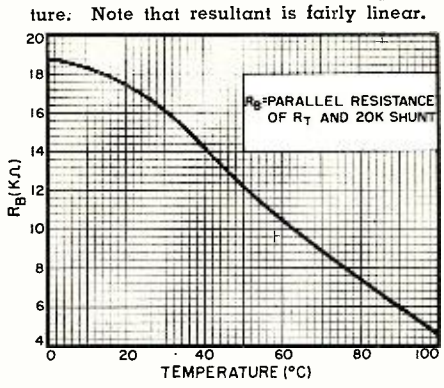
Fig. 1. Thermistor resistance versus temperature for the Victory Eng. Co. 51A1.



Circuit

A *Victory Eng. Co.* type 51A1 thermistor is used for the sensing element. A graph of the thermistor resistance (R_T) *vs* temperature appears in Fig. 1. Because of the logarithmic nature of this curve, using the themistor directly in the measuring circuit would result in an extremely poor temperature-setting dial. Readings toward one end of the scale would be extremely crowded, while those at the opposite end would be excessively far apart. In order to obtain a more linear scale, the thermistor is shunted with a suitable resistance. In this case a 20,000 ohm resistor was selected as optimum for the range of 0 to 97 degrees C. A plot of the combined parallel resistance of the thermistor and its shunt (R_B) *vs* temperature appears in Fig. 2. The resultant characteristic is fairly linear.

Fig. 2. Combined parallel resistance of a thermistor and its shunt versus temperature. Note that resultant is fairly linear.



The measuring circuit (Fig. 4A) is a simple bridge. For clarity, the circuit has been redrawn in Fig. 4B with R_1 plus R_2 of (A) lumped into their equivalent, R_A. Also R_T and R_3 have been replaced by R_B. Our temperature set point is made by adjusting R_1 in (A) to a previously calibrated resistance such that R_A in (B) will be equal to R_B at the required temperature. Therefore, when the temperature of the sensing element is correct, no a.c. voltage will appear between grid and ground. If, however, the temperature should drop below the set point, the resistance of R_B will increase and the bridge will be unbalanced, causing a voltage between grid and ground. If the temperature goes above the set-point, R_B will decrease and a voltage will again appear. In the second case the voltage generated will be in phase with E; in the first case it will be opposite in phase to E. The voltage appearing between grid and ground is known as the error signal, since it is present only when the temperature of the sensing element is incorrect.

The power amplifier stage performs a dual function. First, it supplies the necessary current to close the control relay when an error signal of the correct polarity is applied to its grid. Secondly, it discriminates between desired and undesired error signals. Since the measuring circuit will produce an error signal whenever the temperature of the sensing element is different from the temperature set point, a signal will be generated whether the temperature is above or below the desired point. We have chosen the normally open contacts of our relay as the "Heat Control" switch; we therefore wish the relay to be energized only when the temperature falls below the set point. For this reason we must arrange for the power amplifier to be able to select the desired error signal.

It has already been shown that the error signal generated when temperature is below the set point is opposite in phase to that generated when temperature is above the set point. Therefore, if we apply plate voltage to the power amplifier tube only during the period when the desired error voltage is positive, the undesired error signal will not be capable of actuating the

control relay. This is accomplished by connecting the plate to "raw" a.c., taken from a winding of the same transformer which supplies voltage to the measuring circuit. This type of circuit is economical and has been used to some extent in the field of industrial instrumentation.

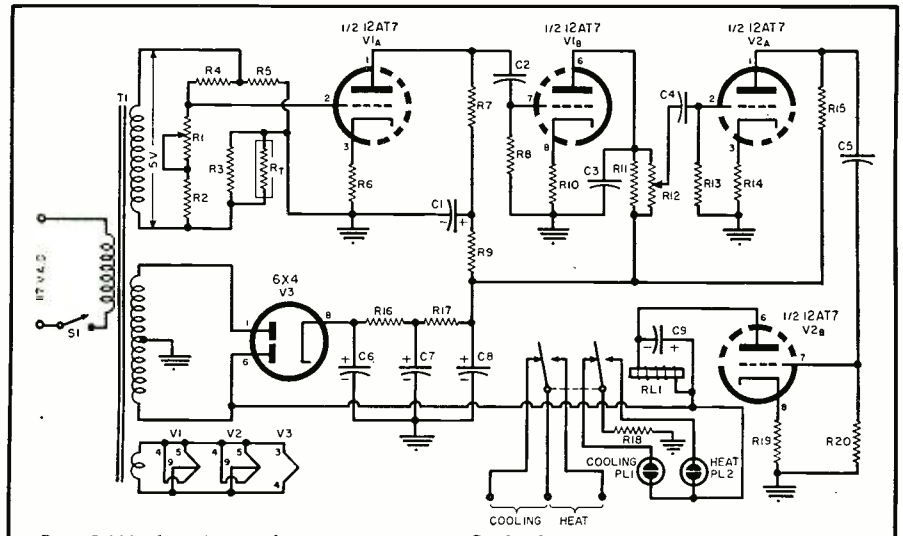
During conduction the plate current of the power amplifier will consist of a small quiescent direct current plus a series of current pulses. These pulses, having the form of a rectified sine wave, have a sizable direct current component. It is this component which operates the d.c. control relay. A 10 μfd. capacitor across the relay coil bypasses the a.c. component. The amplifier tube is heavily self-biased, so that the plate current is low in the absence of excitation or in the presence of incorrect excitation.

Construction

The unit (see photos) is built on a standard 5" x 7" x 2" aluminum chassis, which easily accommodates the required components. In order to minimize pickup, the first amplifier tube is located as far as possible from the power supply. For the same reason shielded wire is used between the thermistor and its input connector and between the connector and the measuring circuit.

The measuring circuit requires some special treatment. For the purpose of minimizing pickup and feedback the four resistors of the measuring circuit (R_2, R_3, R_4, R_5) are well shielded. The brass shield assembly was constructed by soldering a number of small angle pieces to the U-shaped base. A sketch of the assembly is shown in Fig. 5. The resistors are assembled on two Plexiglas spacers, for added support. To prevent any accidental shorting, the inside of the shield assembly has been covered with vinyl tape and sprayed with Kryolite.

The panel is aluminum. Its size is not critical and it may be cut with an eye toward fitting some particular cabinet. The panel on the unit illustrated is 7" x 8". The temperature dial is a piece of white Bristol board. Calibration points are marked in India ink.



R_1—15,000 ohm wirewound pot
R_2, R_4, R_5—5000 ohm non-inductive res. ±1%
R_3—20,000 ohm non-inductive res. ±1%
R_6—390 ohm, ½ w. res. ±5%
R_7—100,000 ohm, ½ w. res.
R_8, R_{13}, R_{20}—1 megohm, ½ w. res.
R_9—33,000 ohm, ½ w. res.
R_{10}—470 ohm, ½ w. res. ±5%
R_{11}—68,000 ohm, 1 w. res.
R_{12}—100,000 ohm pot
R_{14}, R_{19}—1000 ohm, ½ w. res. ±5%
R_{15}—62,000 ohm, 1 w. res.
R_{16}, R_{17}—3300 ohm, 1 w. res.
R_{18}—130,000 ohm, 1 w. res.
*R_T—Thermistor (Victory Eng. Co. 51A1)**
C_1, C_7, C_8—10 μfd., 350 v. elec. capacitor
C_2, C_4, C_5—.1 μfd., 400 v. capacitor
C_3—2700 μμfd. mica capacitor
C_6—4 μfd., 450 v. elec. capacitor
C_9—10 μfd., 50 v. elec. capacitor
RL_1—d.p.d.t. plate relay, 6.3 ma. pull-in (Potter & Brumfield LM11, 5000 ohm coil)
S_1—S.p.s.t. toggle switch
T_1—Power trans. 235-0-235 v. @ 40 ma.; 5 v. @ 2 amps; 6.3 v. @ 2 amps (Stancor PC 8401)
PL_1, PL_2—NE-51 neon bulb
V_1, V_2—12AT7 tube V_3—6X4 tube
**Available through electronics parts distributors from local Graybar Electric Co. distributors.*

Fig. 3. Complete schematic diagram of the Electronic Thermostat unit.

Operation and Calibration

The following procedure should be followed in putting the unit into operation for the first time:

1. Temporarily solder a 33,000 ohm resistor across the thermistor input connector on the rear of the chassis;

(*Continued on page* 134)

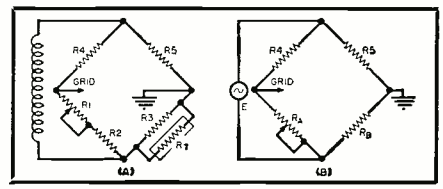


Fig. 4. (A) A simple bridge measuring circuit (B) Equivalent circuit. See article.

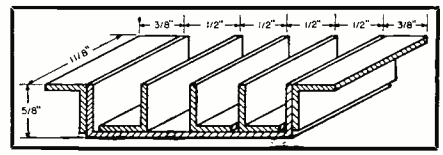
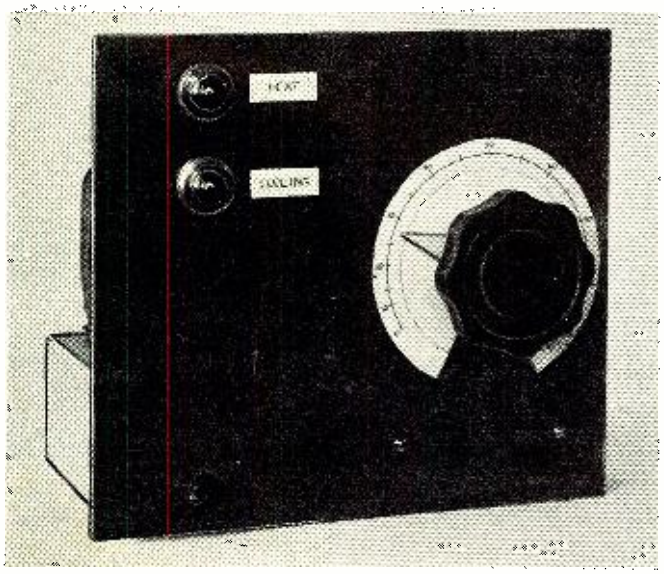
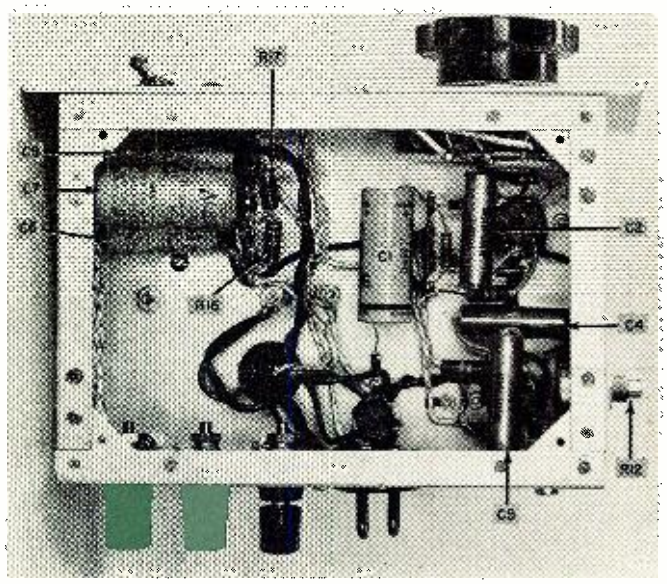


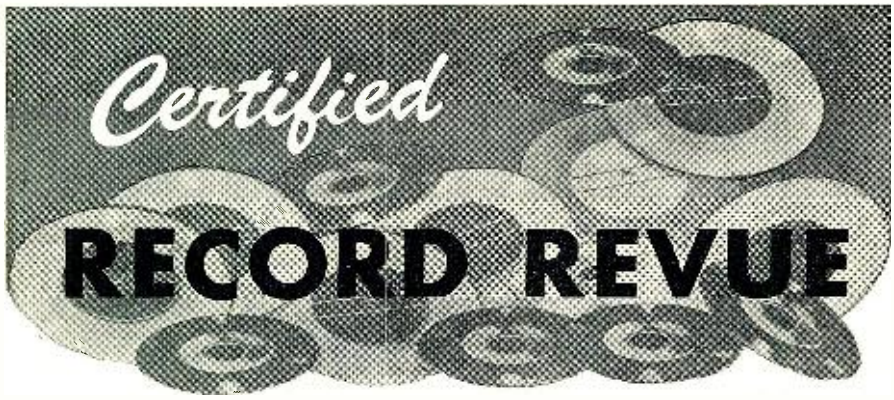
Fig. 5. Mechanical details on the measuring circuit shield assembly discussed in text.

Front panel view of the home-built Electronic Thermostat.



Under chassis view showing location of component parts.





By BERT WHYTE

AFTER last month's lengthy report on three-channel stereophonic sound, I promised you a short introductory section for this month with the emphasis on reviews. So here are a few notes of interest and then we are off!

I attended the annual convention of the NAMM (National Association of Music Merchants) at the Hotel New Yorker in late July, and found out about some new equipment of more than passing interest. For one thing, *Ampex* has pulled out all stops and is actively going after the home hi-fi market with a new series of tape equipment designated as the "A" series. The "A" tape deck is brand new in design and incorporates many innovations in tape handling and operating convenience. It can be had as a straight half-track monaural unit with 3¾ and 7½ ips tape speeds, or as the half-track monaural recorder with stereophonic playback facilities. This latter unit is particularly significant, as it will take care of those folks who wanted stereo playback but who also wanted the convenience of a recorder for off-the-air recording, etc.

Both units handle the 7-inch reels of tape, both are driven by a four-pole induction motor . . . the first time in *Ampex* history they have not used a synchronous motor. According to Mr. Phil Gundy, head of the company's audio division, a new tape drive system is incorporated with these motors and the result is wow and flutter figures under 0.2 per-cent at 7½ ips, which is approximately the same as the sync-motored *Ampex* 601 series. Also for the first time on any *Ampex* is a tape footage counter! This one really seems to do a good job and I was told that it is guaranteed not to introduce any wow or flutter. I listened to these units for quite a while and neither from the use of induction motor nor footage counter, with a wide variety of recorded material was any wow or flutter audibly noticeable. By far the most fantastic "gizmo" on these new "A" series tape machines is the following; when threading tape from the pay-off reel, it is the usual *Ampex* straight slot loading and then instead of inserting the end of the tape in the take-up reel hole, or looping around a peg and winding on a few turns of tape by hand . . . you merely lay the end of the tape in between the sides of the take-up reel and near the reel hub . . . and then simply turn on the "play" switch. And doggone if the end of the tape doesn't *automatically wrap itself around the reel hub* as pretty as you please and that's all there is to it! I haven't the remotest idea how they do it, although someone muttered something about the ratio of hub wind to capstan speed or some such thing. The price for all this bounty? The monaural record/stereo playback goes for $495, the monaural record alone for somewhat less.

Also new is an amplifier speaker combination like the previous Model 620, but this unit has provision for phono and tuner inputs, so that with the addition of a turntable or changer and cartridge you can have a complete hi-fi system. Prize package of the new *Ampex* line, however, was a handsome blonde furniture cabinet about 6 feet in length which incorporated the new "A" monaural/stereo tape deck; two 10-watt amplifiers; an AM-FM tuner; preamp with bass, treble, selector and special function switches; *Garrard* changer and magnetic cartridge; and at each end of the unit, a speaker in a special baffle. This unit is so arranged that just by throwing switches you can record off records, or off-the-air, playback half- or full-track tapes through the two speakers, play AM or FM or records, and playback stereo tapes through the two amplifiers and two speakers. Frankly I was highly skeptical about the speaker placement (6 ft.) for stereo, but Mr. Gundy told me that the distance was arrived at after 6 months of research, and then pointed out to me a very startling and significant thing . . . the speakers in the baffles were *slanted outwards at an angle of about 45 degrees.* This, he claimed, rather effectively eliminates the "hole-in-the-middle" phenomenon that plagues two-channel stereo. After considerable listening I am forced to agree that at least in moderate sized rooms, the "hole" is indeed largely eliminated. There is still not the superior directionality nor depth of true three-channel stereo, but it is awfully good, and probably will suffice for a good many people and at least will make listening more pleasurable until all the problems of the three-channel stuff have been resolved. This new speaker placement is completely at variance with what has been previously accepted, and I have no doubt will cause much new experimenting among the afficionados . . . your truly included!

The price, incidentally, for this *Ampex* console is $1470 and, considering what you get, it is a reasonable buy. For the less affluent, there were other stereo machines at the show priced to aim at a still larger segment of this new and growing market. *VM Corp.* displayed a monaural record/stereo playback unit that did a creditable job of stereo reproduction for $226.00. *RCA Victor* now has a complete monaural record/stereo playback system including the 2 amplifiers and speakers for less than $395.00. Truly, the stereo market is ripe for expansion with these new units.

It is to be hoped that the existence of these new machines will bring some sensible pricing for stereophonic tapes. The present prices are simply way out of line. I am in a position to know fairly well what it costs to produce recorded tapes and the difference between monaural and stereo is so slight as to be negligible. A stereo tape at a dollar or two more than monaural would more than offset any "extra costs" which are purportedly involved. Up to now, with stereo playback systems costing so much, the theory evidently was that if a person could afford a stereo system, he could afford $15 to $20 for a stereo tape. It is just plain common sense to realize that with these new stereo tape playback systems in the $200-$400 class, this is an entirely different segment of the market and these people simply can't and won't pay these premium prices for tapes.

A few more bits of news and notes of interest. I managed to find out some of the future *RCA Victor* stereo releases, which will be available in the coming months and an impressive list it is . . . Beethoven "7th" with the Boston under Munch, Brahms "2nd" by the same, Chausson's "Poeme" with Oistrakh himself on the violin, "Gaite Parisienne" with Fiedler and the Boston Pops, the "Grand Canyon Suite" with the Boston Pops, Saint-Saens "2nd Piano Concerto" with Rubenstein/Reiner and the Chicago Symphony, and "Rhapsody on a Theme of Paganini," same group.

Audio Video Tape Co., pioneer in the recorded tape field, has a new design reel that will be a boon especially to owners of the less expensive tape machines. These units are usually handicapped by motors of limited torque and the result is that the last few minutes of play are loaded with wow and flutter as the take-up reel struggles to get the last few feet of tape off the small diameter pay-off reel. This new *AV* reel obviates this difficulty by having a hub *4 inches* in diameter, for better "gearing." With the regular 1½ mil tape, 24 minutes playing time is obtained, with "long play" one mil tape, 36 minutes playback is possible. Admittedly this larger hub cuts down time but it also cuts the wow and flutter and that is the important factor.

Music lovers in the Hartford, Connecticut area have a treat coming their way. On the evening of October 9th (better check local papers for exact time) the Hartford Symphony orchestra under conductor Fritz Mahler will present a regular concert combined with stereophonic sound demonstration. The program is being co-sponsored by the *Audio Workshop* of West Hartford and *Gray Research & Development Co., Inc.* of Manchester, Conn. Live music *versus* previously recorded stereo will be compared *via* the use of stereophonic *Magnecords* and *Klipschorns,* with Paul Klipsch acting as lecturer and narrator. It should be a most stimulating evening.

There is so much going on in stereo I've yakked more than I intended so I'll chop it . . . right here!

Equipment used this month: *Pickering* "Fluxvalve" cartridge in *Pickering* 190 arm; *Components Corp.* turntable; *Marantz* audio consolette; two *McIntosh* MC60 amplifiers; *Jensen* "Imperial" speaker and *Electro-Voice* "Georgian" speaker, *Ampex* tape equipment.

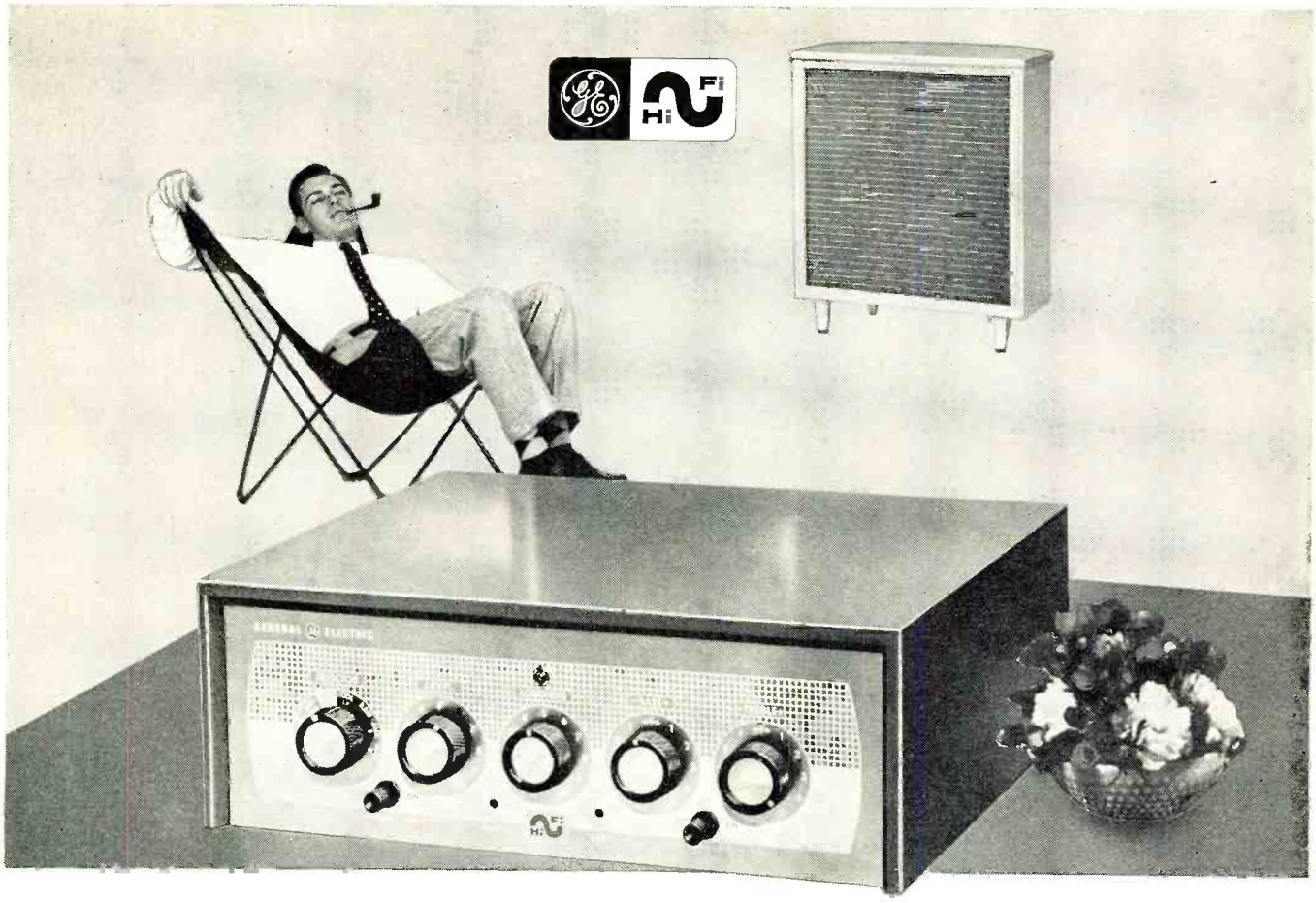
MOZART

VIOLIN CONCERTOS #4 AND #5 Yehudi Menuhin, violinist with Philharmonic Orchestra conducted by John Pritchard. Victor LM1961. RIAA curve. Price $3.98.

Mozart this month fares well in the skillfull hands of Yehudi Menuhin. These are among Mozart's most delightful and ingrati-

(*Continued on page* 150)

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

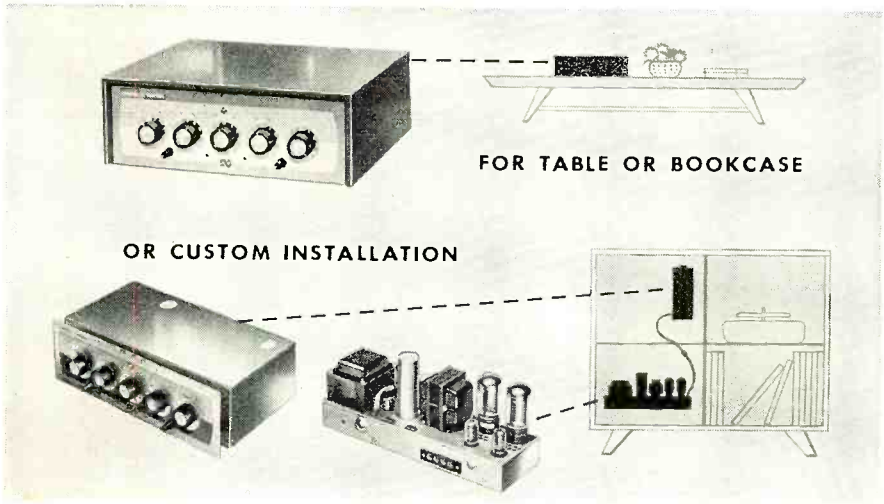


New "Convertible" 20-watt Amplifier and Pre-Amp with controls, in one versatile unit, only $99.95

THE new General Electric Convertible is a dual-chassis design. In a single, amazingly flexible and low cost unit there's a powerful amplifier, with 20 watts of undistorted output—plus a pre-amplifier with seven panel-mounted controls. It gives you sound reproduction as it was meant to be heard.

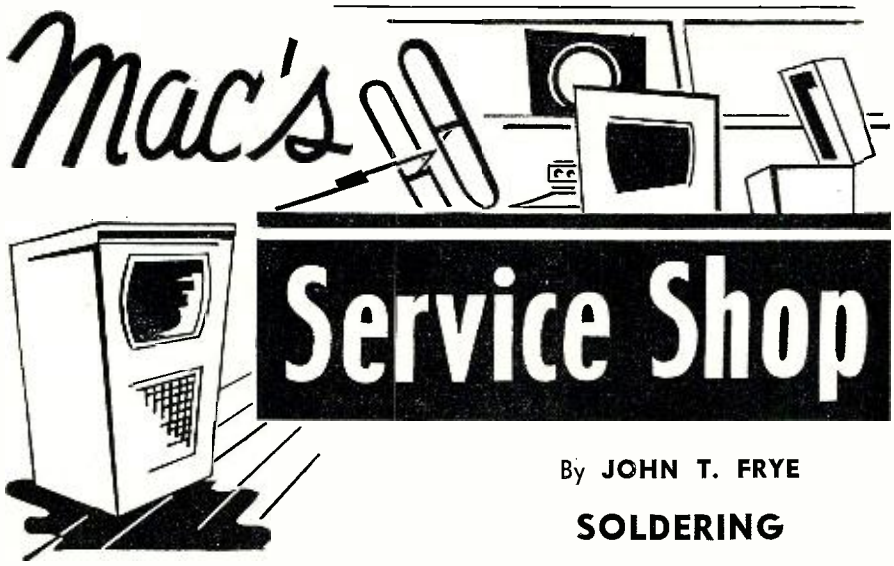
There's New Installation Flexibility, too! With the General Electric dual-chassis design, the amplifier and pre-amp may be mounted independently in built-in systems. Or, as one complete unit, the handsome Convertible cabinet may be placed on a bookshelf or table.

Write today for new hi-fi ideas and the name of your dealer. He can show you the full line of G-E Hi-Fi components. *General Electric Company, Special Products Department, Section R15106, Electronics Park, Syracuse, New York.*



Progress Is Our Most Important Product

GENERAL ELECTRIC



By JOHN T. FRYE

SOLDERING

IT WAS a beautiful, invigorating, crisp fall day outside; but inside the service shop Barney and his boss, Mac, acted more as if they were suffering from spring fever. In spite of the radios and TV sets that were piled all over the place, they were taking a break. Mac was a great believer in these little "recesses," which he contended kept a fellow from going stale and doing careless and sloppy work from sheer weariness and boredom. At any rate, he and Barney were sitting side by side on the service bench chomping away on a couple of candy bars.

"Hey, Mac," Barney mumbled through a mouth full of candy, "I was reading an article in one of my ham magazines the other day written by a guy by the name of J. R. Smith in which he was arguing that the belief you had to make a solder joint mechanically secure before flowing solder around it was just a lot of stuff. What do you think about that?"

"With a few reservations, I'm with him," Mac answered promptly. "I'm glad you brought that subject up. Probably no single operation a service technician performs is more important, because it is used so often, than soldering; yet most of us keep right on making solder joints exactly as we did when the solder itself was far inferior to present varieties and when the iron we used was a heavy, clumsy affair with practically no control over the heat. It is just one of those operations that are so common that we never stop to wonder if we could improve our way of doing them; but I'm willing to wager that most of us—including you and me—could do a much better job of soldering than we are if we could just quit thinking we know all that's worth knowing about soldering."

"Probably the boys who used solder purely for holding mechanical joints gave us the idea that solder connections had to be mechanically solid," Barney offered. "This fellow Smith said that exhaustive tests of solder joints made in government laboratories showed that merely shoving a wire through a hole in a socket connection, laying it in a slot, or bending it at a right angle around a stud and then flowing solder around the wire would produce a joint that would withstand the most severe shock and vibration under extremes of temperature. The wire or pigtail would give up and break long before the solder joint failed."

"That certainly checks with my own experience," Mac remarked. "For a long time now I have made it a practice to install volume controls and other parts in receivers with the thought in mind that one of these days I'm going to have to remove them. You know how exasperating it is to try to unravel one of those soldered connections in which the leads have been twisted securely and the ends tucked in out of sight and reach before the solder was applied. By the time you get all the wires loose, you have probably broken one or two of them and have ruined a component or so with the excessive heat used to keep the knot soft while you sorted out the wires. This sort of thing is especially bad with the connections on small sockets. The sockets themselves will not take too much heat, and the connections break easily under much pulling and twisting. How much easier it is to remove the leads when they have simply been thrust through the holes a sixteenth of an inch or so and solder flowed around them!"

"Yeah, and another advantage of that kind of joint is that you can tell if it's good or not simply by pulling on it after the solder has set. If the joint was made mechanically solid before soldering, this pull test will reveal nothing; but when the solder itself is doing the holding, a little tug will break a rosin joint loose at once. As far as I am concerned, still another advantage lies in the fact you can do a much more professional-looking job by this method once you get the knack of it. I know, I tried it on a transmitter kit I was putting together, and I found it was much faster, made neater joints which were easier to inspect, and used much less solder. But I wasn't going to say anything about doing this until I learned if you went along with the idea."

"Aren't you the cagey one!" Mac exclaimed with a grin. "But you may have encountered one of the exceptions I had in mind in putting that transmitter together. When the lead being soldered is very heavy and stiff, as you sometimes find in tank coil and bandswitching circuits, making the joint mechanically secure before soldering is just taking out insurance against the severe strain and prying the joint may have to endure because the leads are so heavy. This is far in excess of any pressure that could be exerted through ordinary connecting wire used in radio or TV sets or through the pigtail leads of capacitors or resistors."

"I'm away ahead of you," Barney exclaimed. "I *did* make those joints solid before soldering. Awhile ago you said something about solder being better now than it used to be. How about that?"

"It most certainly is," Mac answered. "To appreciate just how much soldering has improved, you should have had to heat a big old heavy iron in a gas flame and then gouge solder off a big bar the way I did when I started in this 'wacky' radio repairing business. The flux used in present day solder is also far superior to the rosin-core solder that first came on the market. In those days, it was not at all unusual to find great lengths of the stuff with no flux in it at all. But I still think there is a lot of difference between present brands of solder intended for radio and TV repairing. The other day the salesman was out of the brand I have been using for years, mostly through sheer habit; so I let him sell me another kind he recommended. I was astonished to discover it melted easier and flowed much more smoothly around a joint than the kind I had been using. Solder is *not* all alike."

"I'm sure some of the present solders are deliberately designed to work with the solder guns that practically all of us use today," Barney observed. "With them, you want a solder that melts easily, sets fast, and has a good flux evenly distributed."

"You have to keep in mind, though, that no matter how you prepare the joint mechanically, you still have to observe the rules for good soldering. I mean the metal parts to be jointed have to be clean and bright; they must *all* be raised to a temperature well above the melting point of the solder; and they must all be held perfectly rigid while the solder is setting. Carelessness in any of these particulars means a bad joint, no matter what other preparations you make."

"Check!" Barney agreed. "And I was just thinking that the advent of printed circuits has made it necessary for us to learn some new soldering habits.

(*Continued on page* 191)

Rohn

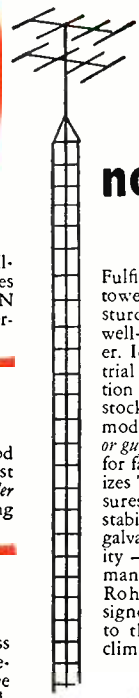
only complete line of

TV and COMMUNICATION TOWERS

proven in Profits *and* Customer Satisfaction

look at these ROHN exclusives

- **HOT DIPPED GALVANIZED**
  The finest, most durable finish is available for ROHN Towers and accessories . . . all done entirely on the ROHN premises under careful ROHN supervision.
- **UNEQUALLED DESIGN AND ENGINEERING**
  ROHN is the only design that has stood up over the years. ROHN has been first and foremost . . . and always the *leader* in new products to meet the changing demands.
- **MASS PRODUCTION FOR LOW COSTS**
  ROHN was the first to utilize mass production techniques to build a superior tower at the most competitive prices. This means no sacrifice in quality yet far greater profits for you.
- **UNIVERSAL CUSTOMER ACCEPTANCE**
  Thousands and thousands of installations prove the ROHN line first in customer satisfaction.
- **PIONEER MANUFACTURERS**
  Pioneers in tower manufacturing—and today one of the world's largest manufacturers of this type equipment. The ROHN Company was built on satisfaction on the part of distributor, dealer and customer alike.
- **COMPLETE LINE**
  Only ROHN offers a full line—*one* dependable one-stop source for all TV installation equipment. Save headaches, save shipping costs, save time . . . use ROHN unequalled service *exclusively*.

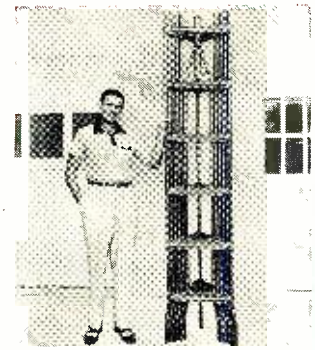


HIGHLIGHTS OF THE ROHN LINE

no. 6 tower

"All-Purpose" tower

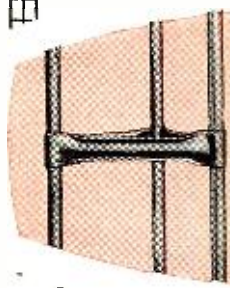
Fulfills 75% of your general tower needs—is structurally as sturdy—yet *costs less* than the well-known Rohn No. 10 Tower. Ideal for home and industrial installations, communication requirements . . . eliminates stocking many different tower models. *Self-supporting to 50 ft. or guyed to 120 ft.!* Easy to climb for fast, efficient servicing. Utilizes *"Magic Triangle"* which insures *far* greater strength and stability. Permanent hot-dipped galvanized coating. Dependability — a feature customers demand — is assured with the Rohn No. 6 Tower . . . designed to "stand up" for years to the rigors of weather and climatic conditions.



Package Tower*

"Space Saver"— cuts storage space 300% or more!

Popular PT-48 has almost 50′ of sturdy tower within a compact 8′ x 20″ package! "Magic Triangle" design is adapted to a pyramid shape using a wide 19″ base with progressively decreasing size upward. Decreases your overhead . . . easy to transport and assemble — cuts shipping costs. Galvanized throughout. Available in heights of 24, 32, 40, 48, 56 and 64 feet!



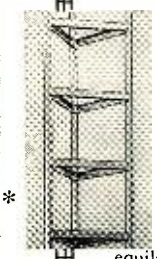
*Pat. Pending

Both Towers Feature **THE ROHN MAGIC TRIANGLE** *

For structural superiority, famed wrap-around "magic triangle" design is featured in these all-steel towers. Towers have full 2½" wide corrugated cross-bracing welded to tubular steel legs. The exclusive design assures dependable strength and permanence.

*Pat. Pending

COMMUNICATIONS TOWER



For extreme heights and communication purposes of all kinds, the Rohn No. 40 gives you strength and durability on which you can depend. The time tested and proven equilateral triangle design using extra heavy duty tubing and corrugated steel cross-bracing is utilized. The No. 40 is structurally sound so you can install it for heights up to 300′; or at lesser heights when considerably greater strength is required because of excessive wind or antenna loading. Use for radio telephone, broadcasting, microwave relay and all other such communication purposes. If a particular job calls for this type tower, save real money by using ROHN towers.

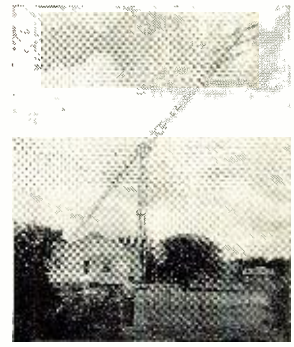
Note: For lesser heights, use the Rohn No. 20 or No. 30 Tower.

Telescoping Masts

Heavy-duty hot-dipped galvanized steel tubing and rigid joints give extraordinary strength. *Quick installation* . . . mast attached to base—antenna fixed, then mast hoisted quickly to desired height. Utilizes special clamp and guy ring arrangement. Flanged interior section; crimped exterior section gives mast stability that can't be beat. Complete with guy rings and necessary erection parts. In 20, 30, 40 and 50 ft. sizes. Bases and ground mounts available.

ROHN FOLD-OVER TOWERS

These unique fold-over towers are perfect for experimentation, TV service departments, amateur use, and special purposes. Uses regular ROHN tower sections with kit. Now available in standard No. 10 tower to 50′, and in ROHN No. 30 & No. 40 towers for heavy-duty use.



ALSO a full line of ROHN ACCESSORIES

Rotor posts, house brackets, eave brackets, peak and flat roof mounts, instant drive-in bases, hinged base sections, telescoping mast bases, guying brackets, UHF antenna mounts, erection fixtures, variety of mounts and supports for masts or tubing, tower installation accessories, TV service tables, mast and TV hot-dipped galvanized tubing, guy rings, "twister-anchors", rubber tower grommets, insulator sections, hinged rotor platform, accessory shelf and platform and dozens of other items. Get the complete catalog TODAY!

ROHN *Manufacturing Company*

116 LIMESTONE, BELLEVUE
PEORIA, ILLINOIS

MAIL THIS COUPON FOR FREE LITERATURE!

Rohn Manufacturing Company
116 Limestone, Bellevue
Peoria, Illinois

Gentlemen: Please rush me complete details on the full line of Rohn Towers and Accessories.

Firm_____

Name_____ Title_____

Address_____

City_____ State_____

Regenerative Transistor Receiver

By **L. FLEMING**

Built of inexpensive and readily available parts, circuit will drive a loudspeaker or provide good headphone volume.

PARTICULARLY suited for home construction, the three-transistor circuit shown in Fig. 1 will give quite satisfactory loudspeaker volume on the stronger local broadcast stations. With headphones, the volume is more than adequate, even on distant stations. At night, the regenerative detector brings in a band alive with signals, a carrier whistle on almost every one of the hundred-odd channels.

The regeneration control operates smoothly. The regeneration setting for the edge of detector oscillation is fairly constant over the tuning range. Smooth operation is enhanced by a novel application of series resistance in the detector emitter circuit.

The circuit is straightforward. Except for the transistors, all the parts are the kind likely to be found in a good junk-box. The detector coil is home-made, with details given in Fig. 2.

The detector circuit, V_1 in Fig. 1, uses a *G-E* 2N135 transistor in a grounded-emitter circuit. A signal is fed to the base of the transistor from a tap on the tuned circuit inductor L_1 through a small coupling capacitor C_2. Regeneration control is effected by varying the emitter bias *via* potentiometer R_2. The tickler coil, L_2, is in series with the collector. Some experimentation with the number of tickler turns may be necessary, although tests with a few different transistors indicated that it was not critical.

The tickler return (terminal #4) is bypassed to ground for r.f. by a .01 μfd. capacitor C_4. The detector load resistor for audio is the 4700-ohm unit R_5. Detector audio output, from the "hot" side of R_5, is fed through a 1 μfd. coupling capacitor C_5 to an ordinary two-stage transistor audio amplifier (V_2, V_3) using *G-E* 2N107's. The collector of the second audio stage, V_3, feeds the primary of a standard replacement-type output transformer, T_1, thence the voice coil of the speaker.

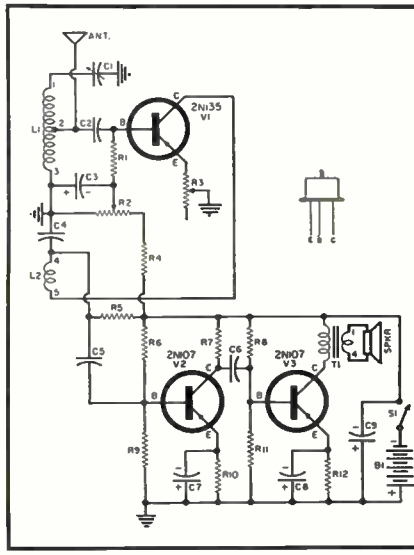
If headphones are to be used, connect them across the primary of the output transformer. If it is desired to omit the transformer and speaker and use phones only, connect the phones in place of the primary, between the collector of V_3 and "battery minus," and increase R_8 to 33,000 ohms.

The 500-ohm potentiometer R_3, a screwdriver adjustment, is a new stunt to reduce "squegging" or "fringe howl" at the edge of oscillation. Set it to the lowest resistance (usually about 200 ohms) that permits smooth regeneration control. No readjustment should be needed unless transistor V_1 is replaced.

Transistors

The transistors specified are easily available and inexpensive types. Limited experimentation indicates that any good general-purpose junction units should work satisfactorily, with the proviso that the detector unit V_1 should have a rated cut-off frequency of at least 2 mc. and the output unit V_3 should be rated at, at least, 50 milliwatts at 12 volts or more. CK722's, for example, would probably do for

Fig. 1. The home-built regenerative transistor receiver. It covers broadcast band.



R_1—10,000 ohm, ½ w. res.
R_2—20,000 ohm pot
R_3—500 ohm pot
R_4—100,000 ohm, ½ w. res.
R_5—4700 ohm, ½ w. res.
R_6—33,000 ohm, ½ w. res.
R_7—3900 ohm, ½ w. res.
R_8—6800 ohm, ½ w. res. (see text)
R_9, R_{11}—2200 ohm, ½ w. res.
R_{10}, R_{12}—470 ohm, ½ w. res.
C_1—365 μμfd. tuning capacitor
C_2—500 μμfd. paper or mica capacitor
C_3—2 μfd., 12 v. elec. capacitor
C_4—.01 μfd., 200 v. capacitor
C_5, C_6—1 μfd., 200 v. capacitor
C_7, C_8—10 μfd., 3 v. elec. capacitor
C_9—50 μfd., 12 v. elec. capacitor
L_1, L_2—See Fig. 2
T_1—Output trans., 2500 to 13,000 ohm push-pull plates to v.c. (Chicago RO-304)
S_1—S.p.s.t. switch
B_1—Two 6-volt cells in series (Burgess Z-4, see text)
V_1—"p-n-p" junction transistor (G-E Type 2N135)
V_2, V_3—"p-n-p" junction transistor (G-E Type 2N107)

the audio stages, and should be tried if some are already on hand. The 2N107 is rated for a 1 mc. cut-off, and when tried in the detector position, would not oscillate above about that frequency; it was also somewhat noisier than the 2N135.

Do not change from *p-n-p* to *n-p-n* types without making the proper changes in power supply polarity. Since a transistor looks like a short-circuit to reverse voltage, damage can result. During initial checking, it is advisable to connect a milliammeter in series with the battery.

Audio

Both audio stages are bias-stabilized. Bypass and coupling capacitor values are not critical. Tranformer coupling would give more gain, but was dropped because of its cost. Interstage capacitors may be either paper or electrolytic. Subminiature components are not particularly necessary, because the speaker, batteries, tuning dial, and other larger components determine the over-all size anyway.

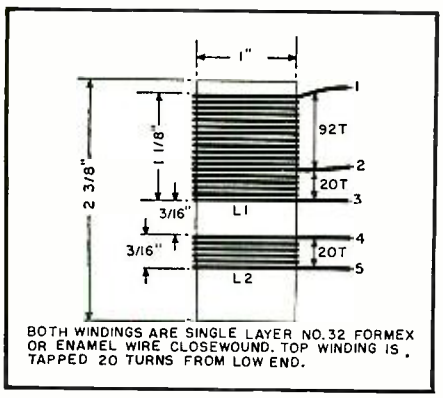
Since the power output is only 5 or 10 milliwatts, an efficient speaker makes a lot of difference. This means the heaviest magnet and the largest cone practicable. If a small speaker of 2½ or 3-inch size is used, it should be the type made for small battery radios, not just a general-purpose replacement unit. As a curiosity, it will be found that a good-grade 12-inch speaker will give a lot more volume than a little unit.

The 50-μfd. capacitor C_9 across the battery is necessary to prevent howling. Transistor audio amplifiers are notoriously sensitive to feedback through common supply impedances.

Total battery drain is about 6.5 milliamperes at 13 volts. The two *Burgess* Z4 batteries used (6 volts each) are each about the size of a flashlight "D" cell. Life is very long. Lower battery voltages down to 1½ volts will work for headphone use.

A fair amount of antenna is needed, about 20 feet of wire plus a ground. Less effective but usable is a 10-foot "hank" antenna and a bed-spring ground. The usual variations in antenna coupling practice will apply, such as connecting the antenna to the high side of the tuned circuit (terminal #1) through a trimmer. —30—

Fig. 2. Details for winding the set's coil.



BOTH WINDINGS ARE SINGLE LAYER NO.32 FORMEX OR ENAMEL WIRE CLOSEWOUND. TOP WINDING IS TAPPED 20 TURNS FROM LOW END.

New

MODEL O-11
Shpg. Wt. 21 Lbs.
$69.50

* *An improved model of what was already an outstanding instrument.*

* *Performance is unmatched in this price range.*

* *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5" Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 1½ DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

Extra!

A FULL YEAR TO PAY

SEND FOR DETAILS OF HEATH TIME-PAYMENT PLAN.

1 FEWER DOLLARS BRING MORE REAL QUALITY.

- Factory-to-you sales eliminate extra profit margin.
- "Build-it-yourself" eliminates labor charge.
- Heath purchasing power cuts component costs.

2 PERSONAL SERVICE ASSURES CUSTOMER SATISFACTION.

- You deal directly with the manufacturer.
- We are interested in you before and after sale.

5 BIG REASONS WHY

Heathkits®

ARE YOUR BEST BUY...

3 PROVEN DESIGNS MEAN RELIABLE PERFORMANCE.

- Research and development efforts concentrated on kits only.
- All kits guaranteed to meet advertised specifications.

4 EVERY KIT BACKED BY WORLD-WIDE REPUTATION.

- The world's largest manufacturer of electronic equipment in kit form.
- Producer of more than a million electronic kits for the home workshop and industry.

5 EASY TIME-PAYMENT PLAN TO FIT YOUR BUDGET.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 15, MICH.

GREATEST SELECTION . . .

Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New **HEATHKIT ETCHED CIRCUIT**

5" Oscilloscope Kit

- ✻ *Brand new model with improved performance specifications.*
- ✻ *Full 5" scope for service work at a remarkably low price.*
- ✻ *Attractively styled front panel in charcoal gray with sharp white lettering.*
- ✻ *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.

MODEL OM-2

$42.50

Shpg. Wt. 21 Lbs.

HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

$3.50

Shpg. Wt. 1 Lb.

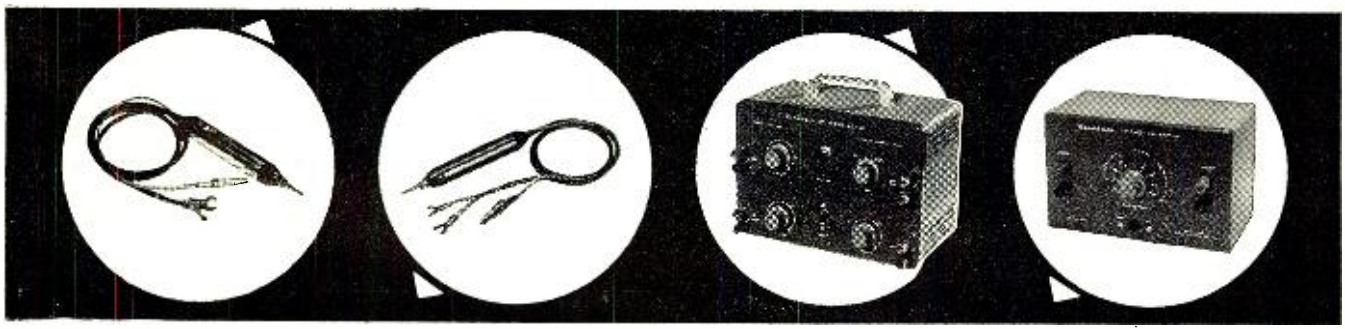
HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

$21.95

Shpg. Wt. 8 Lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

$12.50

Shpg. Wt. 4 Lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE

MODEL V-7A

$24.50

Shpg. Wt. 7 Lbs.

- *Easy to build — a pleasure to use.*
- *1% precision resistors employed for high accuracy.*
- *Etched circuit board cuts assembly time in half.*

Voltmeter Kit

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1

$29.50

Shpg. Wt. 6 Lbs.

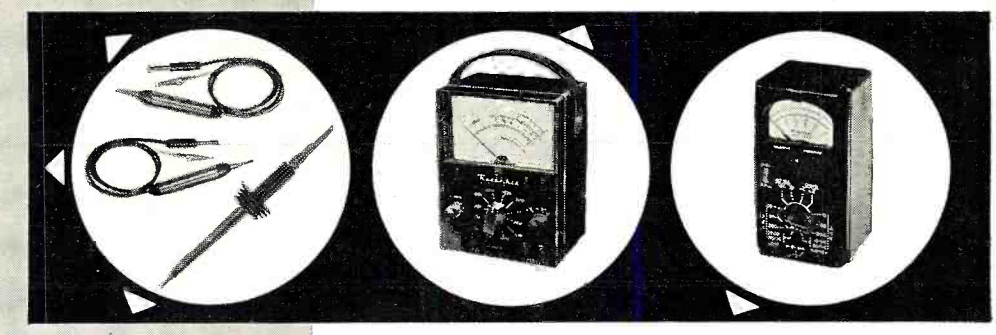
HEATHKIT SCOPE DEMODULATOR PROBE KIT

This probe functions like an AM detector to pass only modulation of signal and not signal itself. Permits observation of modulation from RF or IF carriers in TV and radio receivers. Extends usefulness of your oscilloscope. Voltage limits are 30 V. rms, and 500 V. DC. Very valuable in service or laboratory applications.

No. 337-C

$3.50

Shpg. Wt. 1 Lb.



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336

$4.50

Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1

$14.50

Shpg. Wt. 3 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- ✻ *Brand new circuit for extended frequency response and added stability.*
- ✻ *Ten accurate ranges from 0-.01 to 0-300 volts.*
- ✻ *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3

$29.50

Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1

$29.50

Shpg. Wt. 6 Lbs.

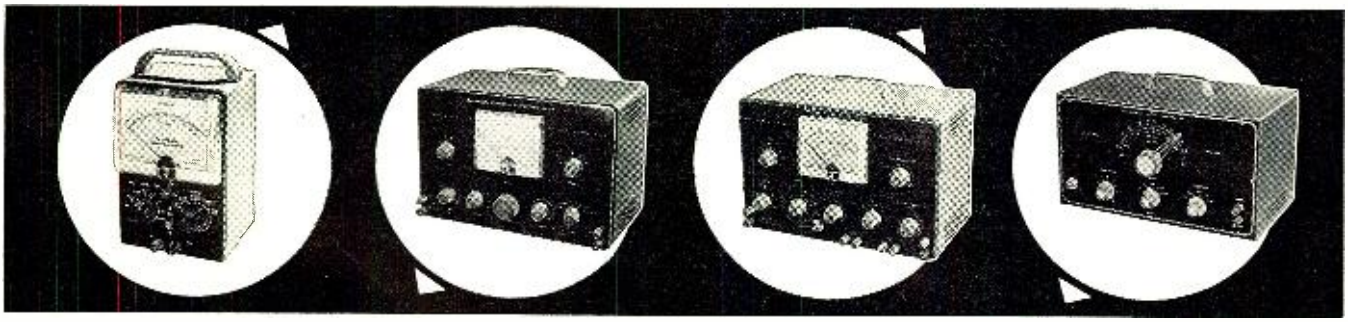
HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1

$59.50

Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), per-cent distortion, and DB.

MODEL HD-1

$49.50

Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1

$24.50

Shpg. Wt. 10 Lbs.

HEATHKIT

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs.

* *Less than 0.1% distortion — ideal for hi fi work.*
* *Large 4½" meter indicates output.*
* *Step-type tuning for maximum convenience.*

Audio Generator Kit

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

$29.50

Shpg. Wt. 11 Lbs.

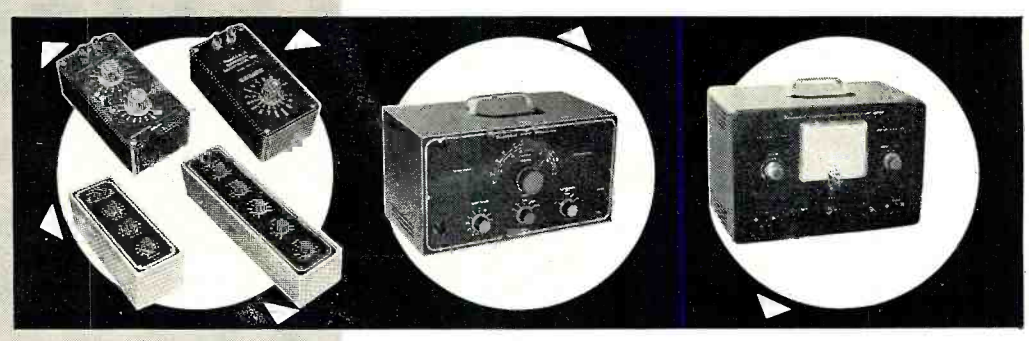
HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

$16.50

Shpg. Wt. 3 Lbs.



HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

$35.50

Shpg. Wt. 17 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

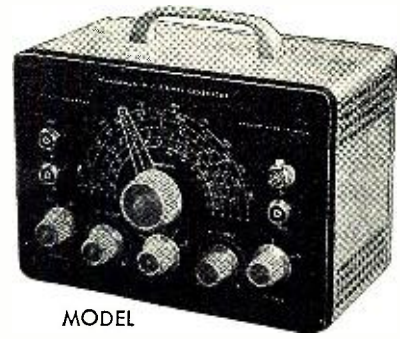
BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

- *No calibration required with pre-aligned coils.*
- *Modulated or unmodulated RF output.*
- *110 mc to 220 mc frequency coverage.*



MODEL SG-8

$19.50 *Shpg. Wt. 8 Lbs.*

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1

$39.50

Shpg. Wt. 16 Lbs.

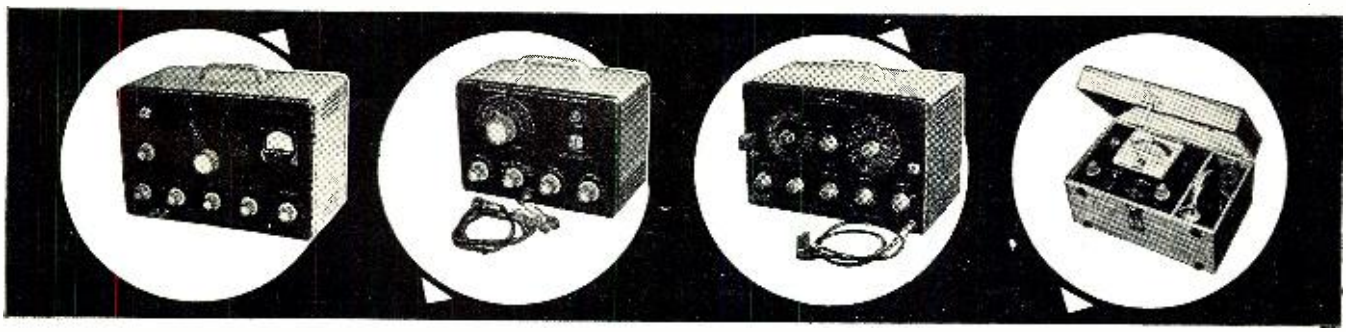
HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A

$49.50

Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2

$22.50

Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

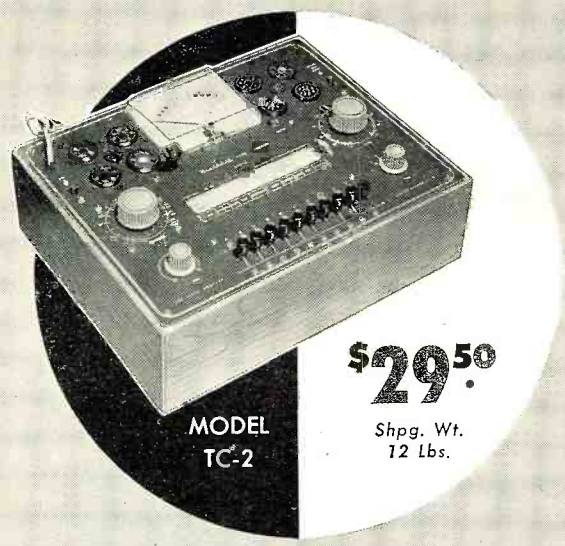
This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1

$22.50

Shpg. Wt. 10 Lbs.

HEATHKIT



MODEL TC-2

$29.50

Shpg. Wt. 12 Lbs.

Tube Checker Kit

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

- *Attractive counter-style cabinet.*
- *Wiring-harness simplifies assembly.*
- *Large 4½" meter with two-color "good-bad" scale.*
- *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P

$34.50 Shpg. Wt. 15 Lbs.

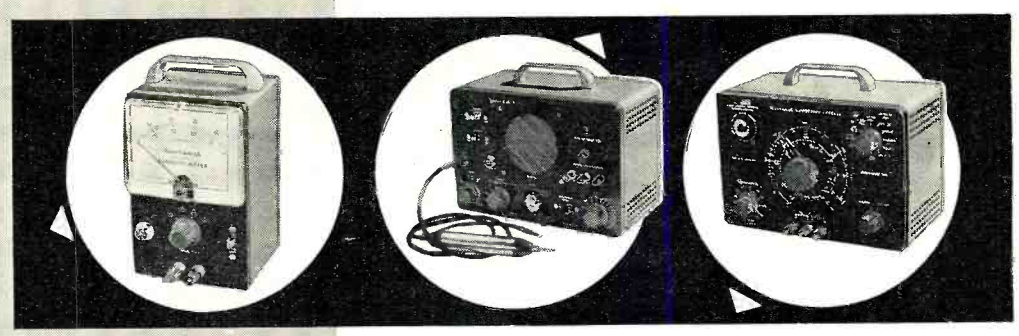
HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.



HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 15, MICH.

PIONEER DESIGN . . .

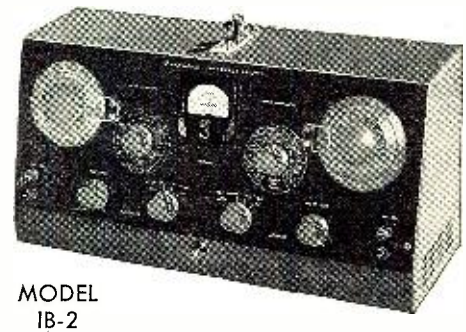
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- *½% precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.



MODEL IB-2

$59.50 *Shpg. Wt. 12 Lbs.*

HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "W" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

$44.50

Shpg. Wt. 14 Lbs.

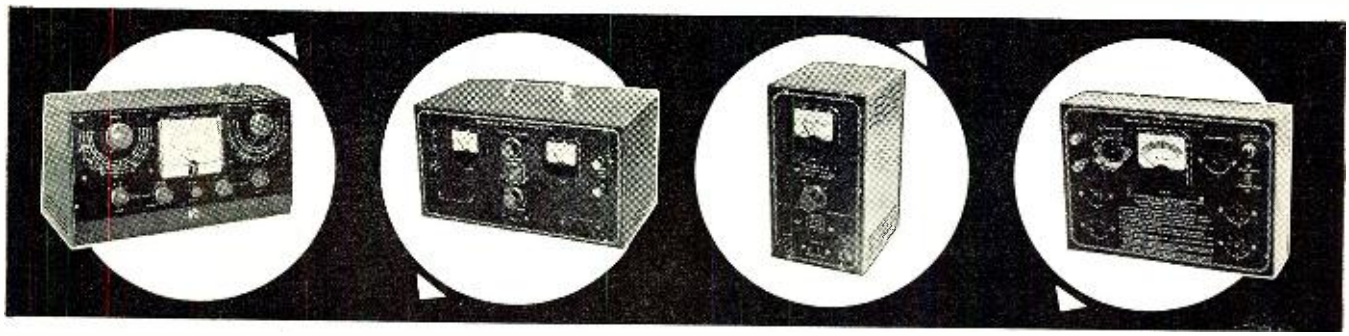
HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

$16.50

Shpg. Wt. 9 Lbs.



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

$31.50

Shpg. Wt. 17 Lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

$14.50

Shpg. Wt. 6 Lbs.

HEATHKIT DX-100 PHONE AND CW

MODEL DX-100
Shpg. Wt. 107 Lbs.

$189.50

Shipped motor freight unless otherwise specified.
$50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jacks—and automatic gain control. Has built-in VFO for CW-reception.

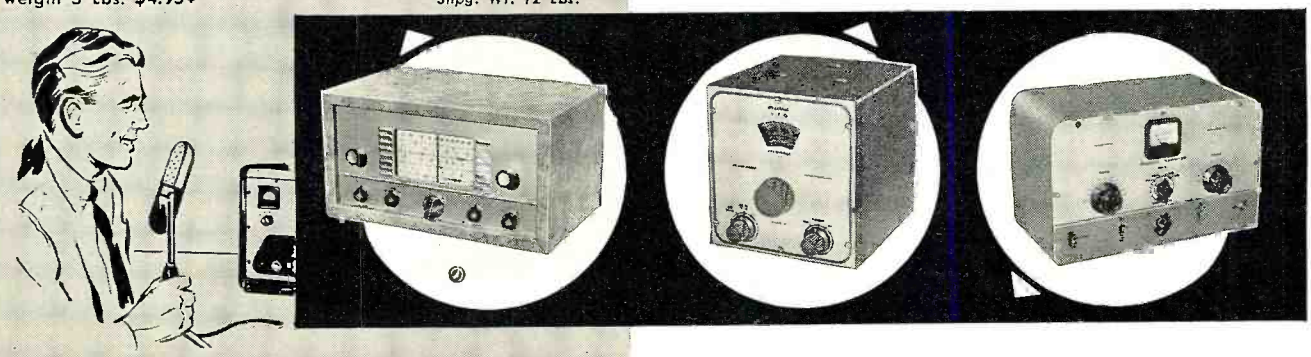
MODEL AR-3
$30.75
INCLUDING NEW EXCISE TAX‡
(Less Cabinet)
Shpg. Wt. 12 Lbs.

‡CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95‡

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

HEATHKIT CW TRANSMITTER KIT

This is the original low-priced Heathkit CW transmitter. Its reliable performance has been proven time and time again on the CW bands. Designed for crystal control, the Model AT-1 covers 80, 40, 20, 15, 11, and 10 meters. May be excited from external VFO. Plate power input up to 30 watts. Power supply built in. Panel meter indicates grid current or plate current for final. Incorporates pre-wound coils, copper-plated chassis, built-in line filter, profuse shielding, and top-quality parts throughout. Crystal socket and key jack on front panel. Built-in key-click filter, and single-knob bandswitching. 52-ohm coaxial output. Uses 6AG7 oscillator-multiplier, 6L6 power amplifier-doubler, and 5U4G rectifier.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off–CW–stand-by–phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

MODEL DX-35

$56.95 *Shpg. Wt. 24 Lbs.*

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

$14.50

Shpg. Wt. 2 Lbs.

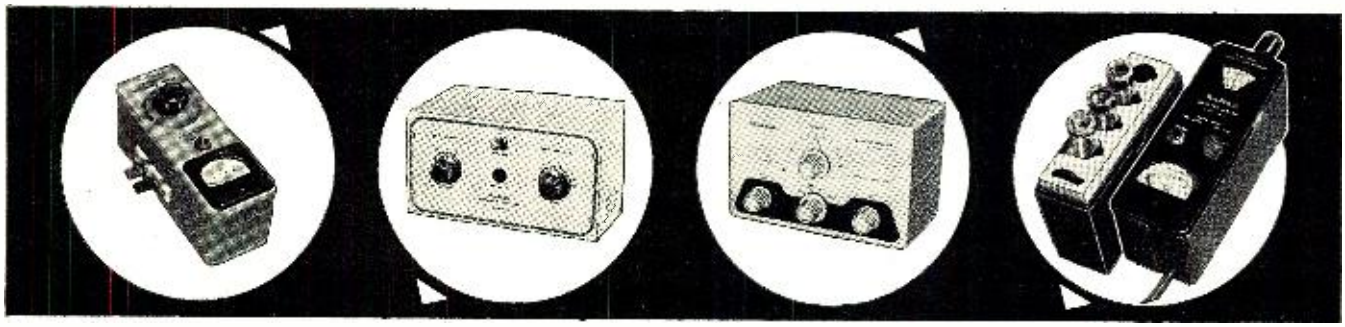
HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95

Shpg. Wt. 3 Lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50

Shpg. Wt. 4 Lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GB-1B

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT BROADCAST BAND

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$19.95
INCLUDING NEW EXCISE TAX‡

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- *Miniature tubes and high-gain IF transformer.*
- *Rod-type built-in antenna. Good sensitivity and selectivity.*
- *5½-inch PM speaker.*
- *Provision for phono jack.*
- *Transformer - operated power supply.*

Receiver Kit

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....$4.95‡

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

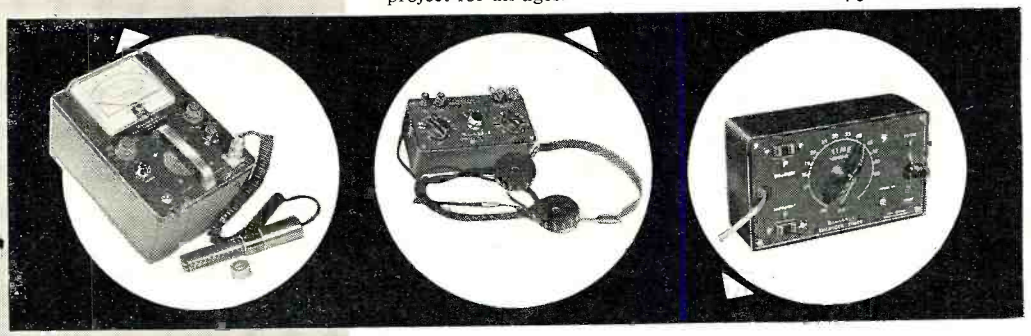
This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception, This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$8.75
INCLUDING NEW EXCISE TAX‡
Shpg. Wt. 3 Lbs.



- *Amazing new circuit for high efficiency.*
- *Compact, portable and rugged.*
- *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

COMPREHENSIVE INSTRUCTIONS . . .

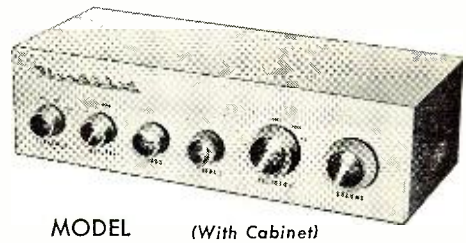
The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.



MODEL WA-P2 (With Cabinet) Shpg. Wt. 7 Lbs.

$21.75 INCLUDING NEW EXCISE TAX‡

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

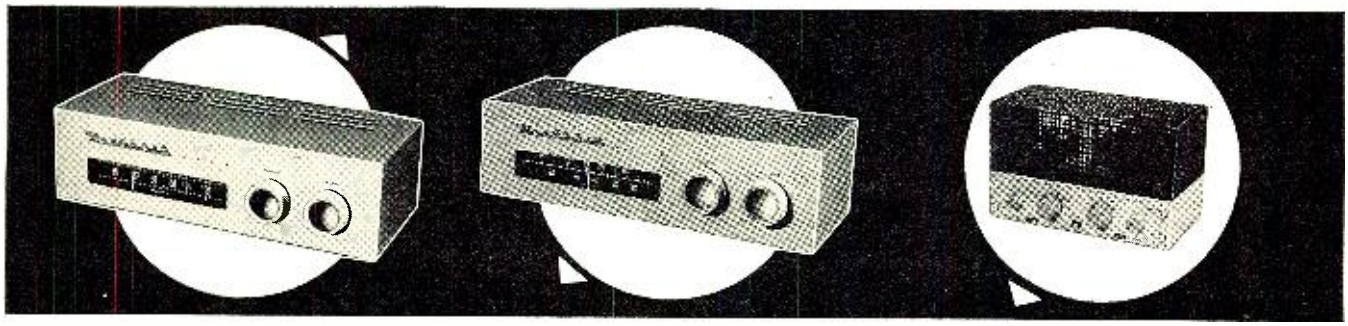
This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A

$26.95*

INCLUDING NEW EXCISE TAX‡

(With Cabinet) Shpg. Wt. 7 Lbs.



HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1

$26.95

INCLUDING NEW EXCISE TAX‡

(With Cabinet) Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 35,000 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1

$18.95

Shpg. Wt. 6 Lbs.

HEATHKIT ADVANCED-DESIGN

MODEL W-5M
Shpg. Wt. 31 Lbs.
Express Only

$59.75

MODEL W-5‡

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $81.50‡

- *Full 25 watt output with KT-66 output tubes.*
- *All connectors brought out to front chassis apron.*
- *Protective cover over all above-chassis components.*

HIGH FIDELITY

Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and 1M distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only..... $49.75

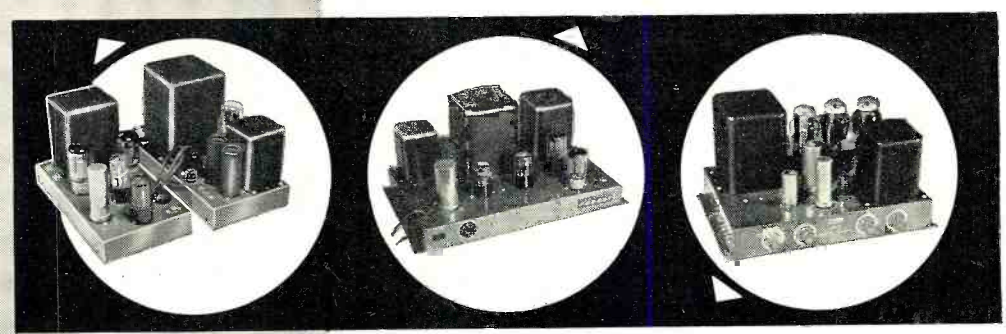
MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only..... $71.50‡

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 2.7% at this same level. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

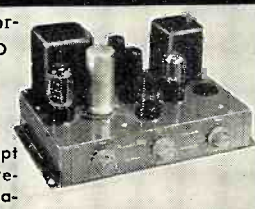
MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only..... $39.75

MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only..... $61.50‡



HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. Shpg. Wt. 10 Lbs.



MODEL A-7D
$18.65
INCLUDING NEW EXCISE TAX‡

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. $20.35‡

HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

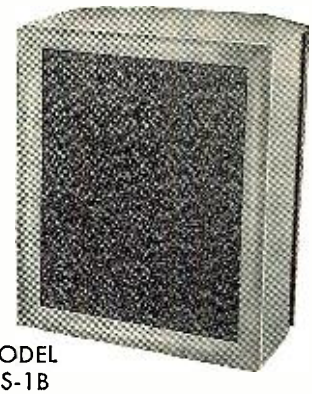
All prices marked with a ‡ include a 10% federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending
SPEAKER SYSTEM KIT

- *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
- *Easy-to-assemble cabinet of furniture-grade plywood.*
- *Attractively styled to fit into any living room. Matches Model SS-1.*



MODEL SS-1B

$99.95

Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**

MODEL SS-1

$39.95

Shpg. Wt. 30 Lbs.

- *Special design ducted-port, bass-reflex enclosure.*
- *Two separate speakers for high and low frequencies.*
- *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 15, MICH.**

ORDER BLANK

NOTE: All prices subject to change without notice.

Enclosed find ( ) check ( ) money order for_____
Please ship C.O.D. ( ) postage enclosed for_____pounds.

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. ORDERS FROM CANADA and APO'S must include full remittance.

Name_____

Address_____

City & Zone_____State_____
(PLEASE PRINT)

SHIP VIA
- ☐ Parcel Post
- ☐ Express
- ☐ Freight
- ☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE

COVER STORY

Portable TV Camera

The Signal Corps' newest combat camera is battery-operated and weighs a mere 8 pounds. Picture quality is excellent.

THE compact, portable, self-contained combat television camera shown on this month's cover is the Signal Corps Engineering Laboratories' answer to the problem of tactical reconnaissance without endangering the lives of advance scouts.

By carrying his own battery pack, the armed TV "roving reporter" is freed for the first time from the cumbersome cable connections that harnessed him to a source of power and limited his movements afoot.

The Signal Corps cameraman can now reach previously inaccessible spots. He can move unhampered over ditches and through streams, and through protective forests and hedgerows.

His mission completed, the TV scout can proceed to a new location taking his "electronic eye" with him.

The camera used in this portable system weighs a mere 8 pounds while the transmitter, complete with a built-in power supply, weighs 47 pounds. The transmitter is back packed and the camera can be carried in one hand, leaving the other hand free to carry necessary weapons.

Since the transmitted image from this unit is said to be equal or better than commercial quality, the Signal Corps suggests that this equipment may have wide civilian application in "on-the-spot" news reporting, for floor interviews at large gatherings, for covering sports events, and for rescue and search operations of all types.

The transmitter is AM with 1.5 watts average power and 2 watts peak. The bandwidth is a nominal 12 mc. with video bandwidth 4.5 mc. Operating frequency is 360 mc. and the antenna is an omnidirectional ground plane. The final amplifier tube is a 5893 pencil triode. The transmitter and sync generator are crystal-controlled. The system will net with all commercial facilities when its Signal Processing Unit is included.

The transmitter is powered by a five-cell rechargeable silver zinc battery which will operate continuously for two hours.

The camera has four interchangeable lenses including a wide angle to view a broad section, a telephoto for far-away subjects, and a "zoom" lens for quick change of magnification. It has a pistol grip to help steady the camera and "pan" the action. The camera can also be mounted on a tripod for unattended operation.

A TV receiver, which feeds several Display Units (each mounting a 10" picture tube), is used to pick up the transmissions. The receiver can be mounted in a jeep or used in a foxhole. The jeep's electrical system provides all needed power at the receiving point. Commercial power or regular household current can also be tapped.

To prevent interception, the camera unit can be used with a cable between transmitter and receiver. With power packaged in the transmitter, cable size is four times smaller than earlier models.

The audio channel for this entire television link is provided by separate, self-contained, portable two-way transceivers.

This newest unit in the Army's arsenal of combat equipment is being made by *Radio Corporation of America* to Signal Corps specifications. —30—

Radar Used for Electronic Surveying

Radar ruler measures distances up to 50 miles within a few feet. Uses portable computer.

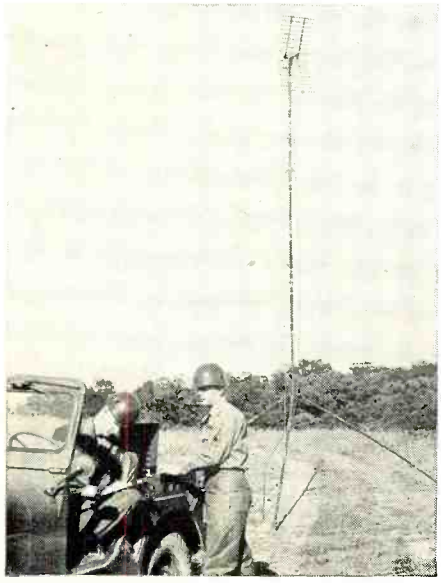
RADAR, the electronic eye that spots planes and catches speeders, now has a new use—measuring great distances for the surveyor. With the "radar ruler," developed by the Army's Signal Corps Engineering Laboratories, he can measure off 50 miles—precise to within a few feet—in a single giant leap.

Designed under Signal Corps contract by Motorola Inc., the new system uses two separate jeep-portable radar stations, one at each end of the distance to be measured. The long-range electronic beam easily penetrates fog, darkness, and foliage—impossible with conventional transit, plumb line, and rangepole. The electronic rangefinder is designed to replace standard surveying gear when long range and speed are essential.

The entire radar station, a 25-foot collapsible antenna mast and three metal suitcases filled with electronic equipment, weighs only 200 pounds. It fits easily into the back of a jeep and can be set up and operated by one man.

A pair of antennas placed at the two distant points play radar catch with a signal, bouncing it back and forth thousands of times a second. Automatic computers count the catches and register the distance in terms of the time the signal takes to make 10,000 round trips. Using a simple chart, the operator can quickly convert this reading to a high precision point-to-point measurement. —30—

Radar antenna, mounted on a collapsible mast in background, readily sees through foliage, bad weather, and darkness. A small jeep-mounted computer takes survey readings that are converted to distance.



RIDER CATALOG

R DER BOOKS HE P YOU

KNOW MORE... DO MORE... EARN MORE!

3 NEW Rider Books

ARITHMETIC FOR ENGINEERS (5th Edition, Revised)

by Charles B. Clapham

An outstanding text on practical, elementary mathematics for shop machinists, shop mechanic trainees, tool and die maker trainees, mechanical engineering students at the industrial level, mechanical drafting trainees . . . and all others who want to learn the elementary mathematics of Mechanics.
Written for use in schools or home study. Ideal for industrial upgrading.
More than 390 numerical examples of solutions fully explained. More than 1,950 problem exercises, with answers.
Cloth Bound, 558 pp., 5½ x 8½", illus.
#183.....Only $6.50

BASICS OF PHOTOTUBES & PHOTOCELLS

by David Mark

Phototubes and photocells are prominently used in a great many applications of electronic devices. Science, industry, government agencies, television, and many communication facilities employ them. This book is devoted to the explanation of the principles and practices surrounding phototubes and photocells, with the utmost in visual presentation to make the subject most understandable. It is tantamount to a "picture course" . . . yet it is authoritative and modern.
Soft Cover, 136 pp., 5½ x 8½", illus.
#184.....Only $2.90

INTRODUCTION TO PRINTED CIRCUITS

by Robert L. Swiggett

Here is a really comprehensive text on PRINTED CIRCUITS, the recent development that has revolutionized the electronics industry. The author, who is an acknowledged expert on the subject, gives complete coverage to the various manufacturing processes used. Numerous practical applications are discussed, and the maintenance techniques peculiar to printed circuits are clearly explained. This authoritative book is of particular interest to technicians, engineers . . . and all industrial personnel who are associated with any phase of commercial or military electronics production.
Soft Cover, 112 pages, 5½ x 8½", illus.
#185.....Only $2.70

BASIC, HOW-TO BOOKS

BASIC ELECTRICITY
BASIC ELECTRONICS
BASIC SYNCHROS & SERVOMECHANISMS

by Van Valkenburgh, Nooger, Neville, Inc.

The fabulous picture-text books that teach faster and easier! The theory, principles, and practice of electricity, electronics, and synchros and servos are here presented in a manner that permits a rapid grasp of the fundamentals of these vitally important subjects. Over 2,000 specially prepared illustrations present, explain, and make every topic discussed picture-clear.

BASIC ELECTRICITY
#169 Soft Cover: 5 volumes, 624 pp., 6 x 9".....Only $9.00 per set.
#169-H, Cloth Bound: all 5 volumes in a single binding....Only $10.50

BASIC ELECTRONICS
#170 Soft Cover: 5 volumes, 550 pp., 6 x 9".....Only $9.00 per set.
#170-H, Cloth Bound: all 5 volumes in a single binding....Only $10.50

BASIC SYNCHROS & SERVOMECHANISMS
#180 Soft Cover: 2 volumes, 270 pp., 6 x 9".....Only $5.50 per set.
#180-H, Cloth Bound: both volumes in a single binding.....Only $6.95

BASIC VACUUM TUBES & THEIR USES

by Rider & Jacobowitz

A text devoted to the fundamentals of vacuum tubes and their uses. Covers diodes, triodes, and multi-electrode tubes. The book is written on an elementary level, with the minimum of mathematics. It is intended to convey a solid foundation for understanding electron tube behavior, which foundation may serve as a base for more advanced knowledge of vacuum tubes. Covers electron theory, rectification, amplification, oscillation, characteristic curves, and tube constants.
Soft Cover, 208 pp., 5½ x 8½", illus.
#171.....Only $3.00
#171-H, Cloth Bound.....Only $4.50

UNDERSTANDING VECTORS & PHASE

by Rider & Uslan

Vectors are the tools of the engineer. This book makes this mathematical tool usable by all . . . even those who have had no engineering training.
Soft Cover, 160 pp., 5¼ x 7¼", illus.
#103.....Only $ .99

HOW TO USE METERS

by John F. Rider

Explains in detail the construction and operation of all types of electrical meters. Gives special emphasis to the details of what kinds of meters to use for making different kinds of measurements in electronic and electrical equipment. Also explains how to make the measurement . . . namely, where to connect the meters.
Soft Cover, 144 pp., 5½ x 8½", illus.
#144.....Only $2.40

HOW TO USE TEST PROBES

by A. Ghirardi & R. Middleton

The only book of its kind! Complete step-by-step explanations with practical examples of applications of all types of test probes used with test scopes, VTVM's, and VOM's.
Soft Cover, 176 pp., 5½ x 8½", illus.
#165.....Only $2.90

HOW TO USE SIGNAL & SWEEP GENERATORS

by J. Richard Johnson

Discusses all types of signal and sweep generators, and their applications in AM, FM radio, and TV.
Soft Cover, 144 pp., 5½ x 8½", illus.
#147.....Only $2.10

FUNDAMENTALS OF TRANSISTORS

by Leonard Krugman

Explains the BIG thing in electronics today . . . the transistor! Written by one of the pioneers in transistor development, this book deals with basic operation, characteristics, performance, and application. The subject is made completely understandable to all.
Soft Cover, 144 pp., 5½ x 8½", illus.
#160.....Only $2.70

ELECTRONICS TECHNOLOGY SERIES

edited by Alex. Schure, Ph.D., Ed.D.

An economically priced series of books devoted to the explanation of the basic concepts and principles of individual phases of electronics technology. Each book deals with a specialized subject; groups of these books form broad categories in the study of electronics technology.
Aimed for use by students in technical institutes, junior colleges, adult education classes, vocational schools teaching electronics technology, operators of communication equipments such as radio amateurs, commercial ship and broadcast station operators, electronics laboratory technicians, and experimenters who desire a more than casual understanding of the subjects covered.

Soft Covers, 5½ x 8½", illus.

RC & RL TIME CONSTANT
#166.....Only $ .90

F-M LIMITERS & DETECTORS
#166-2.....Only $ .90

FREQUENCY MODULATION
#166-3.....Only $ .90

CRYSTAL OSCILLATORS
#166-4.....Only $1.25

A-M DETECTORS
#166-5.....Only $1.25

LIMITERS & CLIPPERS
#166-6.....Only $1.25

MULTIVIBRATORS
#166-7.....Only $ .90

R-F TRANSMISSION LINES
#166-8.....Only $1.25

AMPLITUDE MODULATION
#166-9.....Only $1.25

BLOCKING OSCILLATORS
#166-10.....Only $1.25

WAVE PROPAGATION
#166-11.....Only $ .90

SUPERHETERODYNE CONVERTERS & I-F AMPLIFIERS
#166-12.....Only $ .90

INVERSE FEEDBACK
#166-15.....Only $ .90

RIDER CATALOG

R DER BOOKS HE P YOU

KNOW MORE... DO MORE... EARN MORE!

TV - RADIO THEORY

ENCYCLOPEDIA ON CATHODE-RAY OSCILLOSCOPES & THEIR USES

by Rider & Uslan

The most complete reference book on the subject of oscilloscopes and their uses. Standard throughout the world. Fully and clearly describes the test oscilloscope, its construction, capabilities, and applications to all kinds of uses . . . electronic laboratory, industrial, electrical and electronic maintenance, engineering, and communication. Profusely (3,000) illustrated.

Cloth Bound, 1,008 pp., 8½ x 11".

#133.....Only $11.50

OBTAINING & INTERPRETING TEST SCOPE TRACES

by John F. Rider

Explains screen traces seen on test oscilloscopes in clearly understandable, nonmathematical language. Contains over 800 scope traces in the sinusoidal family, square, rectangular, trapezoidal, sawtoothed, differentiated and integrated waveforms. Shows ideal and practical examples with description and explanation to foster recognition. It also deals with alignment waveforms and response waveforms for all varieties of communication equipment. Shows how to connect the scope and operate the scope for many varieties of observations.

Soft Cover, 190 pp., 5½ x 8½", illus.

#146.....Only $2.40

TELEVISION—HOW IT WORKS (2nd Edition)

by J. Richard Johnson

The most modern and authoritative text describing the theory of operation of all black-and-white television receivers. Each part of the receiver is explained in thorough detail and in a manner that makes the functioning of the components and the organization of the circuitry completely understandable. A prerequisite for the use of the book is familiarity with radio receivers. Written at the TV technician and TV technician-student level. Illustrated with specially prepared drawings to accomplish the utmost in visualization, clarity of presentation, and comprehension.

Leather Finish MARCO cover, 352 pp., 5½ x 8½", illus.

#101.....Only $4.60

#101-H, Cloth Bound.....Only $5.50

TV & ELECTRONICS AS A CAREER

by Kamen & Dorf

A detailed guidebook to a profitable career in the electronics industry. A number of experts describe the opportunities available in electronics . . . how to prepare for them . . . how to go about getting the job desired. Deals with broadcasting, manufacturing, engineering, and servicing . . . in all their aspects.

Cloth Bound, 336 pp., 5½ x 8½", illus.

#137.....Only $2.50

UHF PRACTICES & PRINCIPLES

by Allen Lytel

A clear discussion of UHF concepts, circuits, transmitting and receiving equipment, practical applications, etc.

Cloth Bound, 400 pp., 5½ x 8½", illus.

#141.....Only $6.60

TV PICTURE PROJECTION & ENLARGEMENT

by Allen Lytel

This is the story behind TV picture enlargement by means of viewing lenses and projection systems. Explains the WHY and HOW for adjusting these receivers. A time-saving, money-making book!

Cloth Bound, 190 pp., 5½ x 8½", illus.

#128.....Only $3.30

TV - RADIO SERVICING

HOW TO TROUBLESHOOT A TV RECEIVER

by J. Richard Johnson

A book written for the newcomer, to aid in a systematic procedure for troubleshooting. An easily understandable, step-by-step guide.

Soft Cover, 128 pp., 5½ x 8½", illus.

#152.....Only $1.80

TV TROUBLESHOOTING & REPAIR GUIDEBOOK

by R. G. Middleton

VOLUME 1: For the serviceman requiring practical, down-to-earth servicing information on TV receivers. Shows how to recognize symptoms through the use of picture tube patterns and scope waveforms. Much valuable data on the use of test equipment.

Soft Cover, 204 pp., 8½ x 11", illus.

#140.....Only $3.90

VOLUME 2: A gold mine of information on troubleshooting front ends, servicing the video I-F strips, faults in video amplifiers, trouble analysis in sound I-F and detector systems, etc.

Soft Cover, 160 pp., 8½ x 11", illus.

#140-2.....Only $3.30

TV SWEEP ALIGNMENT TECHNIQUES

by Art Liebscher

An expert of long standing explains in detail the principles and practices of alignment techniques for television receivers. This is the most complete explanation of the subject available in any textbook. Covers the front end, the video and sound I-F's, the sound channel, and response curves of the video amplifier.

Soft Cover, 128 pp., 5½ x 8½", illus.

#145.....Only $2.10

HOW TO LOCATE & ELIMINATE RADIO & TV INTERFERENCE

by Fred D. Rowe

An expert from the Northern California Electrical Bureau tells how to locate sources of radio and TV interference and how to correct them. This is not a theory or "perhaps" book. Its content is completely practical . . . tells what to do and how to do it. It deals with all varieties of interference-producing sources.

Soft Cover, 128 pp., 5½ x 8½", illus.

#158.....Only $1.80

PICTURE BOOK OF TV TROUBLES

by Rider Lab. Staff

A fabulous series of definitive, practical books that teach recognition of faults in TV receivers. Shows incorrect waveforms and resultant picture tube patterns caused by defective components, which are identified. Correct waveforms and schematics are also shown. Used in many TV schools and by tens of thousands of technicians.

Soft Covers, 5½ x 8½", illus.

VOL. 1: HORIZONTAL AFC-OSCILLATOR CIRCUITS

#168, 80 pp.....Only $1.35

VOL. 2: VERTICAL SWEEP-DEFLECTION CIRCUITS

#168-2, 96 pp.....Only $1.80

VOL. 3: VIDEO I-F & VIDEO AMPLIFIER CIRCUITS

#168-3, 96 pp.....Only $1.80

VOL. 4: AUTOMATIC GAIN CONTROL CIRCUITS

#168-4, 96 pp.....Only $1.80

VOL. 5: HORIZONTAL OUTPUT & H-V CIRCUITS

#168-5, 108 pp.....Only $1.80

VOL. 6: HORIZONTAL & VERTICAL SYNC CIRCUITS

#168-6, 120 pp.....Only $1.80

VOL. 7: SOUND CIRCUITS & L-V POWER SUPPLIES

#168-7, 64 pp.....Only $1.50

HANDBOOK OF 630-TYPE TV RECEIVERS

by Miller & Bierman

Deals with ALL versions of the famous 630-type receivers made up to 1955. Explains modifications and circuit improvements made by various manufacturers, and includes 26 pages of troubleshooting charts. A book every technician can use to major advantage!

Soft Cover, 200 pp., 5½ x 8½", illus.

#174.....Only $3.50

TECHNICIAN'S GUIDE TO TV PICTURE TUBES

by Ira Remer

A TV picture tube servicing guide for the TV service technician. Explains the care, handling, and maintenance of all kinds of picture tubes and the related components, yokes, ion traps, focus coils, etc. Completely practical . . . understandable and usable.

Soft Cover, 160 pp., 5½ x 8½", illus.

#163.....Only $2.40

HOW TO INSTALL TV ANTENNAS

by Samuel L. Marshall

An illustrated "antenna bible" for the TV installation man, technician, or student. Tells everything concerning the installation of TV antennas: safety precautions, erecting towers and masts, fringe installations, wind and ice loading problems, types of antennas and when to use them, rigging, roofing, and masonry work. How to do the job RIGHT . . . easily, quickly, safely, and economically!

Soft Cover, 128 pp., 5½ x 8½", illus.

#172.....Only $1.80

RIDER CATALOG

R DER BOOKS HE P YOU

KNOW MORE... DO MORE... EARN MORE!

TV - RADIO SERVICING

RECEIVING TUBE SUBSTITUTE GUIDEBOOK

by H. A. Middleton

The fabulously popular receiving tube substitution guidebook. Lists 2,500 radio-television tube substitutions in numerical sequence with accompanying wiring instructions showing the original and substitute tube socket illustrations. Answers all tube substitution problems.
Soft Cover, 224 pp., 8½ x 11", illus.
#135.....Only $3.00

FIRST SUPPLEMENT
750 completely new and different radio-television tube substitutions not listed in the basic edition. Special section on tube substitution in television receivers.
Soft Cover, 48 pp., 8½ x 11", illus.
#139.....Only $ .99

SECOND SUPPLEMENT
The second supplement features 134 TV picture tube substitutions, as well as more than 190 radio-television receiving tube substitutions. All are listed in numerical sequence with wiring instructions and original and substitute tube socket illustrations. Used in conjunction with the basic edition and the first supplement volumes, it is the most complete coverage available on tube substitutions.
Soft Cover, 48 pp., 8½ x 11", illus.
#139-2.....Only $ .99

SERVICING TV VERTICAL AND HORIZONTAL OUTPUT SYSTEMS

by Harry Thomas

Technicians and students will here find a complete discussion of vertical and horizontal output systems and their operation.
Soft Cover, 176 pp., 5½ x 8½", illus.
#150.....Only $2.40

TV FIELD SERVICE MANUALS WITH TUBE LOCATIONS

edited by Harold Alsberg

This practical series of manuals furnishes tube layouts in TV receivers, adjustment instructions, and lists more than 40 different trouble symptoms for each model, showing tubes to check, parts to check, and adjustments to make. Shows tuner dial stringing, key voltages, series filament wiring, and all other pertinent information necessary for TV servicing in the home. Also very handy to have in the shop. The volumes are organized according to manufacturers. Coverage starts with 1947 production.
Soft Covers (spiral bound), 5½ x 8½", illus.

VOL. 1: Admiral, Affiliated Retailers (Artone), Aimcee (AMC), Air King, Air Marshall, Allied Purchasing, Andrea, Arvin, Automatic.
#155.....Only $2.10

VOL. 2: Bendix, Capehart, CBS-Columbia, Crosley, Dumont.
#155-2.....Only $2.40

VOL. 3: Emerson, Fada.
#155-3.....Only $2.10

VOL. 4: GE, Hallicrafters, Hoffman.
#155-4.....Only $2.40

VOL. 5: Motorola, Philco.
#155-5.....Only $2.40

TV REPAIR QUESTIONS & ANSWERS

by Sidney Platt

A very practical and extremely useful series of question and answer books on the troubles in, and the repair of, TV receivers. Each book covers a separate section of the receiver and the series follows the sequence of the signal as it advances through the receiver.
Soft Covers, 5½ x 8½", illus.

VOL. 1: FRONT ENDS
#173, 128 pp.....Only $2.10

VOL. 2: VIDEO CIRCUITS
#173-2, 128 pp.....Only $2.10

VOL. 3: SYNC & SWEEP CIRCUITS
#173-3, 140 pp.....Only $2.10

VOL. 4: DEFLECTION & H-V CIRCUITS
#173-4, 128 pp.....Only $2.10

VOL. 5: SOUND & L-V CIRCUITS
#173-5, 128 pp.....Only $2.10

ADVANCED TELEVISION SERVICING TECHNIQUES

by Zbar & Schildkraut

A complete advanced TV servicing course, developed by the Radio-Electronics-Television Manufacturers Association, and made available to you at the incredibly low price of $4.55, complete! Shows you how to use every conceivable type of test equipment, how to service every part of a TV receiver.
Soft Covers, 8½ x 11".

MAIN TEXT, 176 pp., illus.
#161.....Only $3.60

LABORATORY WORKBOOK, 32 pp.
#161-2.....Only $ .95

INSTRUCTOR'S GUIDE
Available to schools only, at no charge.

TV MANUFACTURERS' RECEIVER TROUBLE CURES

edited by Milton Snitzer

Gives you specific TV receiver troubles, and the cures specified by the set manufacturer. Listings are by manufacturer, model, and chassis number. Saves you time, helps you earn more!
Soft Cover, 5½ x 8½", illus. Each volume over 115 pp.

VOL. 1: Covers complete details on sets produced by mfrs. (listed in alphabetical order) from Admiral to Dumont.
#143.....Only $1.80

VOL. 2: Covers mfrs. from Emerson to Jackson.
#143-2.....Only $1.80

VOL. 3: Covers mfrs. from Kaye-Halbert to Philco.
#143-3.....Only $1.80

VOL. 4: Covers mfrs. from Philharmonic to Shaw.
#143-4.....Only $1.80

VOL. 5: Covers mfrs. from Sparton to Zenith.
#143-5.....Only $1.80

VOL. 6: All new coverage, through 1954, no duplications . . . Admiral to Firestone.
#143-6.....Only $1.80

VOL. 7: New coverage, from General Electric to Raytheon.
#143-7.....Only $1.80

VOL. 8: New coverage, from RCA to Zenith.
#143-8.....Only $1.80

RADIO

RADIO OPERATOR'S LICENSE Q & A Manual (5th Edition)

by Milton Kaufman

The standard text in schools teaching commercial radio operating. Completely up to date. Questions and answers and **follow-through discussion** on all fundamentals required for all kinds of commercial radio licenses. The follow-through discussion is the key to the success of this book. It supplements the standard answer to a question, and furnishes such explanatory detail as makes answering the FCC multiple choice questions very easy. These follow-through discussions afford a complete understanding of the questions and answers. Abundant illustrations make the technical questions and answers picture-clear. Ideal for the student who desires his commercial "ticket." Also an indispensable reference volume for the licensed operator. Based on government study guide and supplementary FCC releases.
Cloth Bound, 766 pp., 5½ x 8½", illus.
#130.....Only $6.60

ELEMENT VIII—SHIP RADAR TECHNIQUES

Questions, answers, and discussions on radar, taken from the text of the foregoing Radio Operator's License Q & A Manual.
Soft Cover, 32 pp., 5½ x 8½", illus.
#130-A.....Only $ .78

BROADCAST OPERATOR'S HANDBOOK (2nd Edition)

by Harold E. Ennes

Deals with the practical considerations of radio broadcasting and its equipment. Covers operating procedure in control rooms, the master control, remote controls, and the transmitter. Technical data for operators and technicians, including vital preventive maintenance. Intended for students, and veteran operators who wish to keep abreast of current practices in the field.
Cloth Bound, 448 pp., 5½ x 8½", illus.
#138.....Only $5.40

RADIO RECEIVER LABORATORY MANUAL

by Alex W. Levey, B.A., M.S.

A workbook of experiments, designed for students of radio and radio servicing. Covers the construction, analysis, testing, and repair of a radio receiver. Acquaints the student with necessary servicing equipment. There are 33 experiments in all, including 6 demonstration-experiments.
Soft Cover, 110 pp., 8½ x 11½", illus.
#178.....Only $2.00

FM TRANSMISSION & RECEPTION (2nd Edition)

by Rider & Uslan

Covers FM broadcasting of all kinds and explains theory and functioning of FM transmitters and receivers. Also includes TV receivers, with details of maintenance operations on all FM circuits of all kinds of receivers.
Cloth Bound, 460 pp., 5½ x 8½", illus.
#102.....Only $4.95

RIDER CATALOG

R DER BOOKS HE P YOU

KNOW MORE... DO MORE... EARN MORE!

RADIO TROUBLESHOOTING GUIDEBOOK, Vol. 1

by Rider & Johnson

A practical guide to the fundamental principles underlying radio receiver operation. A special section is devoted to trouble diagnosis, the recognition of faults, and their repair. No mathematics is used. The theory section considers each part of the receiver, and the troubleshooting section is organized according to symptoms and parts of the receiver that should be checked to establish the fault. For radio service technicians, students, and experimenters. Written on an elementary level.

Soft Cover, 160 pp., 5½ x 8½", illus.
#149.....Only $2.40

HOW TO INSTALL & SERVICE AUTO RADIOS

by Jack Darr

An expert who does this work daily gives practical, detailed instructions on how to install and service all types of automobile radios. This is not a schematic book. It is a book devoted to answering all of the problems related to auto radio servicing. It is completely practical in every respect. Also shows how to set up an auto radio service shop.

Soft Cover, 128 pp., 5½ x 8½", illus.
#159.....Only $1.80

COLOR TV

INTRODUCTION TO COLOR TV (2nd Edition)

by Kaufman & Thomas

A revised, up-to-date edition of a best seller in books on TV. New edition contains full information on the latest and larger screen picture tubes, simplified receiver circuitry, etc. Most up-to-date introduction to color television available.

Soft Cover, 160 pp., 5½ x 8½", illus.
#156.....Only $2.70

COLOR TELEVISION RECEIVER PRACTICES

by Hazeltine Corp. Lab. Staff

Prepared by experts, this book covers every major aspect of color TV receivers, including the latest 21" picture tube and its required circuitry. For anyone who wishes a solid grounding in color television, this volume is ideal. Destined to become a standard reference work on the subject.

Soft Cover, 208 pp., 5½ x 8½", illus.
#162.....Only $4.50
#162-H, Cloth Bound.....Only $6.00

HIGHLIGHTS OF COLOR TELEVISION

by John R. Locke, Jr.

A "quickie" text on color television receiver principles for those who are familiar with black-and-white receivers.

Soft Cover, 48 pp., 5½ x 8½", illus.
#157.....Only $ .99

COLOR TV DICTIONARY

by J. Richard Johnson

First complete explanation of color television terms with definitions that everyone (service technicians, students, and engineers interested in color television) must be familiar with. More than 50 illustrations.

Soft Cover, 72 pp., 5½ x 8½", illus.
#164.....Only $1.25

HI-FI, SOUND

HI-FI LOUDSPEAKERS & ENCLOSURES

by Abraham B. Cohen

A long-needed book, destined to become a classic volume in hi-fi literature. Completely covers the subject. Answers all your questions about loudspeakers and enclosures, design, cross-over networks, construction of own networks, etc.

Leather Finish MARCO Cover, 5½ x 8½", illus.
#176.....Only $4.60
#176-H, Cloth Bound.....Only $5.50

GUIDE TO AUDIO REPRODUCTION

by David Fidelman

Treats the design, construction, assembly, and testing of sound reproduction systems and components. Discusses pickup devices, preamplifiers, amplifiers, A-F networks, loudspeakers, and enclosures. It also deals with magnetic recording and the measurement of quality in audio reproducing systems. Written for the audio enthusiast with technical background, the sound man, the technician, and electronics experimenters.

Soft Cover, 240 pp., 5½ x 8½", illus.
#148.....Only $3.50

HOW TO SELECT AND USE YOUR TAPE RECORDER

by David Mark

Written for the USER: music lovers, businessmen, lawyers, engineers, teachers, etc. Step-by-step instructions on set-up and using procedures for all applications in the home, office, and professional activities. Also a Buyer's Guide in selecting a machine to suit individual requirements.

Soft Cover, 148 pp., 5½ x 8½", illus.
#179.....Only $2.95

HOW TO SERVICE TAPE RECORDERS

by C. A. Tuthill

Tells you what you need to know about the tape recorder and its operation. Explains the types of circuits, drive mechanisms, troubleshooting, and repair.

Soft Cover, 160 pp., 5½ x 8½", illus.
#167.....Only $2.90

HIGH FIDELITY SIMPLIFIED

by Harold D. Weiler

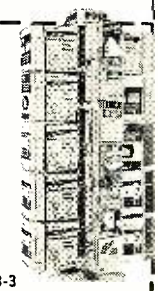
Gives you the complete hi-fi story, and answers all questions about tuners, changers, amplifiers, tape recorders, speakers, record players, etc. There is no other book like it!

Soft Cover, 224 pp., 5½ x 8½", illus.
#142.....Only $2.50

RIDER'S SPECIALIZED TAPE RECORDER MANUAL, Vol. 1

A fact-filled, 288 page manual devoted to servicing information on tape recorders manufactured by the 12 most prominent producers from 1950 through 1954. Covers operation, adjustments, trouble diagnosis, and repair of 88 different models. Contains schematics, voltage data, tube complement and layout, exploded views and mechanical assemblies, troubleshooting charts, and electrical and mechanical parts lists. The manufacturers included are: Bell & Howell, Brush, Crescent, Daystrom, Eicor, Pentron, RCA, Revere, V-M, Webster-Chicago, Webster Electric, Wilcox-Gay.

Soft Cover, 288 pp., 8½ x 11", illus.
#6001.....Only $4.50



Buy these books at your electronics parts jobber, book store, or department store book department. Look for this Rider Book Seller. If your jobber, book store, or department store does not sell the Rider books you want, mail this coupon for prompt delivery. *ORDER TODAY!* Add state and city sales tax where applicable. Canadian prices approximately 5% higher.

JOHN F. RIDER PUBLISHER, INC.
480 Canal Street, New York 13, N. Y.

Enclosed is $_____ Please rush the books I have circled.

101	137	143-2	146	155-4	162	166-5	166-16	169	173-3	
101-H	138	143-3	147	155-5	162-H	166-6	167	169-H	173-4	180-H
102	139	143-4	148	156	163	166-7	168	170	173-5	183
103	139-2	143-5	149	157	164	166-8	168-2	170-H	174	184
128	140	143-6	150	158	165	166-9	168-3	171	176	185
130	140-2	143-7	152	159	166	166-10	168-4	171-H	176-H	6001
130-A	141	143-8	155	160	166-2	166-11	168-5	172	178	
133	142	144	155-2	161	166-3	166-12	168-6	173	179	
135	143	145	155-3	161-2	166-4	166-15	168-7	173-2	180	

Name _____

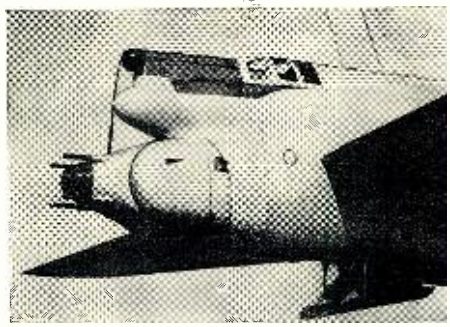
Address _____

City _____ Zone _____ State _____

RN-10

Electronic Brain Controls Airborne Guns

Defensive system of B-52 intercontinental H-bomb carrier employs computer.



Complete defensive system being installed in tail of B-52 jet bomber above. Photo at left shows completed installation. The top "blister" houses a portion of the optical gunsight, while the tracking radar antenna is housed within the lower "blister." The automatically controlled turret with its 4 50-caliber machine guns is also seen.

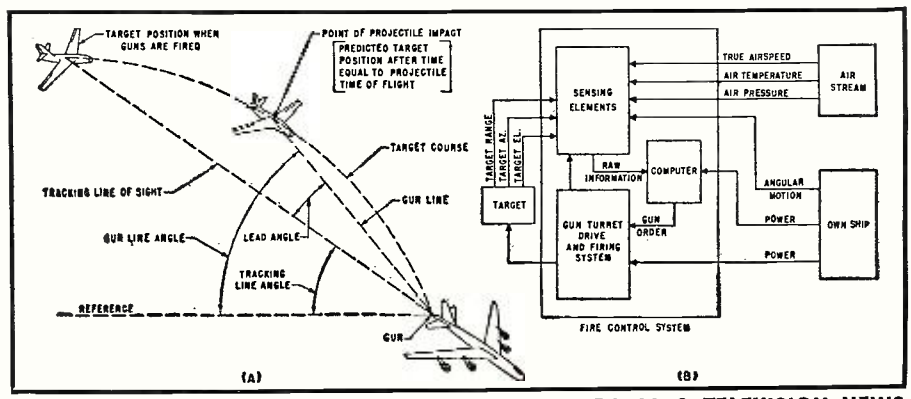
THE eagle-eyed aerial gunner, often called the fightingest sharpshooting man aboard our bombers aloft, has been given an electronic brain. Now, the era of expecting gunners, by themselves and unassisted by modern systems science, to lead and track and shoot down an attacking fighter is ancient history. The gunner in today's Air Force is a man trained to monitor an electronic system, which increases his effectiveness. In either the "optical mode" of operation, employing a greatly advanced optical gunsight, or in the fully automatic "radar mode" the system, designed and manufactured by *Arma,* will out-think an enemy jet pilot and out-shoot an attacking fighter flashing in for the kill at speeds faster than sound.

From the time the system sights a target, which is before the human eye can see it, and is "locked" on to it, until the time the guns are aimed for the kill—no more than three seconds elapse. During this brief time, full information as to distance and direction and speed of the target is gathered the fire control problem is set up and solved, the guns are trained with proper lead to have the projectiles where the target will be when the projectiles get there and, in addition; the gunner is signalled to squeeze his handgrip. The system knows not only where the attacking fighter is every instant, but also where it is going to be the next few instants. It "knows" all this in a fraction of the time required for the simplest sort of human computation. The automatic turrets relentlessly follow every move of the "bandit."

Range, range rate, angular positions, own speed, enemy's speed, air temperature, altitude, roll and pitch of own ship, trajectory characteristics—all these and many other factors are involved and all are continuously changing faster than a human brain can sense.

The system continually searches the sky for an attacking enemy under all conditions of visibility—under glaring sunlight, darkness, fog, or clouds. —30—

(A) Basic fire control problem which is set up and solved by computer in defensive weapons system. (B) Basic information flow diagram showing raw information fed into computer, which then issues a gun order that operates on the turret to aim the guns.



Sun	Mon	Tue	Wed	Thu	Fri	Sat
					4	5
						12
						19
						26

CALENDAR of EVENTS

OCTOBER 9-10

Conference on Computer Applications. Sponsored by Armour Research Foundation. Information on meeting available from Joseph J. Kowal, Conference Secretary, Armour Research Foundation, 10 West 35th Street, Chicago 16, Illinois.

OCTOBER 11-12

National Noise Abatement Symposium, Sherman Hotel, Chicago, Illinois. Sponsored by Armour Research Foundation. Write Joseph J. Kowal, Conference Secretary, Armour Research Foundation, 10 West 35th Street, Chicago 16, Illinois, for details on meeting.

OCTOBER 11-12

URSI Fall Meeting, University of California, Berkeley. Further information and details on program are available from John P. Hagen, Secretary, USA National Committee, URSI, Washington 25, D. C.

OCTOBER 12, 13, 14

High Fidelity Music Show, Hotel McAllister, Miami, Florida. Sponsored by Rigo Enterprises, Inc.

OCTOBER 15-17

Radio Fall Meeting. Sponsored by the Institute of Radio Engineers and the Radio-Electronics-Television Manufacturers Association. Hotel Syracuse, Syracuse, New York. Details from Mr. V. Graham, RETMA, 11 West 42nd Street, New York 26, New York.

OCTOBER 25, 26, 27

High Fidelity Music Show, Hotel Adolphus, Dallas, Texas. Sponsored by Rigo Enterprises, Inc.

NOVEMBER 14, 15, 16

Symposium on Optics and Microwaves. Sponsored by Institute of Radio Engineers, George Washington University, and The Optical Society of America. Lisner Auditorium, George Washington University, Washington, D. C.

HAMFESTS

OCTOBER 6

Syracuse V.H.F. Club Second Annual V.H.F. Round-up, Martin's Restaurant, Liverpool, New York. Preregistration is required. Tickets are $3.75 each. They are available from James V. O'Hern, W2WZR, 103 W. Roswell Avenue, Nedrow, New York. XL's and XYL's cordially invited.

READ ABOUT A GREAT NEW MAGAZINE

BY THE PUBLISHER OF RADIO & TELEVISION NEWS

SEE PAGE 181

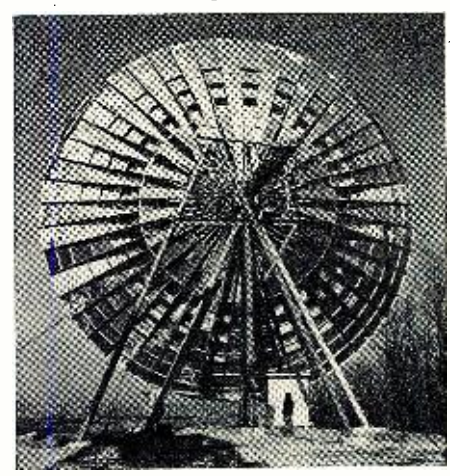
Giant Paraboloid for Scatter Studies

Tests completed on 60-foot precision microwave antenna designed for scatter signals.

ALTHOUGH most present microwave communications systems utilize "line of sight" transmission paths, studies during the past few years have shown that useful amounts of microwave energy can be transmitted around the earth's curved surface beyond the horizon. The mechanism which makes this possible is not fully understood, but scattering by atmospheric irregularities appears to play an important role. To study the characteristics of this "scatter propagation," *Bell Telephone Laboratories* engineers have designed and built one of the world's largest precision microwave antennas at Holmdel, New Jersey. Built of aluminum, the solid surface of this research tool is a paraboloid accurate to about 3/16 of an inch. The paraboloid alone weighs 5½ tons and it, together with its supporting and steering structure, is designed to withstand 100 mile-per-hour winds.

The antenna is intended for use at frequencies of 460 to 4000 mc., but was also tested at 9400 mc. Using calibrated pyramidal horns as standards, the gain was found to be 37 db at 460 mc., 55 db at 3890 mc., and 61 db at 9400 mc. Half-power beam widths at these frequencies were 2.45°, 0.3°, and 0.14° respectively, very close to the computed values. Over-all performance, not only in gain and beam width but also in cleanness of the radiation patterns and in minor lobe structure, was excellent even at the highest frequency. —30—

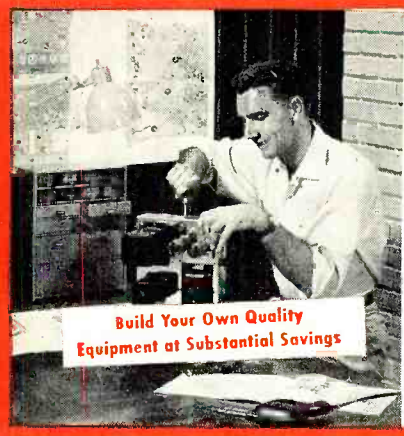
Rear view of 60-foot experimental antenna at Holmdel, New Jersey site of the Bell Telephone Laboratories.



you get the most for your money in

ALLIED'S own knight-kits

THE FINEST ELECTRONIC EQUIPMENT IN MONEY-SAVING KIT FORM



Buy With Confidence From the Pioneers in Electronic Kits

LOWEST COST—our huge buying power means biggest savings for you. You do the easy assembly and your finished instrument is equal in performance and appearance to equipment selling for several times the remarkably low KNIGHT-KIT price.

ADVANCED DESIGN—months of research, development and field-testing go into each KNIGHT-KIT to bring you the latest advances in quality design. And to assure top performance, premium quality parts are supplied in each kit.

EASIEST TO ASSEMBLE—all chassis and panels are punched; all parts are clearly identified—resistors are mounted on cards and values are shown. Instruction manuals are a marvel of clarity, featuring "Step-and-Chek" assembly, "King-Size" diagrams and "Spotlight" pictorials. All you need are soldering iron, pliers and screwdriver.

ALLIED stakes its 36-year reputation in the Electronics field on your complete success and fullest satisfaction with KNIGHT-KITS.

TEST EQUIPMENT • HAM GEAR • HOBBYIST KITS • HI-FI KITS

LATEST PRINTED CIRCUIT

Model F-146

NEW knight-kit LOW COST GENERAL-PURPOSE 5" OSCILLOSCOPE KIT

$49.50

Outstanding value in an all-new, highly versatile 5" oscilloscope kit. Perfect for visual display of all commonly encountered waveforms. Excellent for AM, FM and TV servicing, plus other high-frequency applications. An easy-to-build, easy-to-use, dependable performer that matches or beats commercially wired 'scopes selling at several times more. Up-to-the-minute kit design features printed circuit, laced wiring harness, and pre-cut wires for quick and easy assembly. Has 4 sweep ranges, 15-150,000 cps. High vertical sensitivity: 25 rms millivolts/inch; input impedance, 3.3 megs and 45 mmf; response down only 3 db at 700 kc. Horizontal sensitivity, 70 rms mv/inch; response, down only 3 db at 200 kc; input impedance, 2.2 megs and 30 mmf. Deluxe features include DC positioning controls for fast trace positioning; blanking circuit on all ranges to eliminate retrace lines; graph scope screen and internal, regulated calibrating voltage for highly accurate signal measurements; frequency-compensated vertical attenuator; provision for internal or external, positive or negative synchronization; Phantastron linear sweep generator; high 2nd anode voltage for high-intensity trace. Kit is complete with 5" CRT and all tubes—ready for assembly. Blue steel case with "disappearing" handle. Handsome panel in contrasting gray. Size, 14½ x 9½ x 16" deep. Shpg. wt., 40 lbs.

Model F-146. Complete 5" Oscilloscope Kit. Net only **$49.50**
F-148. RF Demodulator Probe Kit. Net only $3.45
F-147. Low-Capacity Probe Kit $3.45

Model F-123

NEW knight-kit TV-FM SWEEP GENERATOR KIT

$44.75

Guaranteed Linearity • Fool-proof Calibration
Wide-Range Coverage • Electronic Blanking

All-new; precision-designed for lab use, TV and FM servicing, production line testing. Covers 300 kc to 250 mc continuous on 4 bands (all fundamentals). Center frequencies of VHF TV channels appear on scales. Exclusive KNIGHT-KIT sweep circuit assures almost perfect linearity—RF sweep output in excess of 0.15 volts, *flat within 1 db*, is available on all bands. Sweep width continuously variable, 0-13 mc. Crystal-controlled marker oscillator with dual crystal socket and selector switch. Phase control provides blanking shift, 0 to 180°. Step-type and continuous output controls; separate marker amplitude control. Filter connected to 0-50 mc output jack provides 20 db attenuation of frequencies above 50 mc. to assure pure, fundamental output. 5-volt horizontal sweep voltage (for scope) available from front panel. Professional-looking blue-finish steel case with gray panel. Has "disappearing" handle. 8½ x 12 x 7½". With all parts, tubes, test cable, solder and multi-color pre-cut wire. Less crystal. Shpg. wt., 13½ lbs.

Model F-123. TV-FM Sweep Generator Kit. Net only **$44.75**
P-286. 4.5 mc Crystal (.005%). Net $4.80
P-143. 5.0 mc Crystal (.02%). Net $3.95
P-145. 10.7 mc Crystal (.02%). Net $3.95

EASY PAYMENT TERMS

If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan—only 10% down. Write for application form.

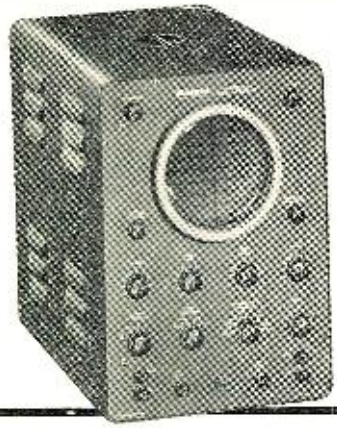
ALL PRICES NET F.O.B. CHICAGO

order from **ALLIED RADIO**

100 N. WESTERN AVE., CHICAGO 80, ILLINOIS

SEE FOLLOWING PAGES

ALLIED'S own knight-kits... better by far



knight-kit 5" ALL-PURPOSE WIDE-BAND OSCILLOSCOPE KIT

2 Printed Circuit Boards • 5 Mc Width for Color TV

Model F-144

$69.00

Wide-band, 5" Oscilloscope; equals or betters the performance of commercially-wired 'scopes costing several times the price. Two printed circuit boards and laced wiring harness assure wiring accuracy and reduce assembly time. Ideal for lab use, color TV servicing and high frequency applications. Provides unusually wide sweep range—*from 15 to 600,000 cps.* Locks in at frequencies as high as 9 mc. Vertical response, 5 cycles to 5 mc. Response, down only 1 db at 3.58 mc color burst frequency; down only 3 db at 5 mc. High vertical sensitivity of 25 mv/inch. Input capacity 20 mmf and 3.5 megs. Outstanding features: cathode-follower vertical and horizontal inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull vertical and horizontal amplifiers; positive and negative locking; faithful square wave response; frequency-compensated attenuator; Z-axis input for intensity modulation; one volt P-P calibrating voltage; astigmatism control; blanking circuit to eliminate retrace lines; DC positioning control. Complete with CRT, all tubes and parts. Handsome, professional, blue-finished steel case with "disappearing" handles. 14½ x 9½ x 16". Shpg. wt., 40 lbs.

Model F-144. Wide-Band 5" Oscilloscope Kit. Net only **$69.00**

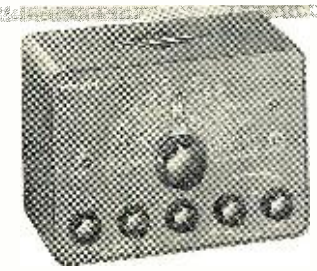
F-148. Demodulator Probe. Net . . **$3.45.** **F-147.** Low Capacity Probe. 12 mmf. Net **$3.45**

NEW knight-kit VOLTAGE CALIBRATOR KIT

Model F-136 **$12.75**

Permits the use of any scope as a precision peak-to-peak AC voltmeter. Provides a true square-wave voltage on scope screen. Range switch and calibrated potentiometer permit selecting any voltage between .01 and 100 volts, in 4 ranges. Fifth position of switch feeds external signal to scope for comparison. Constant output on line volt. variation from 80-135 v. ±6% on all ranges. Shunt capacitance only 15 mmf. Use any 20,000 ohms/volt VOM or a VTVM for initial calibration. Direct coupling of output provides ground reference for DC scopes. Portable case, 7¾ x 5¼ x 4⅜". Ready to build. Shpg. wt., 5 lbs.

Model F-136. Voltage Calibrator Kit. Net **$12.75**

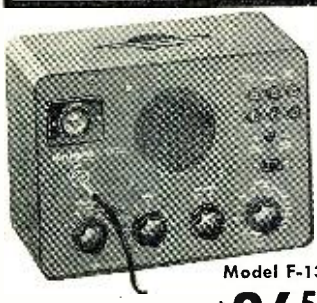


knight-kit LOW COST RF SIGNAL GENERATOR KIT

Model F-145 **$19.75**

Build this wide-range extremely stable RF signal generator and save two-thirds the cost of a comparable wired instrument. Ideal for alignment of RF and IF stages in radio and TV sets, and for trouble-shooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 110 mc; useful harmonics to 220 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit with precision-wound coils—no calibration necessary. Has input for external modulator. Maximum audio output, 10 volts. RF output, over 100,000 micro-volts. Step and continuous-type output attenuators. With all parts, tubes, wire and solder. Portable case, 7 x 10 x 5". Shpg. wt., 10 lbs.

Model F-145. RF Signal Generator Kit. Net only **$19.75**

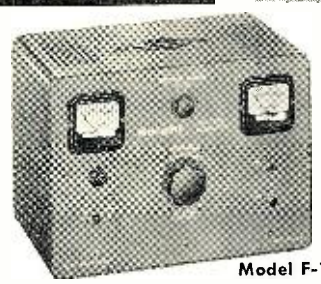


Model F-135 **$26.50**

knight-kit VISUAL-AURAL SIGNAL TRACER KIT

A remarkable value in an instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits—*has highest gain in its price class.* Traces the signal from the antenna to the speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of 91,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; single probe with plug-in head gives instant choice of RF or audio tracing. Provides noise test; built-in watt meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Blue-finish steel case. Shpg. wt., 13 lbs.

Model F-135. Signal Tracer Kit. Net only **$26.50**

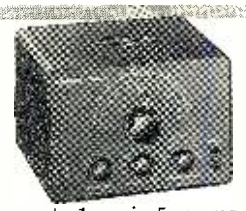


Model F-129 **$37.95**

NEW knight-kit 6-12 VOLT BATTERY ELIMINATOR KIT

A valuable new unit for servicing auto radios, mobile gear, etc. Delivers continuously variable filtered DC output from 0 to 15 volts. Provides DC output at 0-8 volts or 0-15 volts. Continuous current rating: 12.5 amps at 6 volts, 10 amps at 12 volts. Can also be used as battery charger. Oversize rectifiers and transformer for better regulation and long life. Two meters provide simultaneous current and voltage readings; ranges: 0-15 volts DC: 0-20 amps DC. Doubly protected: fused primary and automatic-reset overload relay for secondary. Heavy-duty binding posts. Blue-finish steel case with "disappearing" handle. With all parts, solder and pre-cut wire. 9 x 12⅛ x 7¾". Shpg. wt., 20 lbs.

Model F-129. Power Supply Kit. Net only **$37.95**



knight-kit AUDIO GENERATOR KIT

Model F-137 **$37.50**

An ideal audio frequency source for checking audio circuits and speaker response. Covers: 20 cps to 1 mc in 5 ranges. Output voltage: 10 volts into 600 ohms impedance. *Offers the flat response of a lab standard*—±1 db to 1 meg. Generator imp., 600 ohms. Less than .25% distortion from 100 cps through the audible range; less than .5% when driving 600 ohm load at maximum output. Cont. var. step-attenuated output. 17 lbs.

Model F-137. Audio Generator Kit. Net only **$37.50**

knight-kit RESISTANCE SUBSTITUTION BOX KIT

Model F-139 **$5.95**

Simplifies determination of resistor values needed in a circuit. 36 standard 1 watt resistance values between 15 ohms and 10 megohms with an accuracy of 10%. 18-position switch; also slide switch for multiplying values by 1000. Extra switch wafer serves as tie points, eliminating buss bar. 5 x 3 x 2". Complete with test leads and clips. 2 lbs.

Model F-139. Resis. Sub. Box Kit. Net . **$5.95**

knight-kit CAPACITANCE SUBSTITUTION BOX KIT

Model F-138 **$5.95**

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard capacitor values from .0001 mfd. to .22 mfd., ±20%. Values are 600 volts, except .15 and .22 which are 400 volt. 18-position switch selects all values quickly and easily. In bakelite case, 5 x 3 x 2". Complete with all parts, test leads and clips. 2 lbs.

Model F-138. Cap. Sub. Box Kit. Net . . **$5.95**

QUALITY ELECTRONIC TEST EQUIPMENT IN MONEY-SAVING KIT FORM

...easiest to build...you get more...YOU SAVE MORE

4½" Meter

Model F-128 **$16.95**

knight-kit 1000 OHMS/VOLT VOM KIT

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4½" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, —20 to +69 in 6 ranges. *Uses 1% precision resistors.* 3-position function switch and 12-position range switch. Complete kit with bakelite case, (6¾ x 5¼ x 3¾"), battery, pre-cut wire, solder and test leads. Shpg. wt., 2½ lbs.

Model F-128. 1,000 ohms/volt VOM Kit. Net only. **$16.95**

Model F-140 **$29.50**

knight-kit 20,000 OHMS/VOLT VOM KIT

Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½" meter; accuracy ±2% of full scale; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust" Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-.1-10-100; DC amps, 0-1-10; Decibels, —30 to +63 in 6 ranges. Uses precision 1% multipliers. Moisture-resistant film-type resistors. Complete kit with bakelite case (6¾ x 5¼ x 3¾"), batteries, pre-cut wire, solder and test leads. Shpg. wt., 5 lbs.

Model F-140. 20,000 ohms/volt VOM Kit. Net only. **$29.50**

knight-kit VTVM KIT with Printed Circuit Board

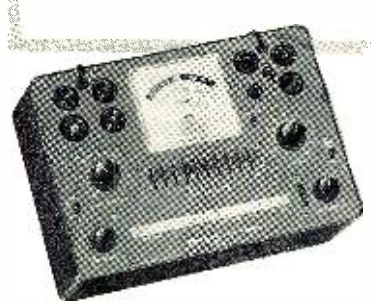
Model F-125 **$24.95**

An extremely stable, and highly accurate VTVM. Greatly simplified wiring—entire chassis is a printed circuit board. Maximum convenience in arrangement of scales; 3X AC and DC scale design permits utilization of best portion of each scale for most accurate readings. Also measures peak-to-peak for FM and TV work. Ranges: AC P-P volts, 0-4-14-40-140-400-1400-4000; AC rms volts and DC volts, 0-1.5-5-15-50-150-500-1500; resistance, 0-1000-10K-100K ohms and 0-1-10-100-1000 megohms; db scale, —10 to +5. AC response, 30 cycles to 3 mc. Low-leakage switches and 1% precision resistors. Balanced-bridge circuit. 4½" meter, 200 microamp movement. Polarity reversing switch. Input res., 11 megs. Shpg. wt., 6 lbs.

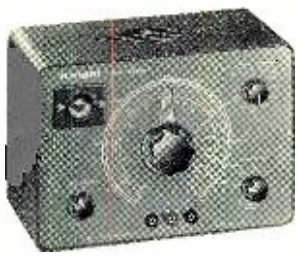
Model F-125 Printed Circuit VTVM Kit. Net only. . **$24.95**

F-126. Hi-Voltage Probe; extends DC to 50,000 Volts **$4.75**

F-127. Hi-Frequency Probe; extends AC to 250 mc. . **$3.45**



PORTABLE MODEL



knight-kit RESISTOR-CAPACITOR TESTER KIT

Model F-124 **$19.50**

Measures capacitance and resistance by accurate bridge method; checks for opens and shorts in paper, mica and ceramic capacitors; shows power factor of electrolytics. Large dial shows capacitance and resistance at a glance; balanced-bridge circuit with "magic eye" null indicator measures power factor from 0-50%. Tests capacitors with rated voltages applied. 5 test voltages: 50, 150, 250, 350, 450. Capacity ranges: 10 mmf to 1000 mfd in 5 ranges. Resistance ranges: 100 to 50,000 ohms and 10,000 ohms to 5 megs. Accuracy, ±10%. Automatic discharge feature prevents after-test shock. Blue-finished steel case, 5 x 3 x 2". With tubes and all parts. Shpg. wt., 8 lbs.

Model F-124. Resistor-Capacitor Tester Kit. Net only. **$19.50**

Model F-143 **$29.75**

knight-kit LOW-COST TUBE TESTER KIT

Offers high accuracy, top versatility and convenience at lowest cost. Tests 4, 5, 6 and 7-pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. *Features test for new 600 ma series string tubes.* Tests for open, short, leakage, heater continuity and quality (by amount of cathode emission). 4½" square meter with clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 14 filament voltages from .63 to 117 volts. Blank socket for future type tubes. Universal-type selector switches for any combination of pin connections. *Single-unit, 10-lever function switch.* Entire switch assembly is installed as a single unit—saves time and greatly simplifies construction. Illuminated roll chart lists over 600 tube types. Shpg. wt., 14 lbs.

Model F-143. Counter Model Tube Tester Kit. Net only. . . **$29.75**

Model F-142. Portable Model Tube Tester Kit. Net only. . . . **$34.75**

F-141. TV Picture Tube Adapter for above. Net only. **$3.75**

NEW knight-kit TRANSISTOR & DIODE CHECKER KIT

Model F-149 **$8.50**

Checks leakage-to-gain ratio and noise level of all junction, point contact and barrier transistors. Also checks diodes, forward and reverse current conduction of selenium rectifiers; useful for continuity and short checks. Easy-to-read meter. Features: spring-return leakage gain switch; calibration control; separate sockets for PNP and NPN transistors. Headphones or signal tracer may be used with checker for noise measurements. Case, 5 x 3 x 2". With 22½ volt battery. 2½ lbs.

Model F-149. Transistor Checker Kit. Net. **$8.50**

Model F-119 **$12.50**

knight-kit LOW-COST "IN-CIRCUIT" CAPACITOR CHECKER KIT

Tests capacitors while they are still wired in the circuit! Saves time and bother; an essential instrument for the service technician. Just press a button and the "magic eye" instantly shows opens and shorts (not leakage). Tests opens and shorts on any capacitor of 20 mmf or greater capacity, even if it is in parallel with a resistance as low as 50 ohms. Tests for shorts may be made on any capacitor even when it is shunted by as low as 20 ohms. Blue-finish steel case, 7¾ x 5¼ x 5". With tubes, all parts, wire and solder. Easy to assemble. Shpg. wt., 5 lbs.

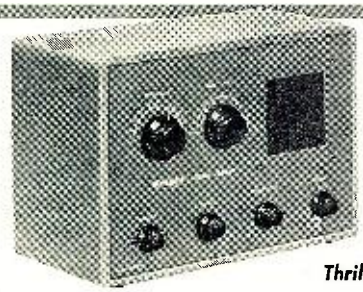
Model F-119. Cap.-Checker Kit. . . . **$12.50**

EASY PAYMENT TERMS: If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan —only 10% down. Write for application blank.

ALL PRICES NET F.O.B. CHICAGO

ALLIED'S own MONEY-SAVING knight-kits

FAMOUS knight-kits FOR HOBBYISTS & EXPERIMENTERS...FASCINATING, INSTRUCTIVE...



knight-kit
"SPACE SPANNER" BAND SWITCHING RECEIVER KIT

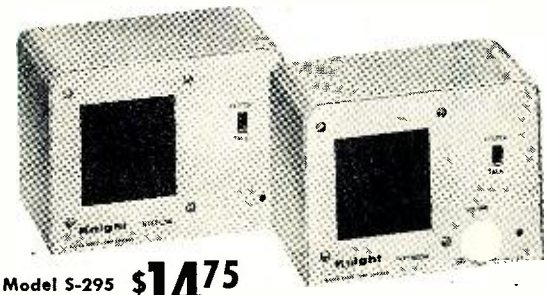
Model S-243 **$15.95**

Thrilling Short Wave and Broadcast

Famous 2-band AC-DC receiver in easy-to-build kit form at a very low price. Pulls in thrilling short-wave (6 to 17 mc) and standard broadcast. It's fun listening to amateur, aircraft, police and marine radio. Features highly sensitive regenerative circuit. Bandswitch selects broadcast or short wave. Has 4" PM speaker and beam-power output tube for plenty of volume; headphone connectors for weak signal listening; slide switch cuts out speaker. Uses 12AT7 regenerative detector and audio amplifier, 50C5 power output, 35W4 rectifier. Six controls: Bandspread; Main Tuning; Antenna Trimmer; Bandswitch; Regeneration; Audio Gain. Includes tubes and all parts. 7 x 10½ x 6". Shpg. wt. 4½ lbs.

Model S-243. "Space Spanner" Receiver Kit. Net only..... **$15.95**

S-247. Matching Cabinet for above. 2 lbs. Net..... **$2.90**

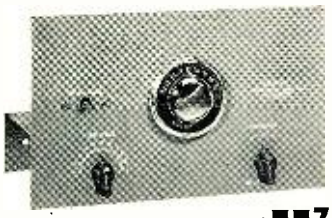


Model S-295 **$14.75**

NEW knight-kit TWO-WAY INTERCOM KIT

New low-cost, easy to build intercom system kit. Ideal for use in home or office. Consists of Master unit and Remote unit, each with press-to-talk switch. Remote unit may be left "open" for answering calls from a distance, for "baby-sitting", etc. Remote may also be connected for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier; each unit has 4" PM dynamic speaker. Complete with Antique White cabinets (4¾ x 6½ x 4⅜"), all parts, tubes and 50 feet of cable (up to 200 feet of cable can be added). For AC or DC. Shpg. wt., 7 lbs.

Model S-295. Two-Way Intercom Kit. Net only.. **$14.75**



Model S-740 **$11.75**

knight-kit
"OCEAN HOPPER" RECEIVER KIT

Tops for exciting broadcast, long wave and short wave reception. Highly sensitive regenerative-type circuit. Excellent headphone reception; can be used with 3-4 ohm PM speaker on strong broadcast band stations. Supplied with plug-in coil for standard broadcast; covers long wave and popular short wave bands with coils below. Pulls in thrilling foreign broadcasts, police, amateurs and aircraft. Controls: Main Tuning, Bandspread, Antenna Tuning. Off-On-Regeneration. With all parts and tubes (less extra coils and headset). AC or DC. Shpg. wt., 5 lbs.

Model S-740. "Ocean Hopper" Kit..... **$11.75**

EXTRA PLUG-IN COILS

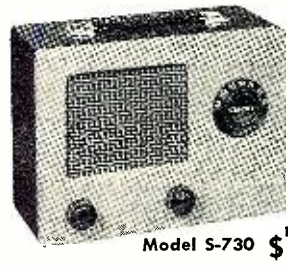
S-741. Long Wave, 155-470 kc. Net..... 79¢
S-742. Short Wave, 1.65-470 kc.
S-743. Short Wave, 2.9-7.3 mc. } Net
S-745. Short Wave, 7-17.5 mc. } each..... 65¢
S-744. Short Wave, 15.5-35 mc.

Model S-735 **$17.25**

knight-kit
"RANGER II" SUPERHET RADIO KIT

Thousands have built and enjoyed the "Ranger" Broadcast Band Receiver. Carefully engineered for easy construction and powerful, sensitive performance. Latest Superhet circuit; tunes 540 to 1680 kc; covers entire broadcast band and exciting police calls. Features automatic volume control, built-in preformed loop antenna, ball-bearing tuning condenser. Develops excellent tone quality from Alnico V PM dynamic speaker. Supplied with following tubes: 12SA7GT converter; 12SK7GT IF amp.; 12SQ7GT det.-AVC-audio; 50L6GT audio output; 35Z5GT rect. Complete with handsome brown plastic cabinet (6 x 9 x 5) tubes, speaker, all parts, and instruction manual. AC or DC operation. Shpg. wt., 8 lbs.

Model S-735. "Ranger II" Superhet Radio Kit. Net only..... **$17.25**



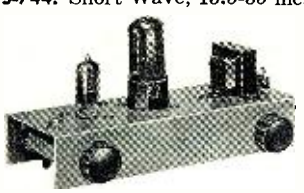
Model S-730 **$19.95**

knight-kit
3-WAY PORTABLE RADIO KIT

A low-cost portable radio covering the full standard broadcast band from 535 kc to 1650 kc. Delivers excellent reception on AC or DC current or from self-contained batteries. Sensitive Superhet circuit features automatic volume control, economical operation. Includes powerful 5" Alnico PM dynamic speaker, efficient ferrite loop-stick antenna. Supplied with following tubes: 1R5 converter; 1U4 IF amplifier; 1U5 detector-AVC-audio; 3V4 audio output. Complete with attractive portable case (7⅝ x 10 x 5¼"), tubes, speaker, all parts and instruction manual. Shpg. wt., 6 lbs.

Model S-730. 3-Way Portable Radio Kit (less batteries). Net. **$19.95**

J-651. Battery Kit for above..... **$2.50**



Model S-790 **$8.95**

knight-kit LOW COST PHONO AMPLIFIER KIT

It's easy to build this fine-performing, low-cost compact phono amplifier. Ideal for use in a portable phonograph—simply add any record player and a 3 to 4-ohm speaker. Amplifier works with crystal or ceramic cartridges. Inverse feedback circuit for rich, clean tone quality. Delivers full 1½-watt output with less than .25 volt input. Includes efficient tone control; has AC outlet, controlled from amplifier switch. Complete with tubes and all parts. Size only 4½ x 7 x 4"—fits into almost any portable phono case. Shpg. wt., 3 lbs.

Model S-790. Phono Amplifier Kit. Net only..... **$8.95**

FAMOUS knight-kit CRYSTAL SET KIT

Model S-261 **$2.15**

Thousands of beginners have started in radio and electronics by building the KNIGHT-KIT crystal set. This feature-packed set delivers loud, clear reception of local broadcast stations. A germanium crystal diode detector assures high sensitivity and simple operation—no crystal adjustment required. "Hi-Q" coil boosts sensitivity. Ball-bearing variable capacitor for easy tuning. With all parts and simple-to-follow instructions. Shpg. wt., 1 lb.

Model S-261. Crystal Set Kit. Net only..... **$2.15**

S-267. Accessory Kit. 2000-ohm headphones and all parts for outdoor antenna..... **$2.95**

Buy with confidence from ALLIED—America's Pioneer in Electronic Kits

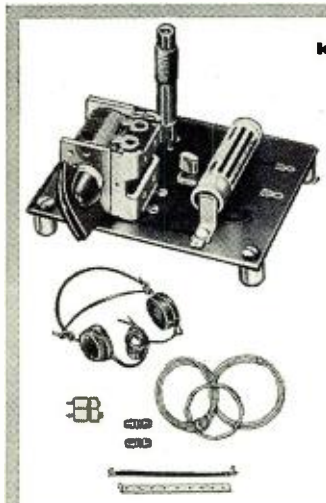
finest quality electronic equipment in lowest-cost kit form

EASY-TO-BUILD HIGH PERFORMANCE KITS • WIDELY USED BY MANY LEADING TRAINING SCHOOLS

NEW knight-kit ELECTRONIC PHOTOFLASH KIT

Model S-244 **$28.50** New feature-packed photoflash kit—designed for top quality dependability—available at a money-saving low price. Ideal for black and white or color photography. Xenon-filled reflector-bulb assembly gives over 10,000 flashes at less than ½¢ each! 1/700-second flash freezes the fastest action. Has 50 watt-second output. Provides light approximating daylight in spectral quality; permits the use of outdoor-type film indoors. Film guide number for color (ASA10) is 45. Designed for "X" or "O" shutters only. Requires sync cable (available from any photo supply dealer) and either battery or AC supply listed below. Complete outfit with battery weighs only 3½ lbs. Kit includes all parts, carrying case and easy-to-follow instructions. Shpg. wt., 3 lbs.

Model S-244. Electronic Photoflash Kit. Net.... **$28.50**
S-246. AC Power Supply Kit. Easy to assemble.... **$3.75**
J-626. Battery for above (Burgess U-200)..... **$8.47**



knight-kit TRANSISTOR RADIO KIT

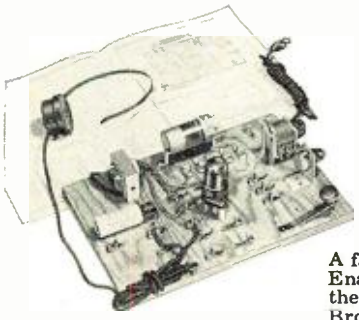
Printed Wiring • Works from Penlight Cell

Model S-765 **$4.35** **Smooth Variable Capacitor Tuning**

Experiment with the marvel of transistors! Printed circuit requires no wiring—just assemble with a few solder connections and enjoy excellent reception over the full AM broadcast band. No tubes to burn out—no crystal. Compact—fits in the palm of your hand—operates for months from a single penlight cell. Transistor provides plenty of power for strong headphone reception. Complete with all parts, transistor and penlight cell. Shpg. wt., 8 oz.

Model S-765. Transistor Radio Kit **$4.35**
S-266. Accessory Kit. 4000-ohm headphones and all parts for outdoor antenna..... **$3.15**

FAMOUS knight-kit LAB KITS



6-IN-1 RADIO LAB KIT

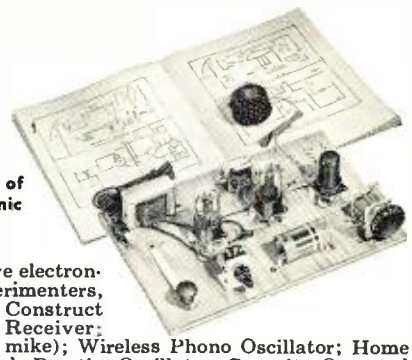
Model S-770 **$7.95** **Build Any of 6 Electronic Projects**

A fascinating and instructive kit. Enables you to build any one of the following projects: Standard Broadcast Receiver; Wireless "Home Broadcaster"; Code Practice Oscillator; Code Practice Broadcaster; Signal Tracer; Sine Wave Generator. Perfect for beginners. Once basic wiring is completed, circuits may be changed without soldering. Safe to build and operate; only tools needed are screwdriver, pliers and soldering iron. The ideal kit for students and beginners in electronics. Kit includes mounting board, tube, all parts and easy-to-follow instruction manual. Less headphone (also serves as mike). Shpg. wt., 6 lbs.

Model S-770. "6-in-1" Lab Kit. Net only..... **$7.95**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna kit for above..... **$1.05**

10-IN-1 LAB KIT

Model S-265 **$12.65** **Build Any of 10 Electronic Projects**



A wonderfully instructive electronics kit. Ideal for experimenters, beginners—fun to build. Construct a sensitive Broadcast Receiver; Amplifier (for phono or mike); Wireless Phono Oscillator; Home "Broadcast Station"; Code Practice Oscillator; Capacity-Operated Relay, or any one of *four* other fascinating projects. Low voltages; safe to build and operate. Only tools needed are soldering iron, screwdriver and pliers. Perfect for self-instruction in circuit fundamentals, and packed with practical applications. Kit includes mounting board, tubes, all parts, hardware, microphone, and 12-page builders' manual. Shpg. wt., 10 lbs.

Model S-265. "10-in-1" Lab Kit. Net only..... **$12.65**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna Kit for above..... **$1.05**

knight-kit WIRELESS BROADCASTER KIT

Model S-705 **$9.50** This fascinating unit makes it possible to "broadcast" witn phonograph or microphone through any standard radio receiver up to 50 feet away—without any connection to the set. May be used with crystal or magnetic cartridge, or with microphone. Broadcasts a clear, full-toned signal. High-gain stage permits using magnetic cartridge without need for external preamp. Complete with all parts, tubes, wire and solder (less microphone). 4½ x 5 x 6". Easy to assemble. Shpg. wt., 3 lbs.

Model S-705. Wireless Broadcaster Kit. Net only..... **$9.50**
S-556. Microphone for above with 5-ft. cable..... **$3.95**

knight-kit PHONO OSCILLATOR KIT

Model S-760 **$5.85** This low-cost phono oscillator may be used with any crystal phonograph for "broadcasting" recorded music through any standard radio receiver up to 50 feet away. Requires no direct connection to radio set. Operates on any frequency between 600 and 800 kc. Has controls for adjustment of modulation level and selection of clear frequency on radio receiver. Uses 50L6GT tube and 35Z5GT rectifier. Complete with all parts, tubes and instructions. 4¼ x 4¼ x 4½". Shpg. wt., 1 lb.

Model S-760. Phono Oscillator Kit. Net only..... **$5.85**

ALL PRICES NET F.O.B. CHICAGO

knight-kit CODE PRACTICE OSCILLATOR KIT

Model S-239 **$3.95** **Transistor Circuit—Powered by Penlight Cell**

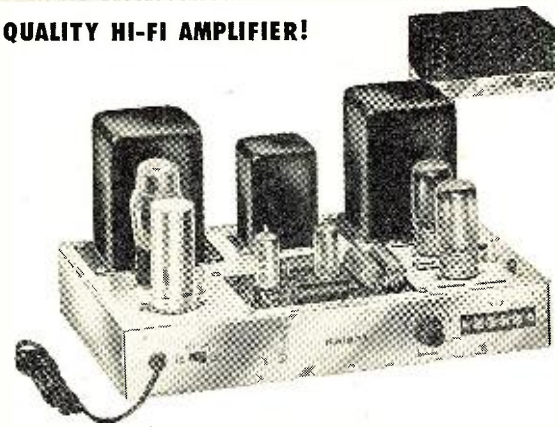
An ideal code practice oscillator. Uses transistor circuit. Extremely low current consumption—powered by single penlight battery. Provides crisp, clear tone (400 to 600 cps). Has input jack for earphone; screw-type terminal strip for key. In compact bakelite case (2⅜ x 3¾ x 1½") with anodized aluminum panel. Complete with all parts, transistor, battery and easy-to-follow instructions. Shpg. wt., 1 lb.

Model S-239. Code Practice Kit.... **$3.95**

See Next Page for Amateur Kits

ALLIED'S own knight-kits give you the most for your money

BUILD YOUR OWN QUALITY HI-FI AMPLIFIER!



knight-kit

BASIC 25-WATT LINEAR-DELUXE HI-FI AMPLIFIER KIT

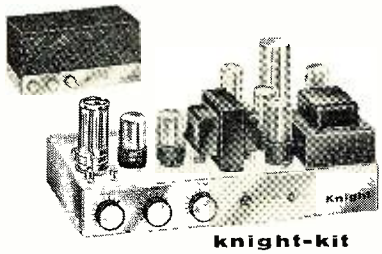
Model S-755

$44.50

Williamson-Type Circuit
Printed Circuit Board
Chrome-Plated Chassis

This super-quality hi-fi basic amplifier is designed to satisfy the most critical listener. Intended for use with tuners incorporating built-in preamp or with separate preamp. Incorporates latest Williamson-type circuit and has potted matched transformers. Delivers maximum output of 45 watts. Frequency response is: ±0.5 db. 10 cps to 120 kc, *measured at 20 watts.* Harmonic distortion is only .15% right up to 30 watts. Intermodulation distortion is only .27% at 10 watts and only .4% at 20 watts, using 60 cps and 7 kc, 1:4 ratio. Hum level is —85 db below full rated output. Output impedance, 4, 8, 16 ohms. Input voltage for 25-watt output is 1.8 volts. Uses two 12AU7's, two 5881's, and a 5V4. Etched circuit is utilized in voltage amplifier and phase inverter stages to speed assembly. Has output tube balancing control, variable damping control, and on-off switch. Handsome chrome-plated chassis, 14 x 9 x 2". Overall height, 7". A deluxe true hi-fi amplifier equal in performance to amplifiers selling at over twice the price. Complete with all parts and tubes. Easy to assemble. Shpg. wt., 27 lbs. **$44.50**

Model S-755. Basic 25 Watt Hi-Fi Amplifier Kit. Net only.....**$44.50**
S-759. Metal enclosure for above; black finish. 3 lbs. Net.....**$4.25**



knight-kit

10-WATT HI-FI AMPLIFIER KIT

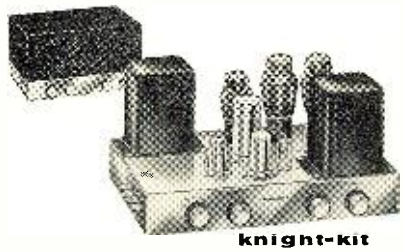
Model S-753

$23.50

Chrome-Plated Chassis

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ±1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chromed chassis; punched to accommodate magnetic cartridge preamp. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-753. Amplifier Kit. Net...**$23.50**
Model S-235. Preamp Kit for above...**$3.10**
S-757. Metal Enclosure. 3 lbs.....**$3.95**



knight-kit

20-WATT HI-FI AMPLIFIER KIT

Model S-750

$35.75

Chrome-Plated Chassis

True hi-fi for less! Frequency response, ±1 db, 20-20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono 72 db below 20 watts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records. Built-in Preamp. Outputs: 4, 8, 16 and 500 ohms. 23 lbs.

Model S-750. 20-Watt Kit. Net....**$35.75**
S-758. Metal Enclosure. 3 lbs.....**$4.15**
S-752. Chrome-plated escutcheon for cabinet installation of amplifier. Net.....**$1.40**

LOW-COST TOP QUALITY KITS FOR THE HAM

knight-kit

50-WATT CW TRANSMITTER KIT

Model S-255

$43.75

Built-in Pi-Type Antenna Coupler

Check the features packed into this new transmitter kit and you'll see why it's one of the greatest Amateur values ever offered. Compact and versatile, it is the perfect low-power rig for the beginning Novice or seasoned veteran. Features: 50 watts input to 807 final; high-efficiency 6AG7 modified-Pierce oscillator takes crystal or VFO without circuit changes; bandswitching coverage of 80, 40, 20, 15, 11-10 meters; pi-section antenna output matches line impedances from 50 to 1200 ohms —permits use with any type of antenna; no separate antenna tuner required. Crisp, clean, cathode keying of oscillator and final. Power take-off plug supplies filament and B-plus voltages for other equipment. Copper-finished chassis and cabinet interior, filtering, shielding, bypassing, and coaxial SO-239 antenna connector provide excellent TVI suppression. Meter reads either plate or grid current of final. Jacks for VFO, crystal and key. Supplied with all parts and tubes. Less crystal and key. 8 3/16 x 11 13/16 x 8 3/4". Shpg. wt., 18 lbs.

Model S-255. 50-Watt Transmitter Kit. Net...**$43.75**

knight-kit

SELF-POWERED VFO KIT

Model S-725

$28.50

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread: separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output on 80 and 40 meters. With Spot-Off-Transmit switch for "no swish" tuning. Extra switch contacts for operating relays and other equipment. With all parts and tubes. 8 lbs.

Model S-725. Self-Powered VFO Kit. Net.....**$28.50**

NEW knight-kit

AMATEUR RF "Z" BRIDGE KIT

Model S-253

$5.85

Measures standing wave ratio (SWR) and impedance of antenna systems; also for adjusting antenna networks for optimum results. Any VOM may be used for null indicator. High accuracy with 20,000 ohm/v VOM. Correction factor info supplied for other VOM's. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart. 1½ lbs.

Model S-253. "Z" Bridge Kit. Net only **$5.85**

ALLIED RADIO

100 N. WESTERN AVE., CHICAGO 80, ILL.

Our 35th year

ALLIED RADIO CORP., Dept. 01-K-6, 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 is shipped collect).

Name _____

Address _____

City _____ Zone _____ State _____

← order Today

New Tube Tester Data

New radio and TV tubes are being constantly introduced. Tubes listed here are not on regular Heath and Jackson tube tester roll charts. Use this data to check them.

HEATH COMPANY MODELS TC-2 AND TC-2P

Tube	Type	Fil.	Plate	Top	Bottom
2AF4	2	2	21	*ABFG*	*DE*
3BA6	2	2.5	23	ABEF	*DG*
3BZ6	1	2.5	20	AEFG	BC
3CF6	1	2.5	19	AEFG	*BD*
	(no open element test on levers E, G)				
3CS6	1	2.5	21	AF	BC
	1	2.5	57	EG	BC
5AQ5	3	5	27	*AEFG*	*BD*
5AT8	2	5	21	AB	*CE*
	2	5	20	FGHJ	*CE*
	(no open element test on levers F, H)				
5AV8	2	5	22	FHJ	*EG*
	(no open element test on lever F)				
	2	5	23	BC	*AE*
5B8	2	5	21	BC	*AE*
	2	5	21	FHJ	*ABCEG*
	(no open element test on lever J)				
5U8	2	5	22	AJ	*EH*
	2	5	22	BCF	*EG*
5Y3	3	5	50	F	*H*
	3	5	50	D	*H*
6AS7	3	6.3	16	AB	*CH*
	3	6.3	16	DE	*FH*
6AU8	2	6.3	21	BC	*AD*
	2	6.3	21	GHJ	*DF*
	(no open element test on lever J)				
6AX7	1	3.3	20	AB	*CDE*
	1	3.3	20	FG	*DEH*
6BC7	1	6.3	20	B	*AD*
	1	6.3	21	F	*DG*
	1	6.3	20	H	*DJ*
6BZ6	1	6.3	18	AEFG	BC
6CG7	2	6.3	23	AB	*CD*
	2	6.3	23	FG	*DH*
6DE6	2	6.3	20	AEFG	*BD*
	(no open element test on levers E, G)				
7E5/1201	2	6.3	34	*ACEG*	*DFH*
12AV5-GA	3	12.6	18	AEH	*BC*
12BK5	2	12.6	22	*ACGH*	*DF*
12BR7	2	6.3	21	AB	*CDE*
	2	6.3	23	F	*DEH*
	2	6.3	23	G	*DEH*
25CA5	3	25	17	*BEFG*	*AD*
25CD6	3	25	20	EHK	*BC*

JACKSON MODEL 648

Tube Type	Fila-ment	D	E	Plate Test
3B2	3.0	12	9	50XZ
3CE5	3.0	AC123	567*	50YZ
3DT6	3.0	A2347	AC156	75XZ
4BS8	4.2	A123	A45	20XZ
		A127	A89	20XZ
5AS4	5.0	13	5	15W
			8	15W
5BR8	5.0	A126	AC789*	55YZ
		A123	AC45	26YZ
5BT8	5.0	A127	AC689*	16WY
		123	4	65X
			5	65X
5V3	5.0	13	5	13W
			8	13W
6BE8	6.3	A127	AC689*	50V
		A123	AC45	68Z
6BH8	6.3	A128	679*	65Z
		A124	A35	36V
6BJ8	6.3	126	AC79	20YZ
		125	4	22Z
		123	8	22Z
6BL4	6.3	234	6	12W
6BR8	6.3	A126	AC789*	55YZ
		A123	AC45	26YZ
6BS8	6.3	A123	A45	20XZ
		A127	A89	20XZ
6BT8	6.3	A127	AC689*	16WY
		123	4	65X
			5	65X
6BW4	6.3	126	4	15W
			9	15W
6CE5	6.3	AC123	567*	50YZ
6CH7	6.3	A1237	A45	41V
			A89	41V
6CL5	6.3	A124	B579	22Z
6CU5	6.3	C123	467	22Z
6DQ6	6.3	1237	AB569	15W
6DT6	6.3	A2347	AC156	75XZ
12BW4	12.6	126	4	15W
			9	15W
12CU5	12.6	C123	467	22Z
12DQ6	12.6	1237	AB569	15W
19AQ5	19.0	237	AC156	38W
25DQ6	25.0	1237	AB567	15W
X-155	6.3	A1237	A45	41V
			A89	41V

*When testing this section for shorts, the K (Cathode) and G1 (Grid No. 1) positions of shorts test switch will be reversed.

Flying Spot Scanner

(*Continued from page* 51)

Color Applications

Flying-spot scanners have as much utility with color television receivers as they have with black-and-white sets. Color television picture tubes currently being used have three electron guns; the stream of electrons from one of the guns is modulated with green information, one with blue information, and one with red information. For black-and-white pictures, each of the three guns receives a certain portion of the black-and-white signal.

In order for color pictures to be displayed as transmitted and for black-and-white pictures to be displayed without color contamination, the various magnetic fields acting on the electron streams must be adjusted so that the electron streams activate only the color dots on the face of the tube for which they are intended, *i.e.,* the stream from the blue gun must hit only the blue dots, the stream from the red gun must hit only the red dots, and the stream from the green gun must hit only the green dots. The adjustments that affect the electron streams are called convergence adjustments.

There are two kinds of convergence adjustments — static and dynamic. Static convergence adjustments control the electron streams when they activate the phosphor dots at the center of the screen, while dynamic adjustments control the streams near the edges of the screen.

For static convergence adjustments, it is necessary to use a white-dot generator. The Model 1000 is converted into a white-dot generator merely by using the white-dot slide. See Fig. 4. On this slide, the center dot is surrounded by little squares so that it is easy to identify its position at a glance. The small squares around the center of the slide are also helpful as the sharp corners of the squares show up any misconvergence.

For dynamic convergence, the white lines of the crosshatch pattern are used. See Fig. 5. Basically, the misconvergence that occurs at the edge of the screen in a three-gun tube is due to the unequal paths of the three beams, and this misconvergence is not the same amount at the top right of the screen as it is at the center of the right side, for example. By using a white-line slide, any misconvergence shows up as parabolic-like red, green, and blue lines of varying width at the sides and/or top and bottom.

The uses to which a flying-spot scanner may be put are extensive. Up to now, high cost has prevented the service technician from taking advantage of this test instrument in his daily work. Now that this obstacle has been largely removed, this type of instrument should be more widely used. —30—

CHANNEL MASTER

Explodes a Spectacular Campaign of

NATIONAL CONSUMER MAGAZINE ADVERTISING

THE FIRST PROGRAM OF ITS KIND IN TV ANTENNA HISTORY

2-Page Spreads . . . Full-Page Ads . . . Full-Color Ads . . .

reaching into millions of American homes on the pages of these outstanding magazines:

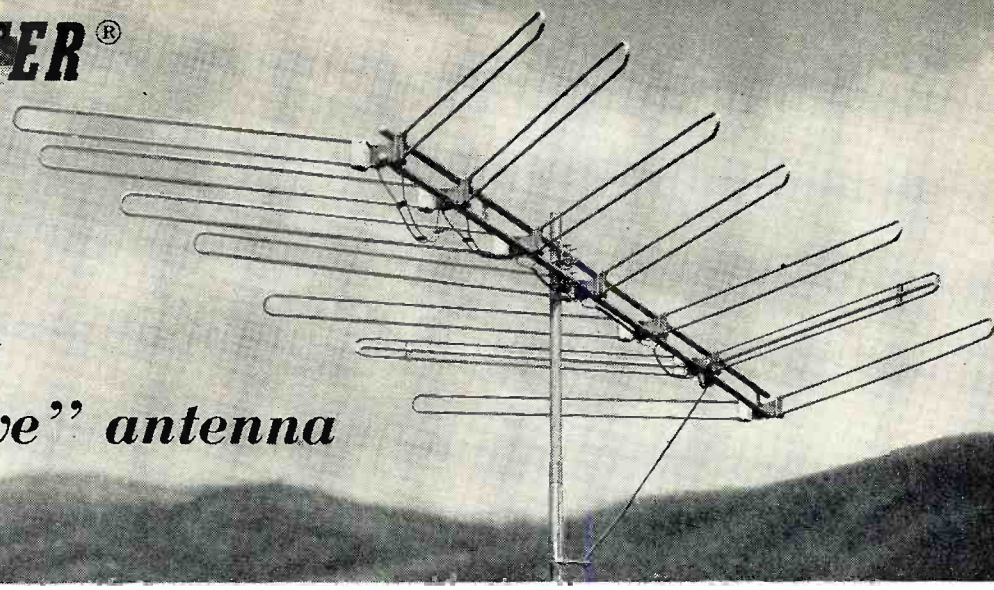
CHANNEL MASTER REVOLUTIONIZES ANTENNA MERCHANDISING! With large-scale national advertising and traffic-building local promotions, Channel Master now places TV antennas on the *same retail level as traffic appliances.* It's actually a NEW WAY for you to sell antennas — and sell *more* of them. Climb aboard the Channel Master brandwagon and tie in with these profit-making promotions. Get details from your Channel Master distributor.

NEW MARKETS . . . NEW CUSTOMERS . . . FOR THESE 2 GREAT NEW ANTENNAS

CHANNEL MASTER®

T-W

the world's first "Travelling Wave" antenna



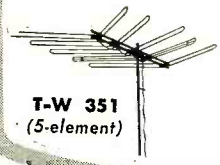
WHAT THE "TRAVELLING WAVE" PRINCIPLE MEANS—

- ideal phase relationships on *all* channels
- optimum impedance matching on *all* channels
- equal flow of current in all dipoles on *all* channels
- fullest use of transmitted energy on *all* channels

IN SHORT — FABULOUS PERFORMANCE ON ALL CHANNELS

SENSATIONAL 3- AND 5-ELEMENT MODELS!

Amazing T-W performance for suburban and near-fringe areas, too! Wonderfully compact and rugged!



T-W 351 *(5-element)*

T-W 352 *(3-element)*

revolutionary new design provides picture quality never before possible

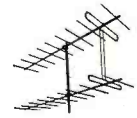
After two years of research—a completely new kind of VHF antenna, operating on revolutionary new electronic principles. The T-W is Channel Master's greatest antenna achievement.

ALL THREE — IN ONE ALL-CHANNEL ANTENNA

1 *HIGHEST GAINS*

Most powerful all-channel antenna ever developed. A single-bay T-W 350 (7-element) actually OUTPERFORMS—

any wide-spaced 5-element Yagi on each low band channel.



any stacked 10-element Yagi on each high band channel.

2 *TOP FRONT-TO-BACK RATIOS*

Low Band:

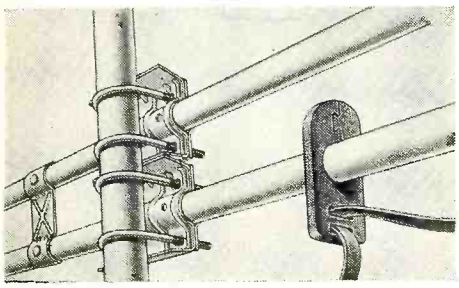
Better than 10:1 on every channel. HIGHER THAN ANY 10-ELEMENT SINGLE CHANNEL YAGI ON ALL CHANNELS!

High Band:

From 5:1 to 12:1. HIGHEST RATIOS OF ANY SINGLE ALL CHANNEL ANTENNA.

3 *GREATEST MECHANICAL STRENGTH*

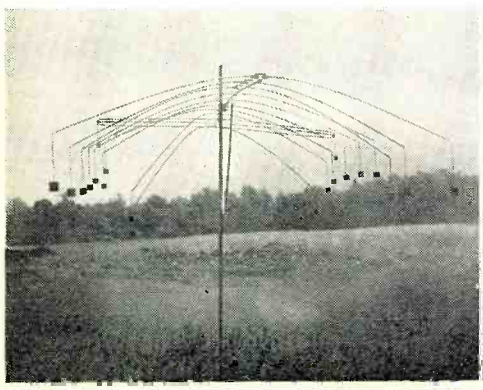
The most rugged antenna ever built. "Twin Truss" design amplifies the strength of every component. And new mechanical features add still greater durability . . .

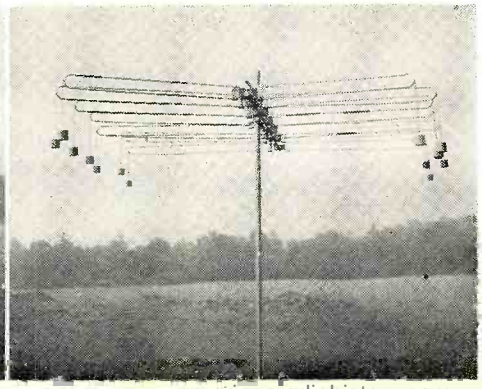


"Twin Booms" . . . *Two full-length crossarms—really rugged and rigid.*

2 "Super-Nests" *One heavy-duty mast clamp on each crossboom . A TOTAL OF 4 U-BOLTS! Antenna cannot move.*

"Line-Lok" . . . . . *Twinlead can't possibly tear away from terminals.*





PROOF OF THE SUPERIORITY OF "TWIN-TRUSS" CONSTRUCTION

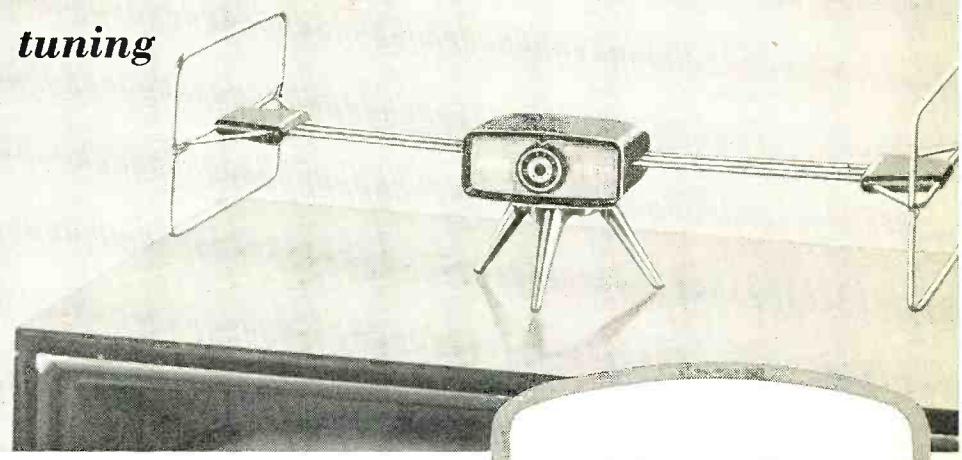
Look at the dramatic result when equal weights are hung on a T-W and a standard 10-element Yagi!

Write for complete technical literature.

®-Trade Mark Reg. U.S. Pat. Off.

CHANNEL MASTER® "Showman"

new "Metro-Dyne" tuning obsoletes "Rabbit-Ears"



the first basic indoor antenna improvement in over 10 years

Channel Master sets an exciting new trend in TV antennas with the Showman. In appearance (so important in the sale of indoor antennas) the Showman is in a dazzling class by itself. Yet, it's a complex electronic instrument—the most powerful indoor antenna yet developed by modern science!

The SHOWMAN is perfect for color reception, tops for black-and-white. And, it provides excellent FM reception, too!

ACTUALLY TUNES OUT "GHOSTS" AND "SNOW"!
MORE EFFECTIVE THAN ANY OTHER INDOOR ANTENNA!

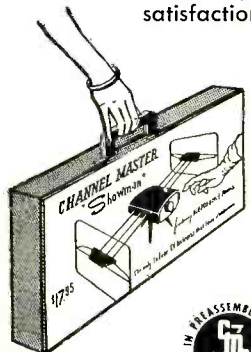
With ordinary indoor antennas

With the Showman

Metropolitan areas, where indoor antennas are most frequently used, are often subject to the most severe "ghosting" problems. Only the SHOWMAN, with its sensational new Metro-Dyne tuning, can overcome this difficulty. You'll be amazed at the job it does on all kinds of interference. Test it for yourself! Demonstrate it for your customers!

Channel Master stands squarely behind every SHOWMAN you sell. An unconditional money-back guarantee assures your customer of complete satisfaction.

UNCONDITIONAL MONEY-BACK GUARANTEE



"High fashion" packaging. Attractive, convenient. Ideal for display.

Available in three "decor designs"—to blend with any setting.

Mahogany and Gold	Blond and Gold	Ebony and Silver
model no. 3900	*model no.* 3901	*model no.* 3902

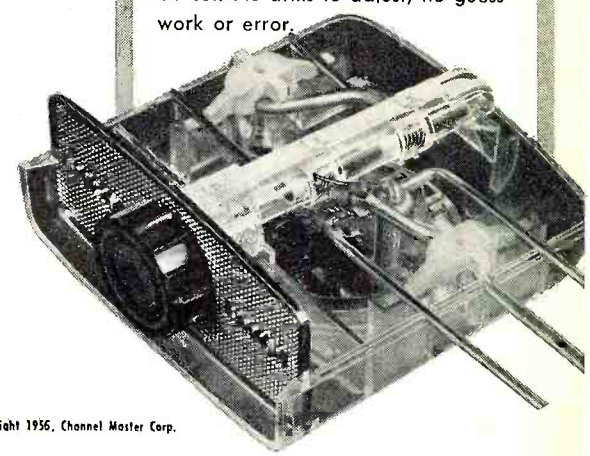
what makes the "Showman" different?

FABULOUS "METRO-DYNE" TUNING!

The Metro-Dyne 12-Channel "Variable Inductance" Tuner

Ordinary switch-type antennas work by connecting various element into different combinations. METRO-DYNE tuning, on the other hand, is "variable inductance" tuning, using the same tuning principles as any TV set. It is the first broad band antenna which can be tuned to a specific channel so that it exhibits the band width characteristics of a single-channel Yagi. This selectivity cuts down tremendously on "electronic noise" and interference. A built-in auto transformer maintains a constant 300 ohm impedance match.

EASY OPERATION: the Showman is calibrated by channels. Just turn it to the same channel number as the TV set. No arms to adjust; no guesswork or error.

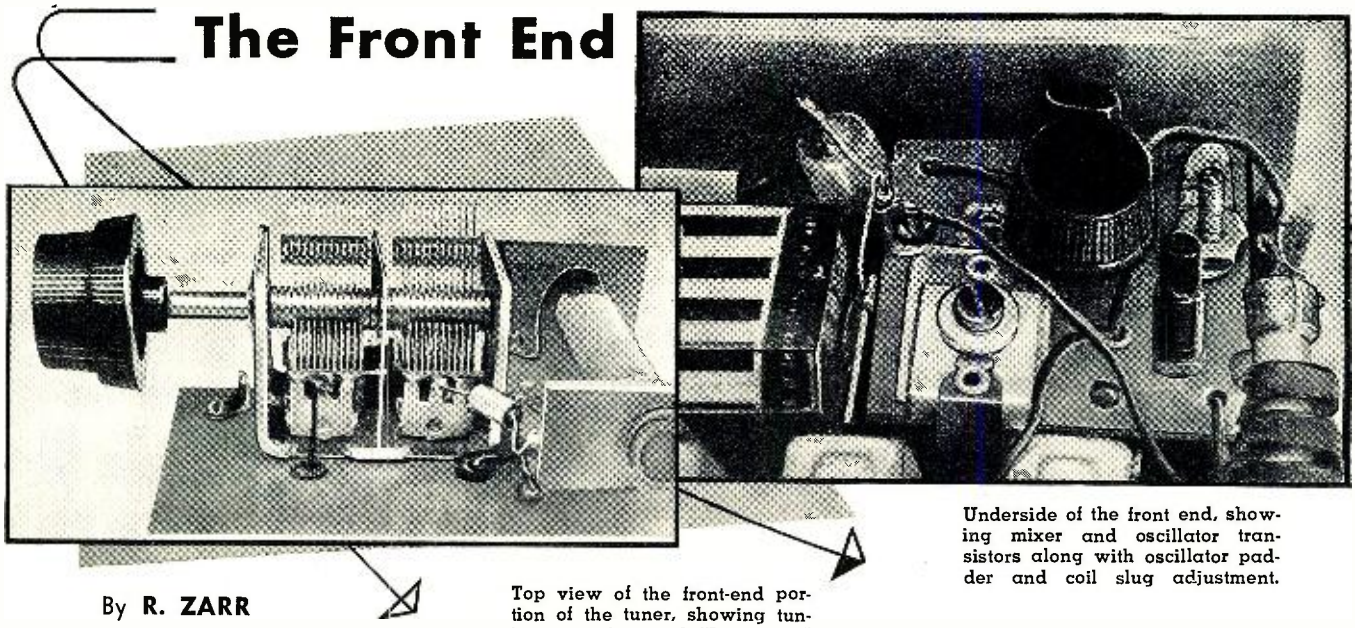


CHANNEL MASTER CORP. ELLENVILLE, N. Y.

the world's largest manufacturer of television antennas and accessories

An All-Transistor Superhet Tuner

The Front End



Top view of the front-end portion of the tuner, showing tuning capacitor and "Loopstick."

Underside of the front end, showing mixer and oscillator transistors along with oscillator padder and coil slug adjustment.

By **R. ZARR**

Part 2. A front end for an all-transistor superhet-type broadcast tuner. The i.f. strip was covered last month.

THE construction of the i.f. strip and detector for an all-transistor superhet broadcast tuner was described last month. This article covers the remainder of the circuitry.

The mixer-oscillator circuit appears here. It uses two transistors which may be either 2N113 or 2N114 (*Raytheon*). The latter is recommended for V_2 for slightly greater gain.

Essential parts of the mixer-oscillator stage are mounted on a piece of Bakelite or plastic 1½ inches square. It holds the two transistors, the padder and oscillator coil, and is mounted under the chassis by means of a long screw and spacer. The small knob seen in the photo is for adjusting the oscillator coil slug. The padder is a mica capacitor with maximum value anywhere between 680 and 1250 $\mu\mu$fd. Its value is not critical. The r.f. choke is rather large and is placed near the front of the tuner under the tuning knob.

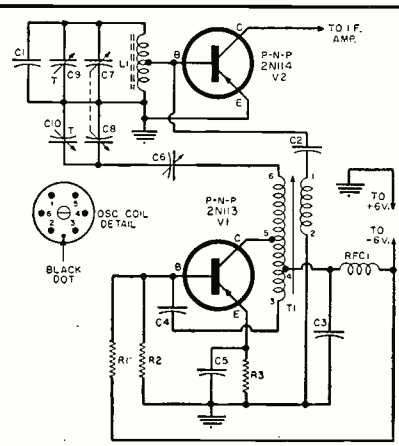
There should be no difficulty in assembling this converter. If desired, it may be checked by placing it near a radio receiver. As the capacitor is tuned, it will be possible to pick up the oscillator output. At minimum capacitor setting, the frequency should be approximately 2 mc. At maximum capacitance, the oscillator should be near 1 mc.

Alignment is done in the usual superhet way. The oscillator coil slug is set nearly all the way in. The antenna trimmer is tuned for maximum output near the high frequency end of the dial and the padder is adjusted for maximum output near the low frequency end. An additional capacitor (22 $\mu\mu$fd.) was added across the "Loopstick" when it was found that adequate coverage could not be obtained otherwise. If desired, make this an adjustable unit to provide vernier tuning of the "Loopstick." However, sensitivity will be found to be nearly uniform all over the dial once the antenna trimmer is set correctly. Alignment may be done with a milliammeter in series with the battery supply. No-signal current is about 5 ma. This increases with signal strength, rising to about 6.5 ma. at full output.

The chassis for the entire tuner is an open-end aluminum unit. Only the dual capacitor, "Loopstick," and 22-$\mu\mu$fd. capacitor are above chassis. All other parts are located below. Note that there remains plenty of space above the chassis to add an audio amplifier.

The all-transistor tuner described here is a compact unit measuring about 4½ x 4 x 3½ inches, complete with battery supply and antenna. It covers the entire broadcast band with high sensitivity. Selectivity is sufficient to separate local stations in a metropolitan area (for example, in New York City), but is less than in a corresponding tube set.

Naturally the power consumption of a transistor tuner is very low. A type Z4 battery should last at least 100 hours. For home use, 4 flashlight cells may be wired in series to make up the 6-volt supply. This supply will keep the tuner going for about 750 hours or a month's continuous operation. Tests show that reception will remain satisfactory even when the battery voltage has dropped down to 3 volts, but some of the pep will disappear. —30—



Complete schematic diagram of front end for all-transistor superhet tuner.

R_1—39,000 ohm, ½w. res.
R_2—27,000 ohm, ½w. res.
R_3—1500 ohm, ½w. res.
C_1—22 $\mu\mu$fd. ceramic capacitor
C_2—100 $\mu\mu$fd. ceramic capacitor
C_3—.02 μfd. ceramic capacitor
C_4—.001 μfd. ceramic capacitor
C_5—.01 μfd. ceramic capacitor
C_6—680-1250 $\mu\mu$fd. max. mica padder
C_7, C_8—Midget 2-gang 365 $\mu\mu$fd. variable capacitor with trimmers
L_1—Antenna "Loopstick," tapped at 600 ohms (Lafayette MS-166 or equiv.)
T_1—Transistor oscillator coil (Lafayette MS-165 or equiv.)
RFC_1—2.5 mhy. choke
V_1, V_2—"p-n-p" junction transistor (Raytheon 2N113 or 2N114)
Batteries—See text

"I told him a hundred times, 'Put a fuse in it'".

You can't really blame the old boy though! He was just too absorbed in his new gear from Walter Ashe.

You see, he didn't think he could afford new equipment this year, but a Walter Ashe "Surprise" trade-in made it possible. Of course, we don't recommend that you burn your house down, but we do recommend that you write us for the highest trade possible on your used, factory-built, communications equipment. Just tell us what new gear you want and what you have to trade. You'll get our answer by return mail. Write, wire, phone, or use the handy coupon below, but do it today.

NEW HALLICRAFTERS SX-101 RECEIVER. Less speaker. Net.....$395.00

HALLICRAFTERS SX-100 RECEIVER. Less speaker. Net.....$295.00

NATIONAL NC-300 RECEIVER
The "Dream Receiver" with super selectivity and sensitivity. For all bands 160 thru 1¼ meters (6, 2, and 1¼ meters with plug-in converters). Less speaker. Net.....$ 399.00

NEW JOHNSON VIKING TRANSMITTERS

"FIVE HUNDRED"

600 watts input CW, 500 AM, 500 SSB P.E.P. (with SSB exciter). Built-in VFO. 80 thru 10 meters. Complete kit with tubes. Net.....$ 649.00
Wired and tested. Net.....$ 799.50

"VALIANT"

275 watts input CW, SSB (P.E.P. with SSB exciter). Built-in VFO. 160 thru 10 meters. Complete kit with tubes.
Net.....$ 349.50
Wired and tested. Net.....$ 439.50

"PACEMAKER"

SSB transmitter-exciter. 90 watts P.E.P. input SSB, CW, 35 watts AM. Upper and lower sideband selection. Built-in VFO. 80 thru 10 meters. With tubes. Wired and tested only. Net.....$ 495.00

All prices f. o. b. St. Louis • Phone CHestnut 1-1125

WRITE FOR FULL INFORMATION ABOUT OUR TIME PAYMENT PLAN

Walter Ashe RADIO CO.
1125 PINE ST. • ST. LOUIS 1, MO.
Our 34th Year

R-10-56

WALTER ASHE RADIO COMPANY
1125 Pine Street, St. Louis, Mo.

☐ Rush "Surprise" Trade-In Offer on my.....
for.....
(show make and model of new equipment desired)
☐ Send NEW 1957 Walter Ashe catalog.
Name.....
Address.....
City.....Zone.....State.....

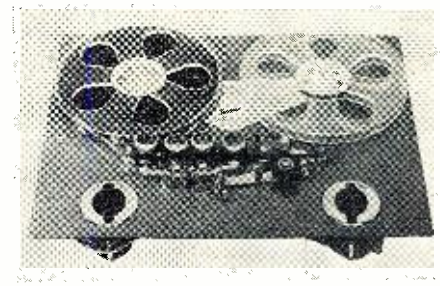
New Hi-Fi-Audio Equipment

3-SPEED DECK FOR STEREO

Fenton Company, 15 Moore Street, New York 4, New York is now distributing the *"Fen-Tone Brenell* Mark IV" three-speed stereo tape deck which supersedes the former Mark II deck and incorporates many improvements over its predecessor.

The Mark IV is available with either a pair of upper track monaural heads (one record-playback and one erase), four pressure pads, and mounting holes for additional heads; or with four staggered stereo heads already mounted (one pair upper and one pair lower track).

The Mark IV has three independent motors (capstan, feed, and takeup) and instantaneous mechanical braking. All braking, switching, and pinch-roller



operations are positively interlocked in two simple control knobs: the left for "fast forward" and "rewind" within 45 seconds; the right for "record/playback" and "off."

The novel speed selection mechanism consists of a precision-ground capstan and a 2:1 ratio screw-on sleeve permitting either 3¾ and 7½ ips or 7½ and 15 ips operation. To operate in either of these modes, the rubber belt can be placed either on the "slow" or "fast" grooves of the double-stepped flywheel and motor pulley assembly.

MINIATURE LAVALIER MIKE

Electro-Voice, Inc. of Buchanan, Michigan has developed a new miniature lavalier dynamic microphone especially for TV applications.

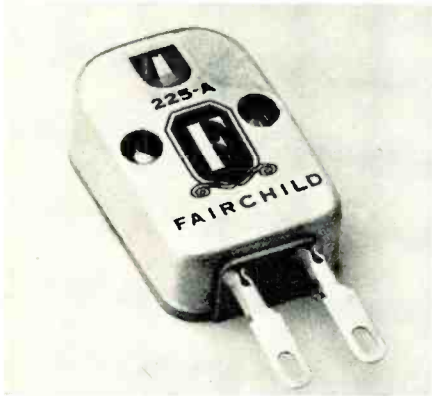
The Model 649 measures $2\frac{11}{16}$" long and ¾" in diameter yet provides the efficient pickup, smooth response, and high output required for many applications. The microphone is omnidirectional and can be hung on a neck cord close to the chest to free the hands of the announcer or performer. It can also be hand-held or used on a desk stand. No closely associated auxiliary equipment is required.

Frequency response is uniform from 70 to 13,000 cps. A 50 ohm impedance is provided as standard but impedance changes can be made in the transformer housing for 150 and 250 ohms. The

mike weighs only 1.3 ounces less cable. It comes complete with 30-foot, three-conductor shielded cable, neck cord assembly, and belt-strain relief clip.

MOVING COIL PICKUP

Fairchild Recording Equipment Company, Whitestone 57, N. Y., has just introduced its new 225 series "Micradjust" diamond stylus pickup which is flat to 20,000 cps with smoothly decreasing response beyond. Its low impedance design provides an average



output of 5 millivolts which will drive all modern preamplifiers without requiring a step-up transformer.

Three models are currently being offered, the 225-A, a 1 mil unit for all microgroove discs; the 2.5 mil 225-B for professional transcriptions; and the 225-C 3 mil unit for 78 rpm records.

Vertical tracking force is 4 to 8 grams depending on the arm, recorded material, and other factors.

Write the manufacturer for a data sheet on this new pickup.

EQUIPMENT CABINET

Daily Manufacturing Company, Box 846, Rockwell, N. C., is in limited production on a new hi-fi equipment cabinet, the X1W.

Of solid walnut construction with a marble top, the cabinet measures 48" long, 20" deep, and 30" high. The in-

side area is 9½ cubic feet. The cabinet is offered as either bass reflex or infinite baffle and will accommodate one or two 12" or one or two 15" loudspeakers. For those who wish to house their entire audio system in a single cabinet, the unit is available with a compartment for changer and amplifier. The enclosure weighs approximately 300 pounds eliminating the problem of vibration when the changer is used in the same cabinet as the speaker.

Write the manufacturer for full details on this and other units in the line.

PLAYBACK SYSTEM TESTER

Elektra Records, 361 Bleecker Street, New York, N. Y., has recently introduced a new "Playback System Calibration Record" which is designed to serve as a standard for calibrating equipment used in playing 33⅓ rpm discs.

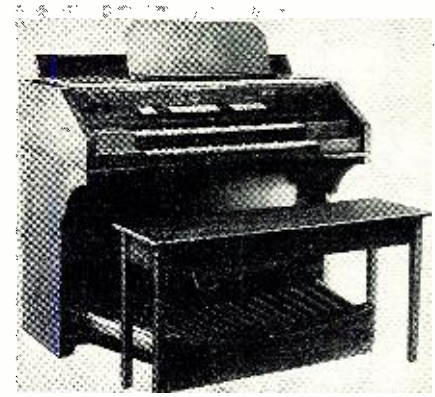
If played on a system adjusted to the RIAA playback equalization, high frequency de-emphasis removed, this record will play back ± 1 db throughout its range. If not, the system is faulty. There are five bands on this test record. Band 1 has 1000 cps tone for checking level. Band 2 provides pauses at 20,000, 16,000, 15,000, 12,000, 8000, 7500, 6000, 5000, 4000, 3750, 3000, 2500, 2000, and 1875 cps.

Band 3 offers pauses at 2000, 1600, 1500, 1200, 1000, 800, 750, 600, 500, 400, 375, 250, 200, and 187.5 cps. The fourth band covers the frequencies from 200 to 18.75 cps in fourteen steps. The fifth band carries the 1000 cps note again for level checking.

ORGAN CONSOLE AVAILABLE

The Schober Organ Corporation, 2248 Broadway, New York 24, N. Y., has announced the availability of a newly designed console to house its electronic organ kits.

Handmade of solid lumber and lumber-core veneer, the console and its companion bench and pedal clavier are available in any desired finish. The console measures 55" wide, 29" deep,



and 43½" high. It will house all of the company's electronic organ kits which, when assembled, form a full concert organ with two 61-note manuals, 19 stops, 6 couplers, and 32 pedals.

The company will supply full details on the console and the organ kits upon written request.

ACOUSTICAL RESISTANCE UNIT

Rockbar Corporation, 650 Halstead Avenue, Mamaroneck, New York is handling the U. S. distribution of the new *Goodmans* acoustical resistance unit which is said to produce better loudspeaker performance than a bass reflex cabinet in an enclosure only two-thirds its volume.

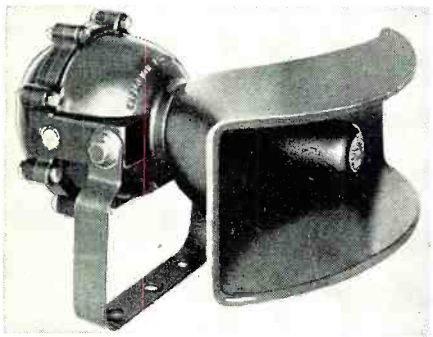
Designed to be used in lieu of the conventional bass reflex port, the unit mounts in an aperture in the wall of

the speaker enclosure. It is a rectangular unit, about 2" deep, which consists of a specially designed wire grid partially coated with flock and suspended in a wood frame. The flock acts as a friction loading device or resistor which inhibits the movement of air in the enclosure and makes it possible to maintain air loading of the loudspeaker cone down to zero frequency. Harmonic and IM distortion due to excessive cone displacement at low frequencies is thereby reduced.

The acoustical resistance unit is currently available in four different sizes for varying speaker characteristics. Write M. Wimpie, sales manager of the firm, for full details and specifications.

EXPLOSION-PROOF SPEAKERS

Atlas Sound Corp., 1451 39th Street, Brooklyn 18, N. Y., has announced the availability of several sizes and types



of *UL*-approved explosion-proof, high-efficiency p.a. loudspeakers. The new line is available in Class I, group C and D; and Class II, group E, F, and D. All four models are available with built-in line matching transformers.

For complete specifications on these explosion-proof units, write the manufacturer direct.

PILOT'S "ENSEMBLE SERIES"

The top of *Pilot Radio Corporation's* "Ensemble Series" line recently introduced to the trade is the PT-1050, a full-door console which is available in a choice of three wood finishes.

The 1050 consists of the company's Model FA 550 AM-FM tuner with controls and dual cascade limiter discriminator circuitry on FM; the Model AA 410 20-watt Williamson-type basic amplifier; an imported *Garrard* Model

RC 88 record changer with manual play position and variable reluctance pickup with diamond stylus.

The fully enclosed speaker compartment houses a three-way, four-speaker

system including 12-inch bass woofer, separate mid-range reproducer, and two armored tweeter speakers.

The cabinet is available in cordovan mahogany and, at a slightly higher cost, in blonde and cherry finishes.

PHILCO ELECTROSTATIC SPEAKER

Philco Corporation, Philadelphia, Pa. has developed a new electrostatic speaker, capable of covering a frequency range between 2000 and 20,000 cps, which will be featured in the company's new line of musical instruments.

The new "Cathedral" speaker provides a 180-degree arc of sound transmission, whereas the conventional cone speaker tends to radiate sound in a narrow beam, restricting high-frequency sound reception to persons directly in front of the loudspeaker.

The speaker is 158 square inches in size, half of a semi-circle 14½ inches in diameter. The membrane is driven uniformly over its entire surface, and in this unit a polyester, metal-coated sheet is stretched over the back of a half-cylinder framework.

"MINIATURE MAESTRO"

Airex Radio Corp., 64 Cortlandt Street, New York 7, N. Y., has come up with an answer to the problem faced by many apartment dwellers—that of obtaining quality sound reproduction despite limited space.

The company has assembled a *Harmon-Kardon* TA-10 AM-FM tuner and 10-watt amplifier, a *Stromberg-Carlson* speaker, and a *Monarch* three-speed changer with *G-E* RPX 050A reluctance cartridge (two sapphire needles), in a compact 30½" wide, 15" deep, 18" high (less legs) housing. The

system is available in unfinished wood or in mahogany or blonde plexitone finishes. Wrought iron legs are available as optional equipment.

Write the company direct for full detail and prices on these items.

RCA "BIAXIAL" SPEAKER

The Tube Division of *Radio Corporation of America,* Harrison, New Jersey has announced the development of a new biaxial high-fidelity speaker (*RCA*-501S1) that combines a 12-inch low-frequency woofer, a specially designed 3-inch high-frequency tweeter, and a crossover network.

The new speaker will handle 12 watts continuously and gives substantially uniform response over the frequency range from 40 to 18,000 cps. The new unit has an 8-ohm aluminum voice coil and features a 14½ ounce *Alnico* V magnet. The tweeter unit is mounted off-axis to permit smooth acoustical crossover. The speaker has good transient response over its entire range because of its inherently good damping.

The unit is housed in an orchid-colored hammeroid casing which is contrasted with a deep purple pot-cover and a satin-finished aluminum escutcheon nameplate. It comes complete with polarized plug-in leads and terminal board.

BATTERY-OPERATED RECORDER

Audio-Master Corp., 17 E. 45th Street, New York 17, N. Y., is han-

dling the U. S. distribution of the German-built "Butoba" portable, battery-operated tape recorder, a lightweight and compact unit.

The tape recorder which is self-powered and self-contained, has a precision hand-wound motor, which is spring-powered, of special construction. The unit will record up to 1 hour of program material at two speeds, one for speech and the other for music, double track operation on standard 5" reels. The unit incorporates a recording and output level indicator and a fast rewind mechanism.

The unit weighs only 21 pounds and measures 12" x 14" x 4¾" over-all. Write the distributor direct for further details on the unit.

HALF-MIL STYLUS

Pickering and Company, Oceanside, Long Island, New York has announced the availability of a half-mil stylus which can be installed in any of the company's "Fluxvalve" pickups, simply by placing the proper plastic insert in the pickup.

The new stylus can be installed in a few seconds without the use of tools. According to the company, the smaller tip reduces wear on the new "miracle" recordings and improves the reproduction of discs with recorded frequencies as high as 15,000 cps.

"CORNERLESS-CORNER"

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y., recently introduced a compact "cornerless-corner" horn-loaded enclosure which has been tradenamed the "Tiny-Mite."

Designed to be used with either 12"

and 8" extended-range speakers or multi-speaker systems employing an 8" woofer and tweeter combination, the new enclosure incorporates the horn-loaded, phase inversion principle.

The enclosure is completely self-contained and may be placed in room and ceiling corners or along a flat wall. The cabinet is made of ¾" wood and is available in mahogany or blonde finishes as well as in unfinished birch.

REGENCY AMPLIFIER KIT

The *Regency Division, I.D.E.A., Inc.,* 7900 Pendleton Pike, Indianapolis 25, Ind., has introduced a power amplifier kit, the HF-50K, which offers 50 watts of power and takes about four hours to assemble.

Frequency response is 20 to 20,000 cps, ± .2 db and ± 1 db from 5 to 100,000 cps. IM distortion is less than 1% at the rated output and less than .2% at normal listening levels. The harmonic distortion is less than 1% from 20 to 20,000 cps up to 50 watts. The damping factor is 15.

The completed unit measures 10¼" x 10¼" x 7¼" and is housed in a gold finished perforated metal cage with black chassis which eliminates the necessity for cabinet mounting, unless desired.

NEW CALIFONE UNITS

Califone Corporation, 1041 N. Sycamore Avenue, Hollywood 38, Calif., is introducing a new 10th anniversary line which includes amplifiers, turntables, and pickups, many of which feature innovations.

Among the new features are a unique "Strobeselector" and center drive turntable permitting exact setting of any desired speed from 16 to 84 rpm, remaining exact from a cold

start or for continuous running. The center turntable drive eliminates rollers, cones, and belts. Cork turntable tops on all models eliminate lint picked up from the usual flocked turntables.

A double wrist-action pickup arm not only assures proper tracking and long record life but allows the whole arm to raise when desired.

TAPE RECORDER LINE

Webster Electric Company of Racine, Wis., has introduced four new "Ekotape" magnetic recorders which retail in the moderate price class.

The new line consists of two port-

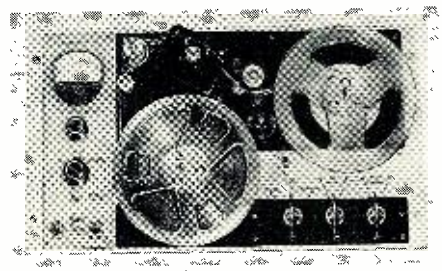
able and two table model recorders. All of the machines include "straight-line" threading, twin-track recording heads, two tape speeds, recording level indicators, program selection finders, simplified controls, and fast forward and fast rewind speeds. Fast forward and rewind is 15 times listening speed at 3¾ ips and 30 times listening speed at 7½ ips.

The portable units have been designated as the Models 260 and 250 while the table units are the Models 252 and 254. Write the company direct for complete specifications on any or all of these recorders.

TRANSISTORIZED RECORDER

The Theatre and Sound Products Department of *Radio Corporation of America,* Camden, N. J., has announced the development of a compact, professional-quality hi-fi magnetic tape recorder utilizing transistors and printed circuitry.

The new unit (SRT-2) is designed for simple plug-in use in home assembled hi-fi music and industrial sound



systems. The unit is said to be virtually non-microphonic and hum-free because the instrument's record and playback amplifier has been transistorized.

The recorder-reproducer chassis measures 10½" high, 19" wide, and 8½" deep. It weighs 35 pounds.

NEW HI-FI KIT LINE

Electromatic Mfg. Corp., 88 University Place, New York, N. Y., has recently entered the hi-fi kit field with an extensive line of audio gear for the assemble-it-yourself market.

At the present time the line consists of five units; a universal power supply (Model PSK), an AM-FM tuner (Model AM-FMK12), and FM tuner (Model FMK-9), and AM tuner (Model AMK-5), and a 20-watt "Ultra-Linear" amplifier (Model WAK).

Each unit comes complete with an elaborate assembly manual which details the construction step-by-step in easy to understand form. A mounting template is included with each manual.

NEW SPEAKER LINE

L.E.E. Incorporated, 625 New York Avenue N.W., Washington, D. C., is now manufacturing and distributing a new line of high-fidelity loudspeakers including systems in every price category.

Featured will be a new and improved version of the famous Catenoid (folded catenoidal horn) speaker system. Since the company's facilities include research, development, envi-

ronmental testing, and manufacturing equipment for electronic and electro-acoustic gear, those interested in custom or special items are invited to contact the firm direct.

AUDIO CATALOGUES

ALTEC HI-FI EQUIPMENT

Altec Lansing Corporation, 9356 Santa Monica Blvd., Beverly Hills, Calif., has issued a 16-page brochure describing its complete line of high-fidelity home music equipment.

Photographs and complete specifications are given on the firm's line of tuners, preamplifiers, amplifiers, record reproducers, speaker systems, speakers, drivers and horns, networks, and speaker enclosures.

Copies of this brochure are available from the company direct at either the California address or from the New York City office at 161 6th Avenue.

RECORD TIMING CHART

A disc timing chart for professional studios and high-fidelity fans who cut their own records is now being offered by *Rek-O-Kut Co.,* 38-01 Queens Boulevard, Long Island City, New York.

Presented in easy-to-read timetable form, the chart gives the playing time in minutes for various diameters (in inches) cut into seven, ten, twelve, and sixteen inch records, using either a standard three mil or microgroove one mil stylus. For standard stylus, the chart has readings for 33⅓ and 78.26 speeds cutting 120 or 150 lines per inch. Readings for microgroove stylus are for 33⅓ and 45 rpm speeds, cutting 210, 216, 240, and 270 lines per inch.

The 20 cent charge for this chart covers handling and postage. Send orders direct to the manufacturer.

KROHN-HITE UNITS

Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass. has issued a short form catalogue which pictures and describes its Model UF-101 power amplifier, the Model 440A *RC* oscillator line, two models of its regulated power supplies, and variable electronic filters in six versions.

Write the firm direct for a copy of Catalogue B.

WORLD RADIO'S "PRIMER"

World Radio Laboratories, 3415 W. Broadway, Council Bluffs, Iowa, is offering readers of this magazine copies of its new "High Fidelity Primer" without charge.

In addition to carrying information on what to look for in buying a hi-fi system to suit a specific purse and purpose, the booklet also includes catalogue data on a wide variety of tuners, amplifiers, speaker systems, speaker enclosures, speakers, recorders, records, miscellaneous audio accessories, etc.

The equipment of well-known audio manufacturers is included, along with pricing data and other pertinent information. —30—

RCA Color Sets

(*Continued from page* 49)

as well be made when the new color receiver is installed rather than wait for the next storm.

Circuits

The new *RCA* color TV receivers use, in addition to two crystal diodes, 27 tubes, including the "B+" and high-voltage rectifiers. Operating controls are located at the upper right of the set, either on the front panel or on the side, and consist of the v.h.f. (and u.h.f., when furnished) channel selectors, fine tuning, "on-off" switch, and brightness and volume controls. A set of secondary controls is located below the screen, covered by a small hinged panel. Some of these are screwdriver adjustments; those which have knobs and can be manipulated by the customer are the horizontal and vertical hold, hue, chroma gain, and contrast controls. At the rear of the receiver are the vertical and horizontal centering, focus, width, and killer threshold controls.

The hue and chroma controls should always be adjusted together with the contrast control because color saturation and over-all picture contrast are closely interdependent. The hue control determines color phase and there can only be one correct setting, that setting when red appears as red, green as green, and flesh color looks most natural.

While some of the earlier color receivers already used two printed-wiring boards, the new *RCA* series of receivers use six such boards. These are used for all sections of the receiver except the power supply, high-voltage circuit, and the tuner. The various controls and the power, audio, and vertical output transformers, and similar components, are mounted directly on the chassis.

The circuit and components used in the "Special" series receivers are practically identical with the chassis used for the "Super" models. Both feature a new triode color demodulator section which is a departure from the pentagrid synchronous demodulator circuit found in the *RCA* "DeLuxe" series. At the same time, the new triode demodulator system is quite different from the high level triode demodulator system used by so many *RCA* licensed manufacturers.

It appears that in 1955 when the *RCA Laboratories* first announced and released its version of a 24-tube color receiver, most of the licensees immediately worked on improving that particular system. The *RCA Victor* division, however, followed a somewhat different path, and developed a different color demodulator and color synchronizing section.

There are certain advantages in the high level demodulator circuit, the most important of which is tube economy. But there also appear to be disadvantages and in the case of *RCA Victor,* the use of additional tubes was preferred.

The circuit of the "DeLuxe" color receiver models uses two 6BY6 pentagrid stages as synchronous demodulators followed by three triodes acting as the three color-difference video amplifiers. In the "Super" and "Special" models, two 12AT7 dual triodes are used and they provide the three color difference signals directly. The "DeLuxe" receivers also use a two-stage sound i.f. circuit and three loudspeakers.

It is significant that even in the low-priced model, the $495 "Aldrich," a total of 27 tubes is used. The only apparent economy in that particular receiver is in the extensive use of printed-wiring subassemblies which are identical in most instances with the subassemblies used in the "Super" and even the "DeLuxe" series. —30—

"Corona Loudspeaker"

(*Continued from page* 57)

trodes and found that each produces a wind, the "positive" wind being stronger than the "negative" one. Placing the ring or grid nearer the positive electrode, he found that by suitable combinations of voltage and position he could adjust the positive wind to equality with the negative, so that with no signal input there is no "net" wind and that "an alternating potential applied to the grid causes the air to pulsate and hence to become a source of sound." This, then, is an embryonic loudspeaker capable of producing a pure a.c. output. See Fig. 2B.

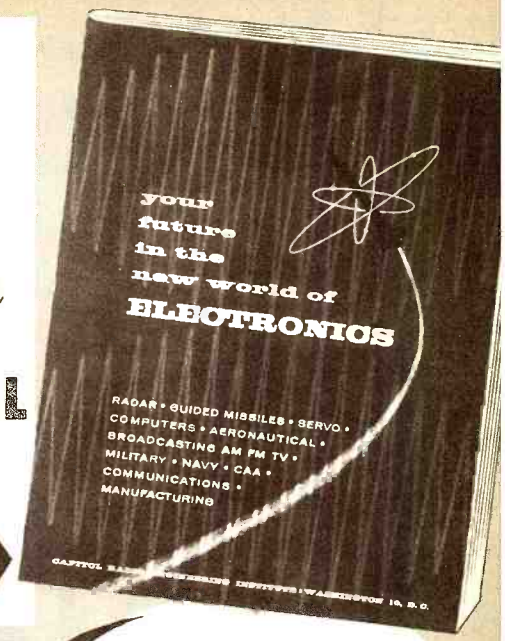
The amount of sound produced by a single corona triode is very faint, so that it becomes necessary to parallel or stack a number of them. The first small model was constructed with a needle spacing of one-half inch, and with an area of a quarter of a square foot, as shown in the photograph. (Fig. 1.) Even this is still too small to produce any *real* volume, although it could be heard in the back row at the demonstration given before the AES, which was in a fair-sized recording studio. It is likely that at least four square feet of area will be required to produce adequate volume for home hi-fi systems, and this is still fairly small when compared with some of the better wide-range conventional speaker systems. Also it is possible that further research will improve the efficiency factor and thus reduce the size requirements. For theater and auditorium use the area would have to be increased proportionately to the power outputs required, or a number of "standard-sized" units could be driven in parallel. The cubic area requirements are likely to be non-critical, since the device itself can be made very thin, and it is only necessary to provide suitable baffling to preserve the low-frequency response. This will probably be of the infinite baffle type,

(*Continued on page* 127)

The Book that Launched Thousands of Careers is yours FREE in a new edition

TELLS HOW YOU CAN BE SUCCESSFUL IN RADIO-TV-ELECTRONICS

Send for Your Free Copy Today!



YOU CAN PLOD ALONG for years, getting paltry increases, enjoying little security, finding your work dull and drab.

Then something happens. Things look up. Your earnings rise.

"Luck," some may say. "Contacts," others may suggest.

But in your heart, you will know the answer: "Training." And it all may have started the moment you sent for a free booklet, "Your Future in the New World of Electronics." This booklet tells you where you stand in Electronics.

Tremendous expansion leaves this gigantic industry pleading for trained men. Top manufacturers sold billions of dollars worth of electronic merchandise in 1955. By 1960, the radio-electronics industry should do no less than 15 billion dollars per year, not counting military orders.

Today, there are over 132,000,000 radios in use. There are 38,000,000 TV sets and 477 TV stations in operation. Color TV is coming into high gear. Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. To fill these posts, trained men are needed—men who somewhere along the line take time to improve their knowledge, their skills. Men who, today, perhaps, take two minutes to send for a booklet.

"Your Future in the New World of Electronics" shows how CREI Home Study leads the way to greater earnings through the inviting opportunities described above.

However, CREI does not promise you a "snap." With an accredited technical course such as this, you must *study* to convert your ambition into technical knowledge you can sell in the fabulous Electronics market.

Since 1927, CREI has provided thousands of professional electronics men with technical educations. During World War II CREI trained thousands for the Armed Services. Leading firms choose CREI courses for group training in electronics, among them United Air Lines, Canadian Broadcasting Corp., Trans-Canada Airlines, Douglas Aircraft Co., Glenn L. Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp. and U. S. Information Agency (Voice of America).

CREI courses are prepared by recognized experts, in a practical, easily understood manner. You get the benefit of time-tested study assignments, of personal supervision of a CREI Staff Instructor who *knows* and *teaches* you what industry wants. You learn on your own time, during hours selected by you. This complete training is the reason graduates find CREI diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold top positions in America's leading firms. CREI's Placement Bureau finds better positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply.

Brand New Edition Now Available

Brings you completely up to date—answers important questions on newest career developments in Electronics—including Radar, Guided Missiles, Servomechanisms, Computers, as well as Aeronautical Electronics, Broadcasting (AM, FM, TV), Military, Navy and CAA Electronics, Communications and Electronics Manufacturing.

Now is the time of decision. Luck will not propel you forward unless it finds you trained. Contacts won't budge you an inch unless you have the skill to back them up. The answer is: Technical Training . . . and willingness to learn. Together they will bring you increased earnings in this new Age of Electronics. Fill out the postage-free reply card and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future—is up to you.

MAIL THIS POSTAGE-FREE POSTCARD TODAY

See Our Ad On The Next Page ▶

MAIL THIS POSTAGE-FREE POSTCARD TODAY

CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula

3224 16th St., N. W., Washington 10, D. C.

(R. N. Oct., 56) **BA**

Please send me your course outline and **FREE** Illustrated Booklet "Your Future in the New World of Electronics". . . describing opportunities and CREI home study courses in Practical Electronic Engineering.

CHECK FIELD OF GREATEST INTEREST
- ☐ Practical Radio Electronics Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Television Engineering
- ☐ Practical Aeronautical Electronics Engineering

Name _____ Age _____

Street _____

City _____ Zone _____ State _____

Check: ☐ Home Study ☐ Residence School ☐ Veteran

To help us answer your request intelligently, please give the following information:

EMPLOYED BY _____

TYPE OF PRESENT WORK _____

SCHOOL BACKGROUND _____

ELECTRONICS EXPERIENCE _____

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED? _____

CREI prepares you quickly for success in

- RADAR
- GUIDED MISSILES
- SERVO-MECHANISMS
- COMPUTERS
- AERONAUTICAL ELECTRONICS
- BROADCASTING, AM, FM, TV
- MILITARY, NAVY, CAA ELECTRONICS
- COMMUNICATIONS
- ELECTRONICS MANUFACTURING

The future is in your hands!

The signs are plain as to the future of the trained men in the electronics industry. It is a tremendous industry, and—at the *present time* there are more jobs than there are trained men to fill them. But—when there's a choice between a trained and untrained applicant, the trained man will get the job. Your biggest problem is to decide on—and begin the best possible training program.

CREI Home Study . . . The Quick Way to Get There.

Since 1927, CREI has given thousands of ambitious young men the technical knowledge that leads to more money and security. The time-tested CREI procedure can help *you*, too—if you really want to be helped. CREI lessons are prepared by experts in easy-to-understand form. There is a course of instruction geared to the field in which you want to specialize. You study at *your* convenience, at *your* rate of speed. Your CREI instructors guide you carefully through the material, and grade your written work personally (not by machine).

Industry Recognizes CREI Training.

CREI courses are prepared, and taught with an eye to the needs and demands of industry, so your CREI diploma can open many doors for you. Countless CREI graduates now enjoy important, good-paying positions with America's most important companies. Many famous organizations have arranged CREI group training for their radio-electronics-television personnel. To name a few: All American Cables and Radio, Inc.; Canadian Broadcasting Corporation; Columbia Broadcasting System; Gates Radio Company; Hoffman Radio Corporation; Federal Electric Corporation; Glenn L. Martin Company; Douglas Aircraft Co.; Pan American Airways, Atlantic Division; U.S. Information Agency (Voice of America); Canadair Limited; Trans-Canada Air Lines; United Air Lines. Their choice for training of their own personnel is a good cue for *your* choice of a school.

Benefits Felt Right Away.

Almost immediately you feel the benefits of CREI training. Your employer, when informed of your step toward advancement (only at your request), is certain to take new interest in you and in your future. What you learn in CREI Home Study can start helping you do a better job immediately.

CREI also offers Resident Instruction

at the same high technical level—day or night, in Washington, D. C. New classes start once a month. If this instruction meets your requirements, check the coupon for Residence School catalog.

PAYS FOR ITSELF QUICKLY. Your very first raise could repay your investment in CREI training, and leave you a profit the very first year. Your increases in pay thereafter are all pure profit, and you'll be prepared for many more promotions and pay raises in the future years of your life.

ELECTRONIC TECHNICIANS

Growing Peninsula Co. has openings for 1st class electronic technicians to work directly with engineering in development of new products. Only those with CREI or equal training and 3 years minimum commercial experience will be considered. Top salaries to qualified applicants. Call Mr. McQueeney, DA. 4-4733 for appointment.
ALTO SCIENTIFIC Co., Inc.
855 COMMERCIAL ST.
PALO ALTO

From San Francisco Examiner, April 1, 1956

Industry Calls for CREI Training by Name . . . So Should You!

Here you see an actual help-wanted ad, one of many which specify "CREI or equal" training. This proves that industry approves CREI training, even insists on it!

Send card today for this fact-packed booklet. It's free.

Take 2 minutes to send for this booklet right now. We'll promptly send your copy. The rest—your future—is up to you.

1st Class
Permit No. 288-R
Sec. 34.9 P.L.R.
Washington, D. C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed in United States

3c Postage Will Be Paid By

CAPITOL RADIO ENGINEERING INSTITUTE

3224 16th Street, N.W.

Washington 10, D. C.

and consist of a fairly shallow enclosure filled with suitable material to absorb the backwave.

Thus far the efficiency of the "Corona Loudspeaker" is roughly comparable to that of electrostatic speakers, if one takes as a measure of efficiency the available sound output per unit of area. If we attempt to measure efficiency, however, on a "watts in" *versus* "watts out" basis, we run into difficulty because conventional speakers require watts of audio *power,* whereas the "Corona Loudspeaker" requires only an audio *voltage* to drive it, irrespective of its size, and the power comes from a d.c. source across the needles.

The frequency response of the "Corona Loudspeaker" is much smoother than that obtained with cone type speakers, and it is expected that in its perfected form it will be essentially flat from zero to or beyond the upper limit of audibility. Even in its present form there is *no audible resonant frequency* at the low end.

In the single-ended form, as shown in Figs. 1, 2A, and 2B there is a certain amount of distortion in the output. Fortunately, however, the device lends itself with equal facility to a push-pull configuration, as shown in Fig. 2C, and it is expected that in this version, together with further refinement and the possible addition of over-all negative feedback, the output should be characterized by a vanishingly low distortion content. In the push-pull form there will be the additional advantage of having the outer electrodes at ground potential, which should eliminate any possible shock hazard.

Audio engineers who have seen and heard the "Corona Loudspeaker" even in its present elementary form are considerably impressed with its possibilities, and some have expressed the opinion that it may well be the "loudspeaker of the future." However, you will not be able to buy one next week, and possibly not for another year or so, since further research and development are required to determine all the optimum parameters, both mechanical and electronic, before it can be produced commercially. But when it does reach the market, the "Corona Loudspeaker" should prove to be a contender in the hi-fi sweepstakes. —30—

BRIGGS' HI-FI CONCERT

GILBERT A. BRIGGS of Wharfedale Wireless Works in Great Britain will present his Second Annual High-Fidelity Concert-Demonstration at Carnegie Hall, New York City, Wednesday, October 3rd, at 8:30 p.m.

The program, planned with the cooperation of British Industries Corp., Columbia Records, Inc., RCA Victor, and Westminster Recording Co., will feature both "live" and recorded performances which will be "compared."

The Garrard equipment for the program will be operated by Harold Leak, designer of the British amplifiers bearing his name. The entire program will promote an appreciation of the science and art of sound reproduction. —30—

Superior's New Model 770-A

The FIRST Pocket-Sized VO T-OHM M IAMMETER

USING THE NEW "FULL-VIEW" METER

71% MORE SCALE AREA

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain *measurements instead of approximations* on a popular priced pocket-sized V.O.M.

● Compact — measures 3⅛" x 5⅞" x 2¼". ● Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter. ● Housed in round-cornered, molded case. ● Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications

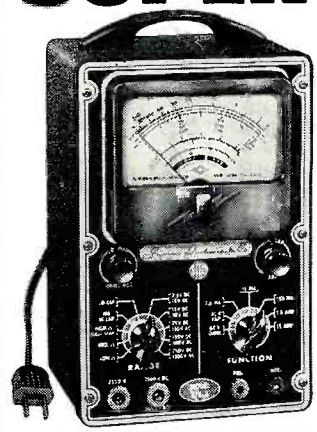
6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts. **6 D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts. **2 RESISTANCE RANGES:** 0-10,000 Ohms, 0-1 Megohm. **3 D.C. CURRENT RANGES:** 0-15/150 Ma., 0-1.5 Amps. **3 DECIBEL RANGES:** —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with self-contained batteries, test leads and all operating instructions.

$15.85 NET

Superior's New Model 670-A

SUPER-METER



A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS.

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts. **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 Volts. **OUTPUT VOLTS:** 0 to 15/30/150/300/1,500/3,000 V. **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. (Good-Bad Scale for checking quality of electrolytic condensers). **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.

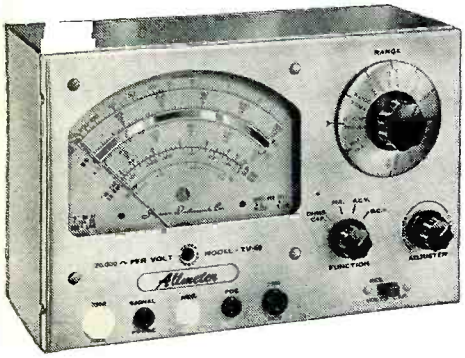
ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's New Model TV-60



20,000 OHMS PER VOLT ALLMETER

Includes services never before provided by an instrument of this type.

Read and compare features and specifications below!

FEATURES

- **A sensitive, accurate Volt-Ohm-Milliammeter with *giant* meter and *mirrored* scale.**
- **An accurate direct-reading Capacity meter.**
- **A Kilovoltmeter.**
- **An R.F. Signal Tracer.**
- **An Audio Signal Tracer.**
- **Giant recessed 6½ inch 40 Microampere meter with *mirrored* scale assures accuracy and easy-reading. All calibrations are printed in large easy-to-read type. Fractional divisions are easily read with the aid of the mirrored scale.**
- **The line cord, used only when making Capacity measurements, need be plugged in only when using that service. It is out of the way, stored in its pliofilm compartment at all other times.**
- **A built-in Isolation Transformer automatically isolates the Model TV-60 from the power line when the capacity service is in use.**
- **Selected, 1% zero temperature coefficient metallized resistors are used as multipliers assuring *unchanging* accurate readings on all ranges.**
- **Use of the latest type of *printed circuit* guarantees maintenance of top quality standard in the production runs of this precise instrument.**
- **A new *improved* type of high-voltage probe is used for the measurement of high voltages up to 30,000 Volts. This service will be required when servicing color TV receivers.**
- **Simply plug-in the R.F. probe and convert the Model TV-60 into an efficient R.F. SIGNAL TRACER permitting the measurement of stage-gain and cause of trouble in the R.F. and I.F. circuits of A.M., F.M., and TV receivers.**
- **Plug in the Audio probe and convert the Model TV-60 into an efficient AUDIO SIGNAL TRACER. Measure the signal levels and comparative efficiency of hearing-aids, public-address systems, the amplifier sections of Radio & TV receivers, etc.**

SPECIFICATIONS

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.

7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.

2 CAPACITY RANGES: .00025 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 + 58 db.

R. F. SIGNAL TRACER SERVICE:

Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE:

Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R. F. Signal Tracer Probe and Audio Signal Tracer Probe. Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. Only

$52.50 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 approval form on page 131 for complete details.)

Superior's New Model TC-55

TUBE TES ER

FOR { **The Experimenter or Part-time Serviceman,** who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap"

Checks for shorts and leakages between all elements
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench — use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

Superior's New Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for 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 Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ 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.

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover

$47.50 NET

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

$72.50 NET

ALSO TESTS TRANSISTORS!

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 approval form on page 131 for complete details.)

About Testing Picture-Tubes . . .

Of course you can buy an "adapter" which theoretically will convert your standard Tube Tester into a picture - tube tester. Sounds fine - but - it simply doesn't work out that way!

We do not make nor do we recommend use of C.R.T. adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a make-shift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensible instrument. Incidentally, the Model TV-40 is the only low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electric-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

PICTURE TUBE TESTER

A complete picture tube tester for little more than the price of a "make-shift" adapter!!

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (Ion trap need not be on tube). Throw switch up for quality test...read direct on Good-Bad scale. Throw switch down for all leakage tests.

Tests all magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!

SPECIFICATIONS:

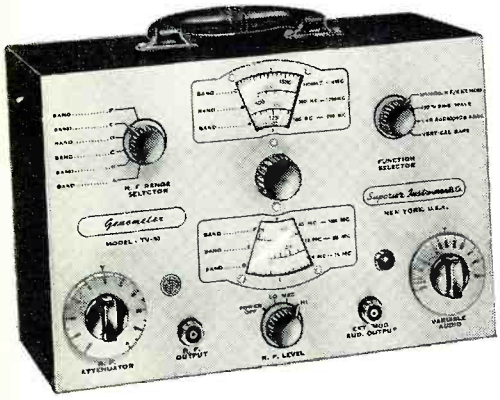
- Tests all magneticolly deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only

$15.85 NET

Superior's New Model TV-50

GENOMETER



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

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

R. F. SIGNAL GENERATOR: The Model TV-50 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.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50 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.

CROSS HATCH GENERATOR: The Model TV-50 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.

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-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50 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-50 comes absolutely complete with shielded leads and operating instructions.

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 approval form on page 131 for complete details.)

Superior's New Model TV-80

5" OSCILLOSCOPE

The Model TV-80 is a *practical* Radio & TV Oscilloscope. It *does not include* those requirements which are provided in Scopes intended primarily for laboratory and research work. It *does include all* the services required for Radio TV Servicing.

When you read the specifications which follow, you will find not a single Radio & TV service requirement has been omitted. Yet, by eliminating "laboratory" features rarely if ever needed by the average Radio-TV Serviceman, SUPERIOR is able to offer a comparatively low-priced scope which provides maximum usage.

SPECIFICATIONS

- Push-pull vertical and horizontal amplifiers.
- Cathode follower vertical input circuit.
- High vertical amplifier sensitivity. .02 volts (20 MV.) per inch.
- Vertical frequency response flat within 2 db from 20 cycles to 500 Kc.
- Vertical square wave response from 20 cycles to 50 Kc.
- High horizontal amplifier sensitivity. .05 volts (50 MV.) per inch.
- Horizontal frequency response flat within 3 db from 20 cycles to 200 Kc.
- Wide range horizontal phasing control.
- Internal linear sweep from 10 CPS to 30 Kc.
- Positive and negative sweep synchronization.
- Direct reading peak to peak voltage calibrator.
- Built-in 60 cycle sine wave sweep phasing control.
- External beam modulation connections.
- Direct deflection plate connections easily accessible.
- Non-glare removable calibrated graph screen.

Model TV-80 comes housed in rugged steel cabinet. Complete with book of instructions.....only

$127.50 NET

READ THIS!! READ THIS!! READ THIS!!

You don't pay for the Tester you select until AFTER you have examined it in the privacy of your home! All models

SHIPPED ON APPROVA

NO MONEY WITH ORDER — NO C.O.D.

Yes, when you send in the coupon (below) you are merely giving us permission to submit the item(s) you select for your approval. If, after trying it you decide to keep it, then and only then do you send us the down payment and pay the balance at the monthly indicated rate with not *one penny added for interest or finance charges*! If not completely satisfied (we can't please everyone) you simply return the unit to us; no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-288, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

Address.....

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

- ☐ Model 670-A . .Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.
- ☐ Model TV-11 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TV-40 .Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TV-50 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model TC-55. . Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TV-12. Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.
- ☐ Model 770-A Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.
- ☐ Model TV-60 Total Price $52.50 $12.50 within 10 days. Balance $8.00 monthly for 5 months.
- ☐ Model TV-80—Total Price $127.50 $27.50 within 10 days. Balance $20 monthly for 5 months.

All Prices net, F.O.B., N.Y.C.

Spot Radio News

(*Continued from page* 16)

changes in pressure and temperature within very short distances, in contrast to the uniformity assumed in classical theories. Thus, the classical assumption has proved inadequate for calculating the viscosity of gases surrounding even relatively slowly moving objects. Considerable effort has therefore been made to develop mathematical theories that take the effect of departure from equilibrium into account. The study of sound propagation provides one of the more direct experimental checks on these recent theories.

Under ordinary atmospheric conditions and at audio frequencies, there is no detectable dispersion of sound; *i.e.*, all these frequencies travel with the same speed. Otherwise, for example, the sounds from a flute and a bass drum, though emitted simultaneously, would not reach the back of the concert hall at the same time. When the frequency is raised sufficiently, however, or if the pressure is correspondingly reduced, an effect known as translational dispersion occurs.

Translational dispersion can be traced to the non-uniform conditions created by the passage of a sound wave. In one region of the gas, for example, the molecules will be moving with an average speed in excess of that of the molecules a little farther on in the direction of propagation. Ordinarily, the molecular speeds are sufficient to transmit the excess speed as fast as the wave pulses arrive. At extremely high frequencies, however, or at extremely low pressures (when the molecules must travel farther between collisions) only the faster molecules participate in the transmission process. As a result, the higher frequencies travel with greater speed.

The Bureau's measurements were made with a double-crystal interferometer. The essential parts of this device are two x-cut quartz-crystal transducers for transmitting and receiving 11-megacycle sound waves. Electrical circuits are used for exciting the transmitter crystal and for amplifying the received signal and measuring its phase and amplitude. The attenuation and speed of the sound are determined from the changes in amplitude and phase of the received signal when the length of the sound path is altered by shifting the transmitter crystal.

Although called an interferometer, the instrument is not operated in the interference region, but under conditions that make the standing waves between the crystals practically negligible. Under such conditions the received phase varies linearly and the received amplitude exponentially with the length of the sound path. The amplitude is presented by a recorder having a logarithmic characteristic, and the phase by a conventional recorder. As a result, when the recorders are driven synchronously with the motion of the transmitter crystal, the slopes of the straight-line records give directly the attenuation, and velocity of sound in the medium.

The studies in Washington are intended as part of a larger program to accumulate data on the dispersion of sound in various gases and mixtures of gases, and to correlate this data with the available theories. Preliminary measurements have already been made in air, oxygen, nitrogen, and hydrogen. During the passage of a sound wave, it has been learned, energy is transmitted first in the form of kinetic energy of translation; and a period of time must elapse before this is shared with the rotational and then with the vibrational modes. In carbon dioxide, for example, it requires about 60,000 mean collision intervals for the energy to be transferred to the vibrational modes. Hence, as the ratio of sound frequency to collision frequency rises the proportion of energy in the translational form increases and the sound wave is transmitted with correspondingly greater speed.

A NEW DEVELOPMENT IN underwater TV, which is expected to have wide application in salvage operations, submarine engineering, marine biology, oceanography, and probably, in underwater intelligence in the event of another war, has been announced in England.

The development, centering about a small hand-held underwater TV camera, can be dropped to a depth of 250 feet. The camera is contained in a 12-inch sphere weighing about 38 pounds on land, but buoyant in the water. The camera can be adjusted from a control unit above water; a diver's only concern is to position the camera correctly.

A larger version has also been designed to operate at depths down to 3000 feet. This model, encased in an aluminum sphere 19 inches in diameter, is also weightless in water, and can be either held in a diver's hand, suspended by a cable from a moving ship, or propelled by an electrically-operated cradle.

THE ANNUAL NATION-WIDE SEARCH for the amateur radio operator who performs the most outstanding public service during the year was announced recently with publication of the rules for the Fifth Annual Edison Radio Amateur Award. A principal winner and several special citation recipients will be chosen from the nation's 140,000 licensed radio amateurs, said L. Berkley Davis, award committee chairman and general manager of the electronic components division of *General Electric,* sponsor of the Edison Radio Amateur Award. He said the winners will be chosen by four nationally known judges from nominations submitted by individuals and groups familiar with public services performed by radio "hams" during 1956.

The judges will review the candidacies shortly after nominations close Jan. 3, 1957. Judging will be based on the amount of sacrifice, ingenuity, and greatest benefit displayed by amateurs in employing amateur radio in the public interest. Copies of the rules and a guide to preparing nominations are available from the secretary of the Edison Radio Amateur Award Committee, Electronic Components Division, *General Electric,* Schenectady, N. Y.

A COMPATIBLE SYSTEM now making it possible to economically combine slow and fast scan television has been developed in the Electronics Laboratory of the *General Electric Company.* The system changes fast TV to slow scan TV by means of an electronic converter.

Slow scan TV produces one picture every four or five seconds, contrasted with fast scan which sends thirty pictures per second.

Still in the laboratory developmental stage, the conversion system promises to widen the combined use of fast and slow TV in industrial and commercial applications. Slow scan TV has the greatest possibilities in uses not requiring transmission of motion. Distortion of the picture results from movement of the subject. However, pictures without much action, such as a picture of a check for signature comparison, can be sent over lines that approach the telephone line bandwidth and can be received by slow television monitors. Use of modified telephone lines eliminates the need for long hook-ups with a costly coaxial cable.

THE BOTTLENECK TV station-grant situation continued to hold down the number of authorizations as this column was being written. Only a handful of OK's were given out, as noted on page 12 of this issue.

COVERAGE OF THE DEMOCRATIC and Republican national conventions by local radio and television stations, and newspapers, too, got a terrific boost this year from special tape recording centers installed both in Chicago and San Francisco.

The tape centers enabled newsmen to record on-the-spot interviews, news stories, and special commentaries and reports. Thousands of feet of magnetic tape, nearly 500 miles of it, were rushed by air express to the newsmen's home stations and newsrooms, not only in this country, but in Canada, too.

A total of 24 tape recorders was on hand for fixed work, and a number of lightweight portable tape recorders were also provided for roving coverage.

This unique service was provided to all accredited newsmen, without charge, as a public service, to keep the American people fully informed on the vital news being developed at these major political events. . . . . L.W.

Electronic Thermostat

(*Continued from page 73*)

do not plug in the thermistor as yet. Insert tubes and connect power. Set sensitivity (R_{12}) at about ½ scale.

2. When the unit has warmed up, check the power supply output voltage by connecting a d.c. voltmeter across C_8. Voltage should be approximately 250.

3. Turn the temperature set control (R_1) through its range and note whether the relay opens and closes. The 33,000 ohm resistor connected in place of the thermistor corresponds to a sensing element temperature which should fall about mid-scale on the dial. If the relay does not work correctly, connect a high resistance voltmeter across it and see how much direct current is going through the coil as R_1 is moved (the resistance of the coil is 5000 ohms, so I equals E/5000). When working correctly, the quiescent current through the coil should be slightly less than 1 ma. Current in excess of this value may result in the relay not dropping out when it should. If everything works satisfactorily but the quiescent current is a trifle high, it may be well to raise the value of the bias resistor R_{10} slightly.

Since the phasing of the power transformer is not indicated by the manufacturer, it will be necessary to determine it experimentally. When phasing is correct, the relay will be closed when the temperature set control is turned to the high end of the scale, and open when the control is turned to the low end of the scale. Should conditions be found to be reversed, simply change the wire feeding the relay to connect to the opposite side of the transformer high-voltage winding.

4. Disconnect the 33,000 ohm resistor from across the input connector and plug in the thermistor. The relay should now operate somewhere in the bottom region of the scale. Adjust the sensitivity control so that the relay opens and closes when R_1 is moved by just a small amount. The unit is now ready to be calibrated.

Calibration can be performed with a reference thermometer and a jar of water. By adding ice to reach the lower range of the temperature scale and hot water to reach the upper range, the calibration can be completed with little difficulty. Care should be taken to avoid wetting the electrical connections to the thermistor.

Since the manufacturer of the thermistor does not guarantee its resistance to close tolerances, the actual range of the instrument may be found to be slightly different from its nominal range. Readjustment may be made by slight changes in the values of R_2 and R_3. In making changes in the measuring circuit, care must be taken that the thermistor power dissipation does not exceed 1 milliwatt, since error due to self-heating may thereby be introduced. —30—

MONEYBACK GUARANTEE ON THE WORLD'S FINEST SERVICE DATA!

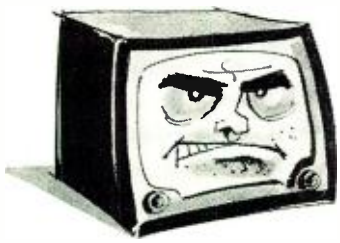
Howard W. Sams will prove to you that PHOTOFACT will help you solve any service problem

FASTER, EASIER, BETTER, MORE PROFITABLY

GET THE PROOF...*DO THIS NOW:*

1.

Choose a "Tough Nut"



Pick a set that's been giving you plenty of trouble—the tougher the test, the better the proof. Get the make and chassis number of the set . . .

2.

See Your Parts Distributor

Look up the set in the Sams Index to PHOTOFACT Folders. In just 60 seconds you'll find the applicable Folder Set. Buy it—take it back to your shop . . .

3.

Give PHOTOFACT the "Acid Test"

With the proper PHOTOFACT Folder by your side, start solving your service problem . . .

THEN, YOU BE THE JUDGE:

If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly.

TRY THE PHOTOFACT MONEYBACK OFFER NOW

LEARN FOR YOURSELF HOW PHOTOFACT SAVES YOU TIME ON EVERY SERVICE JOB...

HELPS YOU EARN MORE DAILY

HOWARD W. SAMS, I C. • 2203 E. 46th ST. • INDIANAPOLIS, IND.

LAFAYETTE SENSATIONAL VALUES! IN COMPLETELY WIRED TEST EQUIPMENT at LESS than the PRICE of KITS!

LAFAYETTE SIGNAL GENERATOR

NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 130 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY

22.50

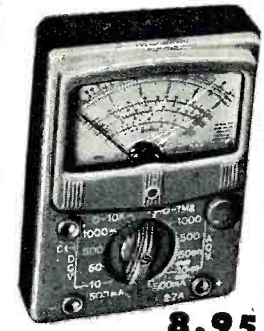
A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC—1000KC, 1MC—3.2MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts, AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR 22.50

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH



FULL SCALE RANGES

DC Volts: 0-10; 0-50; 0-500; D-1000 Volts — *AC Volts:* 0-10; 0-50; 0-500; 0-1000 Volts—*DC Current:* 500 ua and 500 ma — *Resistance:* 0-10K; 0-1 Meg — *Decibels:* —20 to +22; +20 to 36 db (0 db — 0.775 V)—*Capacity:* 250 mmfd to .2 mfd—.005 mfd to 1 mfd—*Output Ranges:* D-1D; 0-50; 0-500; 0-1000 volts

8.95

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼"x3½"x1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A ..... Complete **8.95**

NEW! LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED

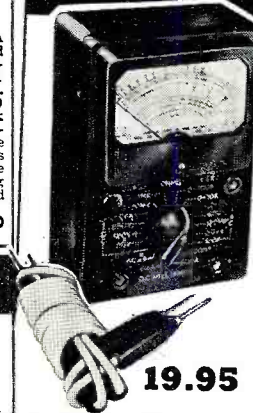
- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS
- 4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

34.50

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001 -.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14½"L x 8¾"H x 5"D. Shpg wt. 19 lbs.

MODEL LC-4 ..... NET **34.50**

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER



LOOK AT THESE FULL SCALE RANGES!

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts — A.C. VOLTS: 0-6; 0-30; 0-120; D-600; 0-1200 Volts — RESISTANCE: 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms— D.C. CURRENT: 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps — DECIBEL: —20 to +17 db (0 db—0.774V) — CAPACITY: .0001-.01; .005-.15 mfd — INDUCTANCE: 20-2000 millihenry —OUTPUT RANGES: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts

19.95

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V A.C., for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6¼"x4¼"x2½". Complete with batteries and leads. Shipping weight 4½ lbs.

RW-30A ..... Singly, Each **19.95**

In lots of 3, Each **19.25**

NEW! LAFAYETTE CAPACITOR-RESISTANCE TESTER

COMPLETELY WIRED AND TESTED

21.50

COMPLETELY WIRED AND TESTED

- CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION
- DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS

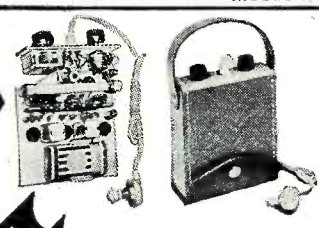
A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9⅜"L x 7⅛"H x 5¼"D, Shpg. wt. 10 lbs.

MODEL LC-15 ..... NET **21.50**

4 AND 6 TRANSISTOR SUPERHET KITS POCKET AND HOME RADIOS FOR SPEAKER AND EARPHONE OPERATION

POCKET SIZE: 4"L x 3-5/16"W x 1"D BUILT-IN ANTENNA! REQUIRES NO EXTERNAL ANTENNA OR GROUND!

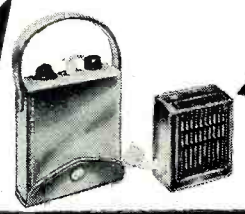
FIRST BUILD THIS



Lafayette engineers have designed this fascinating 4-transistor superhet receiver kit in a unique and interesting form. It is, by itself, a completely self-contained, pocket sized personal portable set which operates a miniature earpiece so only you can hear; by plugging into the KT-96 kit listed below, it is instantly converted to a full 6-transistor home radio, complete with speaker for the entire family to enjoy. Circuit features use of 4 transistors (2 high frequency and 2 audio type) plus a germanium diode, 2 I.F. stages and built-in high gain ferrite core and antenna. The result is a sensitive, stable and selective set covering the entire broadcast band. Requires no outside antenna or ground connection. The kit is furnished complete with transistors and all parts, including battery and chassis already drilled and punched. The earpiece and carrying case are accessory items, not supplied. All necessary pictorial and circuit diagrams are furnished with simple, easy-to-follow instructions.

KT-94 —Kit, shpg. wt., 2 lbs. ..... Net **19.95**
MS-311—Leather Carrying Case ..... Net **1.95**
MS-260—Super power dynamic earpiece ..... Net **3.95**

THEN BUILD THIS



2-TRANSISTOR PUSH-PULL OUTPUT KIT WITH SPEAKER SELF-CONTAINED IN BEAUTIFUL PLASTIC CASE.

- CONVERTS 4-TRANSISTOR KIT INTO A 6-TRANSISTOR HOME RADIO WITH SPEAKER

Add a completely transistorized push-pull audio stage to your 4 transistor receiver. Complete stage including speaker and case measures only 3" H x 2⅜" W x 1⅜" D. Plugs right into 4 transistor kit above. Converts your 4 transistor set to a 6 transistor plus diodes superhet receiver. Performance equal or superior to commercially wired sets selling at more than twice the price. Kit includes 2 transistors, 2 transformers, 2½" PM speaker, pre-punched chassis, speaker case to hold entire stage, battery, hardware, instructions and diagrams.

KT-96—Shpg. wt., 1 lb. ..... Net **11.50**

LAFAYETTE RADIO DEPT RJ-1

JAMAICA 33; N. Y. 165-08 Liberty Ave. Write for FREE Bargain Packed Catalog!

100 SIXTH AVE., NEW YORK, N. Y.
BOSTON, MASS., 110 Federal St.
PLAINFIELD, N. J., 139 West 2nd St.
NEWARK, N. J., 24 Central Ave.
BRONX, N. Y., 542 E. Fordham Rd.

FREE! LAFAYETTE CATALOG

ELECTRONIC CATALOG PACKED WITH MONEY SAVERS

Packed with the largest selection of Electronic, Radio and T.V. Parts, and equipment, PA, Hi-Fi systems, tubes, antennas, Transistor Kits, parts and components, Test Equipment, new build your own kits, tools, books, Microscope, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies — ALL AT GREAT SAVINGS — For the economy minded servicemen, dealer, engineer and technician. CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TO-DAY.

35 WATT HI-FI AMPLIFIER KIT WITH METERED OUTPUT AND 4 PUSH-PULL PARALLEL NEW EL84 TUBES

New Lafayette high power amplifier kit with a host of features not in any other single amplifier. Calibrated output meter permits use as either a recording or reproducing amplifier. EL84 power pentodes provide high peak power and low distortion required for better audio quality. Features exceptional control versatility and ample inputs for all associated custom hi-fi equipment. DC operated preamp filaments and balancing adjustment to minimize hum. Meter can be switched to indicate either recording voltage or output level of amplifier. Features rumble filter, loudness control, separate bass and treble controls, silencing switch, speaker selector switch, output balancing adjustment and monitoring jack.

SPECIFICATIONS

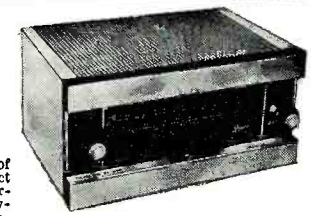
FREQUENCY RESPONSE: ± 1 db 20-40,000 cps. **HUM:** 85 db below rated output. **POWER OUTPUT:** 35 watts with 4% total distortion at full rated output. **INPUTS:** TV Sound, Radio, Magnetic Phono, Crystal Phono, Tape. **OUTPUT IMPEDANCE:** 4, 8 and 16 ohms; high impedance for tape recorder. **TUBE COMPLEMENT:** 3-12AX7, 1-12AU7, 4-EL84, 1-5U4. **FEEDBACK:** Negative feedback loops virtually eliminate distortion. **POWER:** 117V, 60 cps, 80/150 watts with auxiliary power receptacles. Removable escutcheon. Size 12⅛" L x 9¾" D x 4⅛" H.

A combination of high power, high fidelity, gleaming beauty and advanced engineering features unmatched at even twice the price. Supplied in complete kit form with simplified easy-to-follow instruction sheets. Shpg. w., 25 lbs.

KT-115—Complete kit, ...Net **59.50**

LAFAYETTE'S FM-AM TUNER KIT

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL



The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output: **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 μv for 30 db quieting; AM, Loop sensitivity 80 μv/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwith, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 Complete kit, less cage. .....Net **34.95**
LT-10 —Completely wired..... Less metal case. .....Net **52.50**
ML-100—Metal cage for above, shpg. wt., 3 lbs.....Net **5.00**

New! HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4¼" long x 3" diameter, lens extends 2½". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 .....Net **14.95**

METAL-CASED CONE TYPE HI-FI TWEETER

FREQUENCY RESPONSE 2000 - 16,000 CPS · HANDLES 20 WATTS OF POWER

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required; the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3⅛" x 2⅛" x 3" Diam. Shpg. wt., 3 lbs.

HK-3 .....Net **5.95**

CROSSOVER NETWORK

- CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS
- BUILT-IN LEVEL BRILLIANCE CONTROL

The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2½ ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2⅝" H x 2⅝" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 .....Net **8.75**

2 WAY SPEAKER SYSTEM 40-16,000 CYCLES

A modest budget need no longer limit your Hi-Fi aspirations. The system consists of the G.E. 12" woofer with heavy 14.5 oz. alnico V magnet and 1¼" aluminum voice coil rated at 25 watts; the new metal cased HK-3 cone type tweeter; and the LN-2 crossover network with level and brilliance control. Both tweeter and network are described on this page. The complete 2-way speaker system covers the frequency range 40-16,000 cycles. Shpg. wt., 16 lbs.

SY-87—Complete System.....Net **27.50**

SY-86—Complete System, same as above except the HW-7 Tweeter with acoustical lens is supplied instead of HK-3. Shpg. wt., 20 lbs.....Net **36.50**

New! LAFAYETTE Mail Order Center

Lafayette Radio

DEPT RJ-2

165-08 Liberty Ave.
JAMAICA 33; N. Y.

NAME _____

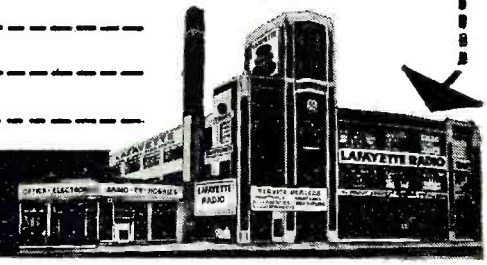
ADDRESS _____

CITY _____

ZONE _____

STATE _____

SEND FREE LAFAYETTE CATALOG



CUT OUT AND MAIL TODAY!

Transistor Preamp

(*Continued from page* 48)

R_2 and R_4 fixed, R_5 decreases as R_3 increases; (c) with R_2 and R_3 fixed, R_5 increases as R_4 increases; and (d) with R_5 constant, sensitivity and voltage gain increase as R_2, R_3, and R_4 increase. Although zero values for R_2, R_3, and R_4 were successfully tried out, they are not suitable in practice for the purpose in hand. This is because the corresponding resistance of R_5 is reduced to an impractical value. When $R_2 = 0$, even with high values for R_3, R_4, and R_5, voltage gain and sensitivity to low signal voltage are drastically reduced. Much higher input voltages (up to approximately 1 volt or so) can be tolerated without distortion under this condition. Recommended low limits for resistors R_2 through R_5 are, respectively, 470, 1000, 22,000, and 10,000 ohms.

Finalized Amplifier

The final circuit has the component values listed on the diagram of Fig. 2. In the breadboard prototype, R_5 actually measured 200,000 ohms. However, in the completed unit it was necessary to reduce this resistor to 180,000 ohms due to the commercial tolerances. With a commercial 220,000 ohm resistor, the positive half of a sine-wave output was badly clipped. This serves to demonstrate the necessity for making preliminary tests on a transistor amplifier prior to final assembly and housing. Figs. 1 and 3 show the completed amplifier. Voltage gain at 10 cps was about 20 db and 30 db at 50 cps. From about 100 cps upward, it remained steady at approximately 38 db.

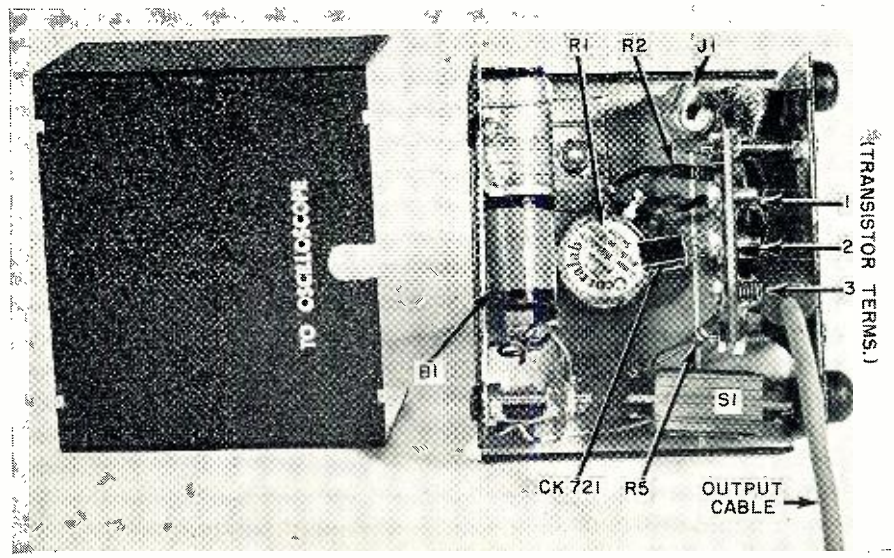
Construction

The amplifier was built into an *LMB*-135, 3" x 3½" x 2⅛" black, wrinkle-finished, interlocking aluminum box. Two terminal strips of the screw-type with solder lugs on the under sides were used. These had two and three terminals, respectively, for the 3-volt battery and the CK721 transistor. The latter was numbered 1, 2, and 3 to correspond to the transistor element numbers. A red dot was marked at terminal #1 to coincide with the similar mark beside the collector wire on the CK721. The battery terminals were marked "+" and "—" with the former grounded to the chassis. This grounded terminal is visible in the lower left-hand corner of the interior view of Fig. 3. Note that the top of the unit is actually at the left in the photograph.

The battery is clamped to the top of the box and short leads soldered to its flat strip connectors. S_1 and J_1 are located at the right- and left-hand sides of the unit. A six-foot, single-conductor shielded ¼" o.d. cable is permanently wired to the output between a ground lug to the shield and the center conductor to terminal #1 of the transistor. It is brought out through a grommet and slot in the bottom center of the rear cover and anchored internally with insulated plastic tape. Rubber feet were added to the bottom of the box, but they are not absolutely essential. Decals were used to give the completed unit a "professional" appearance.

As a result of the probing necessary to design and build this circuit, the author found that a CK721 transistor may be used as a high-voltage, high-impedance amplifier providing that, as with vacuum-tube types, (a) component resistances are relatively high and (b) R_2 is not less than 470 ohms. Results indicate that more than one high-voltage, high-impedance amplifier stage is impractical without distortion, hence input should be limited to not more than about .02 volt (measured at the base, with gain control at maximum). The transistor amplifier of Fig. 2 will give a relatively high voltage gain provided the input looks into a source of several megohms and the output into a load of not less than one-half megohm. —30—

Fig. 3. Internal view of chassis showing the locations of various component parts.



Loran APN/4 Oscilloscope

Easily converted for use on radio-TV Service Bench!

BRAND NEW
Completely Assembled

Supplied only with 5" Scope type 5CP1 and RCA Crystal Unit... **$14.95**

TS-100/AP OSCILLOSCOPE

BRAND NEW (worth $750) **OUR LOW PRICE** **$34.50**

Can be used with linear sweep or general purpose test scope. Cables included. Also used with circular sweep as precision range calibrator. Self-contained in metal case 8" x 12½" x 16" deep. For 110V 50 to 1200 cycles AC. Demilitarized, New, with all tubes including crystals and C. R. Tube.

TS-16/APN TEST SET

Very Special at this low price. **BRAND NEW.** Complete with all cables..... **$12.95**

Type 2J1F1 SELSYNS

Operates from 57½ volts, 400 cycles. New tested. Conversion diagram for 110 volts AC included. **BRAND NEW,** each..... **$2.95**
CAPS FOR ABOVE.....50c

BC-906-C FREQ. METER—SPECIAL!

Cavity type, 144 to 235 Mc. BRAND NEW in original factory packing, complete with antenna & operating manual.
OUR LOW PRICE **$8.88**

NAVY RECEIVER TYPE ARB

Four Band. 105 to 9050 kc. Low Freq., Ship, Broadcast—40 to 80 meters. Includes tubes and dynamotor, for 24 volt operation. Easily converted for 110 V., 12 V, or 6 V. Schematic Included. Excellent Condition. Overall: 8¼" x 7¼" x 15¼". Wt. 30 lbs.
COMPLETE WITH ALL TUBES,
Special..... **$21.50**

NEW! Cathode Ray Tubes NEW!

3CP1	$ .88	5BP4	$2.22
3FP7	.88	5CP1	2.45
5BP1	2.22	9LP7	1.88

DYNAMOTOR VALUES!

Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
DM-28	28V	224V .07A	1.95	4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A	1.95	3.95
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A	....	7.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24
PE-103	6V	500V .160A		
	12V	500V .160A	19.50	34.50
PE-186	28V 11A	400V .400A	....	6.95

MG-149-F INVERTER

Special **$19.49**

Input 24 VDC @ 36A
Output 26VAC @ 250 VA;
115V. @ 500 VA.
single phase, 400 cycles.

SPECIAL G.E. DYNAMOTOR

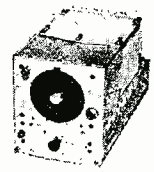
INPUT: 28 V. D.C. @ 19 A.
OUTPUT: 1000 V. D.C. @ .350 A.
Model 5D48B9A. **BRAND NEW**.... **$4.95**

2-VOLT BATTERY "PACKAGE"!

1—2V. 20 Amp. Hr. Willard Storage Battery. **$2.45**
1—2V. 7 prong Synchronous Plug-in Vibrator **1.49**
1—Quart Bottle Electrolyte (for 2 cells)... **1.45**
ALL BRAND NEW!
Combination Price... **$4.99**

Willard 6-Volt Midget Storage Battery
3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte.....Only **$2.22**

BC-946B BROADCAST RECEIVER



520 to 1500 Kc, 6 tubes: 3—12SK7, 12SR7, 12A6, 12K8. For dynamotor operation. Easily converted to 110 or 32 Volt. 2—IF stages. 3-gang tuning cond. Complete with all tubes, in original sealed carton. BRAND NEW..... **$19.95**

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.....**$7.88**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW.....**$7.88**
BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal. BRAND NEW.....**$11.95**
BC-696 TRANSMITTER—3 to 4 Mc. BRAND NEW, complete with all tubes & crystal.....**$8.88**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Excellent Used	Brand NEW
BC-453	Receiver 190-550 Kc..	$9.95	$11.95	$14.95
BC-454	Receiver 3-6 Mc.....	7.19	8.29	11.95
BC-455	Receiver 6-9 Mc.....	5.25	7.95	9.95
BC-456	Modulator	2.24	2.75	4.24
BC-450	3-Receiver Control Box	...	1.49	1.95
BC-451	Transmitter Control Box	...	1.25	1.49
BC-696	Xmtr 3-4-Mc (like new	...	6.95	8.88

110 VOLT AC POWER SUPPLY KIT

FOR ALL 274-N and ARC-5 RECEIVERS

Can be assembled quickly and easily, on pre-drilled chassis. Plugs into the rear of any model 274-N receiver and delivers 24 volts as well as "B" voltage. Complete kit of parts with metal case, instructions..... **$7.95**

SPLINED TUNING KNOB for 274-N RECEIVERS. Fits BC-453, BC-454 and others. **Only**.. **49c**

ARC-5/R-28 RECEIVER

2 Meter superhet, 100 to 156 Mc in 4 xtal channels. Louvred alum, cabinet 7⅜ x 4⅞ x 14". Complete with 10 tubes and 4 xtals Excel. Cond. **$12.95**

ARC-5/T-23 TRANSMITTER

Companion for above, incl. 2-832A, 2-1625 tubes and 4 xtals. **BRAND NEW**.....**$14.95**
Less Tubes.....**$6.95**

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**

Ham Special! Famous BC-645 XMITTER-RECEIVER

With DIAGRAM for Easy Conversion to CITIZENS' BAND!

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. CONVERSION DIAGRAM INCLUDED. This swell rig originally cost over $1000—yours for practically a song! You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. **Conversion Instructions Included.** Shpg. wt. 25 lbs..... **$29.50**

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) .....only **$7.95**
UHF ANTENNA ASSEMBLY, for BC-645 ....**$2.45**
Complete set of 10 Plugs for BC-645 ..... **$5.50**
CONTROL BOX for above.....**$2.25**
SHOCK MOUNT for above.....**1.25**
CONVERSION BOOKLET. Instructions for most useful surplus rigs..... **$2.50**

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.
BRAND NEW, in original carton. **$19.95**
TAPES FOR ABOVE AVAILABLE

TG-5-B TELEGRAPH SET

Made for USA Army Signal Corps. A dandy little field set for 2-way communication. Sturdy metal container, 6¾"x4¾"x4", with hinged covers, complete with telegraph key and headset. BRAND NEW, in carrying case with shoulder strap..... **$9.95**
Used, exc. Cond.....**$7.95**

BUBBLE SEXTANT

Made for U. S. Armed Forces, by AGFA ANSCO. Actually worth $150 or more! Has illuminated averaging disc for nighttime use. Complete with carrying case. Only..... **$9.95**

WRITE FOR FREE CATALOG!

Please include 25% Deposit with order—Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

G & G Radio Supply Co.
Dept. N-10
51 Vesey St., New York 7, N. Y., CO 7-4605
Branch: 5009 N. Neva Ave., Chicago 31, Ill.

BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. **BRAND NEW**.. **$8.88**
Brand New, less tubes..**$5.95**
USED, with tubes.....**$5.95**
USED, less tubes..... **2.95**

SCR-522 FINEST 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, complete with all components. 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.
COMBINATION.....**Special** **$33.33**
Receiver Only, with all tubes...**$19.50**
Transmitter Only, with all tubes.**$22.25**

LORAN APN-4

FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, Export packed. **COMPLETE**..... **$129.50**

SPECIAL APN-9A LORAN Receiver Indicator, less tubes, NEW (demilitarized)..... **$29.50**

AN/ARR-2 RECEIVER

BRAND NEW—A Terrific Value! Tuning Range 234 to 258 Mc. Tubes: 7-9001, 3-6AK5, 1-12A6. Only a few at this low price! **Complete $8.88.**
With 28 V 1.6A Dynamotor, complete..... **$12.98**

110 VOLT AC POWER SUPPLY KIT for above **$7.95**

BC-221 FREQ. METER.....**$129.50**

BC-221 FREQ. METER CASE

Aluminum case for BC-221 or TS-164 Freq. Meters. With volt. reg. supply using VR105. 2 ballast tubes, relay, cable, etc. Inside front: 9¾ x 7½ x 7⅜". Inside rear: 2" deep. Shock-mounted. **BRAND NEW,** (Add 50c for packing) **$3.99**

Original Crystal for BC-221 1000 Kc BRAND NEW.....**$8.45**

COMPLETE OPERATING MANUAL for BC-221 Freq. Meter..... **$1.95**

BENDIX DIRECTION FINDER

MN-26-C. 12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands. 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises:
MN-26-C Receiver, used, with 12 tubes..... **$16.50**
MN-26-C With 12 Tubes, BRAND NEW.....**$22.50**
MN-20-E Rotatable Loop..... **4.25**
MN-52 Azimuth Control Box..... **2.95**

MN26Y BENDIX DIRECTION FINDER

150 Kc. to 7 Mc. Complete with tubes, motor. **BRAND NEW**..... **$26.95**
Used, like new, incl. tubes and dynamotor..**$18.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike.....$5.45		$7.95
T-30	Carbon Throat Mike...	.33	.69
T-45	Navy Lip Mike.....		.99
RS-38	Navy Type	2.45	4.95
T-24	Carbon Mike		3.95
T5-9	Handset		4.95

DYNAMIC HANDMIKE, with "Press-to-talk" Switch, cord and plug—BRAND NEW, only.....**$2.95**

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
H5-23	High Impedance.....$2.25		$4.35
H5-33	Low Impedance	1.99	4.65
H5-30	Low Imp. (featherwt.).	1.49	2.25
H-16/U	High Imp. (2 units)...	2.75	7.95
CD-307A	Cords, with PL55 plug and JK26 Jack		.99

DYNAMIC HEADPHONES, 600-ohm impedance, with large earphone cushions, cord and phone plug. BRAND NEW, special.....**$2.95**

SOUND POWER Headphone with Dynamic Mike, BRAND NEW..... **$3.95**

HI-FI DYNAMIC HEADSET with Cushions
Freq. Range: 40-14000 CPS. No Distortion. **BRAND NEW** **$5.95**

EE-8 FIELD PHONES

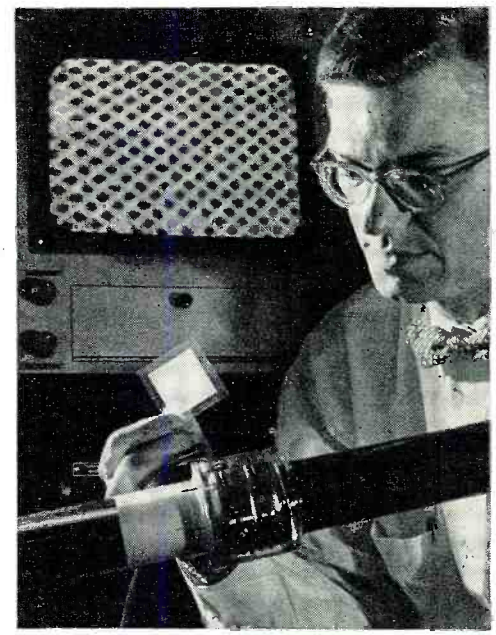
OUR PRICE, EACH..... **$16.66**
BC-605 INTERPHONE AMPLIFIER. Easily converted to intercom set—ideal for office, home or factory! BRAND NEW, with original schematic.....**$4.44**

BC-442 ANTENNA RELAY UNIT

Wonderful Value! Consists of ¾ amp 2" RF Ammeter (antenna current indicator, 0-10 scale, Transmitter-Receiver Switching relay, in aluminum case with associated components. BRAND NEW..... **$2.24**

"Honeycomb" Signal Storage Tube

New tube with mosaic target holds nearly million "bits" of information and makes possible smaller computers having bigger memories.



Dr. Harold R. Day, scientist at the General Electric Research Laboratory, holds a thin information storage mesh above the "reading and writing" tube in which it operates. Tiny honeycomb is electronically magnified on the television screen in background. Tube is expected to have wide use in computers.

AN inch-square "honeycomb" developed recently by a *G-E* scientist will store up nearly a million bits of information. Smaller electronic computers with bigger memories are among the anticipated applications.

Dr. H. R. Day of the *G-E Research Laboratory* described his new information storage tube at an electronics conference recently. At the heart of the tube is a thin sheet of glass in which small holes have been etched and then filled with metal. In practice, information is written onto one side of the honeycomb by an electron-beam scanning method similar to that used in television. A "reading gun" picks up the information from the opposite side. Early laboratory models have permitted storage for several minutes and Day is confident the time can be extended.

Since the holes in the honeycomb are spaced 500 to the inch, each square inch has 250,000 individual storage cells—and each cell will recognize at least 10 different levels of intensity from the writing gun. Logarithmic calculations increase to more than 800,000 the number of bits of information that can be stored at one time (250,000 times log to the base 2 of 10).

Possible applications for the new storage tube in addition to computers include television cameras and "scan converters" in which radar information is collected and then displayed on an ordinary television screen.

The "mosaic" principle has long been recognized as ideal for storage tubes, but Day's device is believed to be the first developed with sufficient resolution and ruggedness to be suitable for most applications. Each storage cell "remembers" by building up charge in the capacitance formed between the recessed metal plugs and the conducting layers on both surfaces of the glass. The glass honeycomb itself acts as an insulator between the plugs and the surface layers—and between the plugs themselves. Because the spacing between elements is rigidly maintained, the entire structure is very rugged and the usual problem of microphonics does not arise. —30—

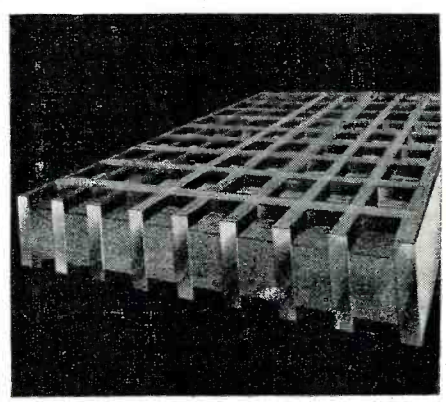
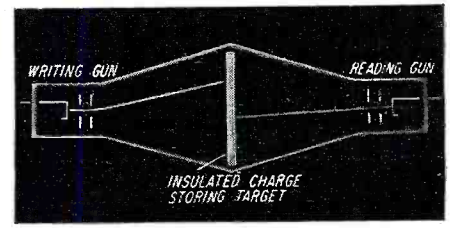
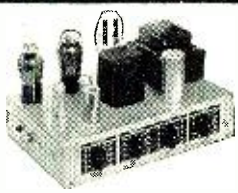


Illustration at left shows greatly enlarged view of glass mesh and its recessed metal plugs. These plugs are only 1/500 inch apart. Diagram below shows "writing gun" placing information on the cell by a TV-like scanning method. The "reading gun" picks up the information from the other side.



AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

ECONOMY 20 WATT AMPLIFIER $22.95



Model HF-20

NEW 1957 MODEL

Push-Pull 6L6 Output Tubes
Response 30-15,000 CPS
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V.R. Phono

With CU-14Y, 12" Coax Speaker...$32.95
With P15-CR, 15" Coax Speaker...$42.95
With Imperial IV System.....$39.95
With Imperial VI.....$48.95 With HF-33GE $69.95

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7⅜" x 10½" x 7⅛" high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier. McGee's sale price, $22.95.

NEW "LOW-BOY" 3-WAY SPEAKER SYSTEM

15" COAXIAL SPEAKER
6" SPEAKER-CROSSOVER
30 to 17,000 CPS

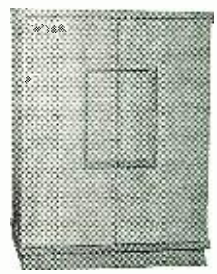
SALE PRICE **$29.95**

Low-Boy, 3-way High Fidelity speaker system. Designed expressly for apartment size high fidelity. Available in mahogany finish cabinet only. Use with any high fidelity amplifier. Matches 8 ohm impedance. Equipped with a top quality 15" coaxial speaker and a 6" speaker on one side for augmented mid-range audio dispersion. Size, approx. 29" high, 24" wide and 21" front to back. A tremendous high fidelity speaker system with response from 30 to 17,000 cps. Stock No. GM-415, ship. wt. 40 lbs. Sale price $29.95.

BLOND OAK 3-WAY HI-FI SPEAKER SYSTEM

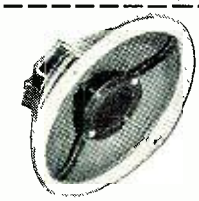
HEAVY ELECTRO-VOICE SALE PRICE
15W-15" WOOFER
E-V 847 MID-RANGE
4401 HORN TWEETER
BUILT-IN CROSSOVER—
30-15,000 CPS

$179.95



A new 3-way High Fidelity console speaker system which features a beautiful blond oak cabinet, an Electro-Voice $78.00 net 15" woofer and mid-range horn, University 4401 tweeter and 3-way crossover network. Electro-Voice 15W, 15" woofer has a frequency response from 30 to 1200 cps, essentially flat. Woofer has a net weight of 37 lbs. Mammouth 5¼ lb. Alnico V magnet measures 8" in diameter and is 4¼" deep. Has 2½" voice coil, will take up to 30 watts. Electro-Voice 847, 2-way driver horn is used as the mid-range speaker with response of 300 to 10,000 cps. University 4401 tweeter is of the horn type and responds to frequencies up to 15,000 cps. 3-way crossover network is of the inductance-capacitance type which presents a constant resistance type load to your audio system. Equipped with an L-pad to vary loudness of the middle-high ranges. This crossover blends all three speakers into a practical system with only two wires to connect to any 8 ohm output of your high fidelity amplifier. Quality blond oak cabinet measures 43" tall, 31" wide and 23½" deep. Intended for a TV set, this cabinet cost the manufacturer over $100.00. We have converted it to a speaker cabinet, adding a full acoustical lining and back. This saving makes our low price possible.
Model EV84-15W, complete speaker system. Ship. wt. 150 lbs. Sale price, $179.95.

McGEE'S NEW 1957 MODEL
25 WATT 12" COAXIAL SPEAKER



★ 14½ oz. G.E. 12" WOOFER—
★ 3½" COAXIALLY SUSPENDED TWEETER—
★ BUILT-IN CROSSOVER—
★ ALUMINUM VOICE COIL WOOFER—

$18.95

McGee's new 1957 model, GE-120XT, 12" 25 watt high fidelity coaxial PM speaker. No frills or dummy pot cover, it's all speaker value. Features a General Electric 12", 14½ oz. Alnico V woofer with aluminum voice coil and exponential, molded seamless cone. The tweeter is a specially made 1.47 oz. Alnico V, 3½" speaker which extends the high frequency response to 17,500 cps. It is electrically connected to accept only the upper register of audio. Only two wires connect this complete high fidelity speaker to any 8 ohm amplifier. Ship. wt. 8 lbs. Stock No. GE-120XT. McGee Sale price, $18.95.

New 1957 model, 20 watt deluxe 12" coaxial PM speaker. Only 2 wires to connect to any 8 ohm Hi-Fi radio or amplifier. Features an aluminum voice coil General Electric 12" PM speaker with 10 oz. Alnico V magnet, plus a coaxially suspended tweeter. Crossover network built-in. Responds up to 17,500 cps. Stock No. GE-100XT, 12" coaxial PM speaker. Ship. wt. 8 lbs. Sale price, $14.95.

McGee's Famous
12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y

$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR. McGee's Sale Price, $23.95.
McGee's new 15" Junior coaxial PM speaker. 15" woofer has 6.8 oz. Alnico V magnet. 5" coaxially suspended tweeter with crossover. Only two wires to connect to any 8 ohm radio or amplifier. Freqaency response from 40 to 15,000 cps. Model No. M15-CR, 15" Junior coax PM speaker, Sale price, $16.95.

IMPERIAL 30 WATT AMPLIFIER $29.95

NEW 1957 MODEL

Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike

With CU-14Y, 12" Coax Speaker .$39.95
With P15-CR, 15" Coax Speaker..$49.95
With Imperial IV Speaker System.$46.95
With Imperial VI.....$55.95 With HF-33GE $76.95

Model IMP-30

New 1957 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A $100.00 list value for only $29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feed-back; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8" speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone. 4 controls are mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components would cost you up to $15.00 if purchased separately. Gold color chassis is 12¼" x 7¾" x 7¼" high. Complete with tubes: 6AT6, 12AU7, 6C4, 12AU7, 2—6L6GA, plus 5U4G rectifier. Stock No. IMP-30, 30 watt Imperial High-Fidelity amplifier complete with tubes and diagram. Ship. wt. 23 lbs.. Sale price only $29.95.

NEW IMPERIAL 24 WATT AMPLIFIER $39.95

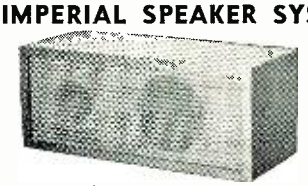
PUSH-PULL EL-34 ENGLISH MADE MULLARD OUTPUT TUBES
WILLIAMSON TYPE CIRCUIT
RESPONSE 15-20,000 CPS

With CU-14Y, 12" Coax Speaker..$49.95
With P15-CR, 15" Coax Speaker..$59.95
With Imperial IV Speaker System.$56.95
With SP12125CR..$65.95. With HF-33GE..$86.95. Model IMP-34X

New, 1957 model Imperial 34X, 24 watt high fidelity amplifier for the audio enthusiast who want McGee's finest amplifier. This amplifier features push-pull EL-34 English made Mullard output tubes in a Williamson circuit. Heavy duty 6 lb. specially wound Williamson type ultra-linear output transformer in potted case has a response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. Amplifier has input for crystal pickup and built-in pre-amplifier for the popular General Electric and Goldring variable reluctance cartridges; as well as input for crystal or high impedance dynamic microphones. 4 controls are microphone gain, phono gain and separate variable treble and base boost tone control with off-on switch. Chassis size: 12¼" x 7¾" x 7¼" high. Complete with 7 tubes and diagram. Model IMP-34X, 24 watt high fidelity amplifier, ideal for use with any of our high fidelity coaxial or multiple speaker systems. Ship. wt. 26 lbs. Sale price, $39.95.

NEW IMPERIAL SPEAKER SYSTEMS

Imperial IV with 8" G.E. High Fidelity Speaker
$19.95



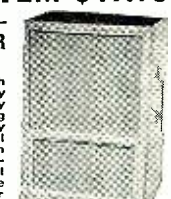
3-Way Imperial VI with 12" G.E. Speaker
$29.95

New 1957 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95.

1957 Model Imperial VI, 3-way speaker system. Baffle is of heavy wood, leatherette covered. Similar in appearance to the Imperial IV pictured above, except 4" taller and 1" deeper. Equipped with 3 matched speakers. A 12" G.E. Model 1203 with 9 oz. Alnico V magnet, plus 5¼" PM for middle range and 3" tweeter. Simple to connect to any high fidelity amplifier. (8 ohms impedance). Stock No. IMP-VI, Sale price, $29.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

CONSOLE HI-FI SPEAKER SYSTEM $49.95

12" G.E. PM WOOFER—10" PM MID-RANGE—8" G.E. MODEL 850 MID-HIGH RANGE SPEAKER AND 600 CYCLE L-C CROSSOVER NETWORK.



Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires feed the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets: blonde or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE. Sale price, $49.95.
Model HF-44GE, console speaker system, same as above except has a heavy duty 12" G.E. PM Model 1201, plus 8" G.E. PM Model 850, 10" mid-range speaker and 5" hard cone tweeter. Sale price, $54.95. (Specify cabinet finish.)
Model HF-55GE, super deluxe quality console speaker system, same as HF-33GE described above, except has 15", 21 oz. Alnico V magnet woofer, 10" mid-range PM speaker and Model 4401 University horn type tweeter. All 3 systems incorporate 600 cycle L-C type crossover network with variable tone compensating control. Model HF-55GE, Sale price $69.95 (specify cabinet finish).

THEATER QUALITY HIGH FIDELITY SPEAKER SYSTEM $39.95

15" WOOFER PLUS—ELECTROVOICE MODEL 847 MID-HIGH RANGE SPEAKER — 600 CYCLE LC CROSSOVER.

A theatre quality, powerful speaker system for homes and sound demonstration rooms. This speaker arrangement will connect to any high fidelity audio amplifier (8 ohms impedance) Features a 15" electro-dynamic heavy duty woofer which is equal to a PM speaker with up to 10 lbs. of Alnico V magnet. This woofer reproduces the low audio register from 600 cycles down to 20 cps. An Electro-Voice Model 847 horn type speaker is used for the middle range and high range of audio. These two speakers are connected to a 600 cycle inductive-capacity crossover network. Built in the network is the field exciter for the 15" woofer. You could spend over $100 for a speaker system and not beat this one. Stock No. EV-15847X, McGee's sale price, $39.95.

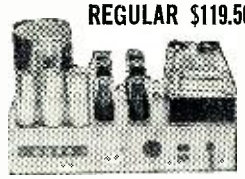
McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 2-5092
1903 McGEE ST., KANSAS CITY, MISSOURI

McGEE's $100,000 SALE! FM/AM CHASSIS-CHANGERS — MONEY-SAVING VALUES

FM/AM TUNER
ESPEY 14-TUBE MODEL 700G



ESPEY 24 WATT
MODEL 501G AMPLIFIER

REGULAR $119.50 VALUE

ESPEY 14 TUBE FM/AM TUNER ON SALE $79.95

24 WATT HIGH FI AMPLIFIER $39.95 EXTRA

34 WATT HIGH FI AMPLIFIER $54.95 EXTRA

McGEE'S FINEST VALUE EVER OFFERED

YOU COULD SPEND MORE But Get NO BETTER

McGee offers you for only $79.95 Espey's regular $119.50 14 tube Deluxe AM-FM tuner. (Separate audio amplifier required such as model 501G or 501E.) Prices above with 14 tubes including rectifiers. Tuner has its own built-in AC power supply. Your savings are almost $40.00. Espey Model 700G performance features: Sensitivity 3mv on AM, 5mv on FM for 30db quieting. AM selectivity 10kc at 6db. FM 240kc at 6 db. Audio response flat from 20 cps. to 20,000 cps. with less than ¼ percent distortion with one volt audio output. Chassis is 14" long, 8½" high and 10" deep. Features a one-piece molded, gold-colored, plastic front which makes custom installation easy. Features full tuner RF stages—AFC on FM with defeating switch for easy FM tuning. Built-in pre-amplifier for GE variable reluctance phono cartridge, Pickering, etc. Three-position equalizer switch for—LP, AES or European phonograph records. Separate bass and treble tone controls with 23db. boost. Chassis is equipped with AC outlet jacks, auxiliary input jacks for tape recorder, etc. Built-in ferrite loop antenna for AM broadcast and 300-ohm input for FM band.
The Espey 700G FM/AM tuner is second to none. It has all the features you might expect even if you paid up to $200.00 for a tuner.
This 700G FM/AM tuner chassis has all controls on the front which is desirable when you are using it with any good audio amplifier many of which are designed with no tone control or preamplifier circuits. We offer the 700G FM/AM tuner at only $79.95. Shipping wt. 20 lbs.
Espey 700G with Model 501G 8-tube Hi-Fi audio amp. both for $119.90. Stock No. 700G-501G. Shipping wt. 42 lbs.
Espey 700G with Model 501E 8-tube 34-watt Hi-Fi power amplifier, $134.90.

Espey model 501G 8-tube ultra linear high fidelity 24 watt audio amplifier matching unit for use with model 700G tuner. Regular $79.95 value—$59.95 when purchased alone and $39.95 when ordered with the Espey 700G tuner. This amplifier features less than ½ percent distortion with high fidelity audio frequency response from 10 cps. to 20,000 cps. Hum level so low it can be detected by electrical instruments only. Chassis size—12"x5"x8". Output tubes—4 6V6GT in push-pull Williamson high fidelity. Plus 6SN7 phase inverter and 2 5V4G rectifiers. Features an eight-pound potted case $20.00 value output transformer with grain oriented iron core. Output impedance taps for 4, 8 and 16 ohms. Each $39.95

Espey model 501E 8-tube 34-watt ultra linear high fidelity audio amplifier companion unit to be used with the Espey 700G tuner. Same appearance as model 501G. Equipped with 4 EL 37 English Mullard output tubes. Regular $79.95 value—$69.95 if purchased separately; $54.95 if purchased with our 700G tuner. Each $54.95

ESPEY DEAL—1

Espey 700G-501G tuner with 24 watt amplifier plus Monarch UA6U and Goldring phono cartridge. Net $144.95

If 34 watt amp is desired in place of 24 add $15.00.

ESPEY DEAL—2

Espey 700G-501G tuner with 24 watt amplifier plus new 456 Collaro changer equipped with a GE RPX-052A cartridge. Net $164.95

If 34 watt amp is desired in place of 24 add $15.00.

ESPEY DEAL—3

Espey 700G-501G tuner with 24 watt amplifier plus Garrard RC-98 equipped with a GE RPX-052A cartridge. Net $194.95

If 34 watt amp is desired in place of 24 add $15.00.

SPEAKERS RECOMMENDED

Order any of the following speakers with your Espey tuner and amplifier:
12" coaxial PM, CU-14Y—$10.00 extra
15" coaxial PM, P15-CR—$20.00 extra
Imperial IV system—$15.00.
Imperial VI system—$25.00.
Norelco 9762—12" regularly $59.50 at $30.00 extra.
EV84—15W system—$150.00 extra.

BUY YOUR AUTOMATIC CHANGER AT McGEE

COLLARO 456 - $34.50 | MONARCH UA6U - $29.95 | WEBCOR ON BASE | GARRARD RC-98

4-SPEED COLLARO Latest 1957 Model RC-456, Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Inter-mixes records of the same speed and shuts off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. All of the desirable features of the Model RC-532, plus 4 speed operation. Model RC-456 Collaro 4 speed automatic record changer, less cartridge, Sale price, $34.50. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus, Sale price, $46.95. Large spindle $3.30.
Monarch Model UA6U—new, imported high fidelity 3 speed automatic record changer. Plays 7", 10" and 12" records automatically. Intermixes records of the same speed in any order. Features a 4 pole high fidelity motor eliminating rumble and wow. Pickup automatically returns to rest and motor turns off after last record has played. Full size 10" turntable has molded rubber pallet for better record cushioning. Base size, 10⅞"x12¾". Tone arm is counter balanced to assure minimum record wear. The changer features, at no added cost the regular $9.90 net value Goldring —500 variable reluctance cartridge for the finest high fidelity record reproduction. Output 10 millivolts. Response, 20 to 16,500 cps. It requires the same input gain as popular American made variable reluctance cartridges. Model UA6U, Monarch automatic changer with Goldring cartridge, ship. wt. 15 lbs. Sale price, $29.95; Large spindle for 45 RPM records, $1.88 extra.
Popular Webcor changers at McGee for less money. Webcor 1642-1—popular 3-speed changer on metal base equipped with crystal cartridge. Sale price $27.95.
Webcor 1642-21. Same as above with base as pictured except with GE RPX-050 VR cartridge. Sale price, $31.95.
New 1957 Garrard Model RC98, "crown II," 3-speed super automatic changer, one of the world's finest. Provides the greatest combination of Hi-Fi features ever found in an automatic changer. Model RC98 changer, less cartridge—$66.15. With VR cartridge, 1 mil diamond and 3 mil sapphire needles, RPX-052A—$78.15. Large 45 rpm. center spindle $3.43, extra.
Popular RC88 "Triumph" model with most of the features of the 98. RC88, less cartridge—$53.41. With RPX-052A cartridge as above—$65.41.

NEW CHROME WEBCOR CHANGER WITH RPX-050 G.E. VAR. REL. CART. $34.95

New Webcor model 1121-270, chrome plated, 3 speed automatic record changer with RPX-050 General Electric variable reluctance cartridge. Has heavy 4 pole motor. Plays all 3 speeds and all 3 sizes. Shuts off automatically after last record. Has neutral position to prevent damaging of drive wheels. Chrome plated. Size 12x13½". Requires 2½" below and 6" above mounting board. Shipping wt. 15 lbs. Only a few to sell at this low price of $34.95. Not Illustrated.

6-TUBE, 6-VOLT AUTO RADIO WITH 6x9 SPKR. $19.99

6-TUBE 12-VOLT $29.99

Six-tube, 6 volt universal mounting auto radio. Thin neat construction lends itself to a nice looking underdash installation. Some auto dash panels have room to cut out for custom installing. Speaker is not built in. Set is furnished with the popular 6x9 size. Set dimensions—9" wide, 4¼" tall, 7¼" front to back. Dial is 5½"x2½". Priced with tubes. Shipping weight, 12 lbs. Stock #AH-759. Made to sell for much more than our $19.99 price.

NEW 12-VOLT MODEL WITH SPEAKER $29.99

Model AH-1259, 12 volt universal mounting auto radio. This is the same set as pictured above (AH-759), except made for 12 volt model 1955 and 1956 cars. Stock No. AH-1259 with 6x9" or 5x7" speaker, $29.99.

NEW 8 TUBE 6 VOLT PUSH-BUTTON MODEL $37.95

New model SH-78555-X, 8-tube, 6-volt universal mounting auto radio with push buttons and 6x9 speaker. Made for Hudson cars, but their compact construction lends them to underdash installation. Has push-pull 6AQ5 high-powered audio. Stock No. SH78-555-X with 6x9 speaker—$37.95. With 2—5x7 speakers—$39.95; with 1—5x7 speaker $37.95. Specify speaker size wanted. Three-section top cowl mounting antenna —$2.29 extra.

JACKSON AM9A

9-TUBE HI-FIDELITY

20 Watts Audio
Dual Tone Controls
Push-Pull Mullard EL 37

$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson Model AM9A, 12 watt high fidelity audio amplifier and broadcast tuner combined, at less than you would normally pay for the amplifier alone. Push-pull EL37 output. Frequency response from 30 to 15,000 cps. Inputs for crystal or G.E.-7. variable reluctance pickup and crystal or dynamic microphone. Separate bass boost and treble tone controls. Radio-phono switch on front of chassis. Shielded output transformer matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power transformer. 9½" illuminated slide rule dial with etched glass scale. 3 gang condenser with tuned R.F. stage and loop antenna. Receives broadcast 550 to 1650 kc. Size 13" long, 6" high and 9½" deep. Complete with tubes: 2-6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2-EL37 and 5Y3. Knobs, escutcheon, diagram and instructions included.
Model AM9A, Hi-Fi amplifier and tuner. Ship. wt. 9 lbs. Sale price, $39.95.
Model AM9A with our CU-14Y 12" coaxial PM speaker, both for $49.95.
Model AM9A with our P15-CR 15" coaxial PM speaker, both for $59.95.

11-TUBE FM-AM HALLICRAFTERS

HALLICRAFTERS S-78A

PLUS MONARCH RECORD CHANGER WITH RONETTE CERAMIC CARTRIDGE AND 12" COAXIAL PM SPEAKER

$132.40 VALUE ALL FOR $86.95

A COMPLETE HI-FI SYSTEM

McGee's best buy in a high fidelity home music system. You get the regular $89.50, S-78A Hallicrafters 11 tube FM-AM chassis, Monarch model UA6H, 3 speed English made record changer with Ronette super high fidelity ceramic cartridge and our CU-14Y, 12" coaxial PM speaker all for only $86.95. Hallicrafters chassis receives broadcast 540 to 1700 kc and FM 88 to 108 mc. AFC holds FM stations in perfect tune. Output transformer matches 500 ohm line as well as the 12" coax. High fidelity response 50 to 14,000 cps. Bass boost tone control. A full 11 tube transformer powered chassis with push-pull 6K6 audio. Size: 7⅜" x 12½" x 11" deep. Complete with tubes, knobs, escutcheon, diagram and instructions. High quality Monarch record changer plays 7", 10" and 12" records automatically. Intermixes records of the same speed in any order. Shuts off after last record has played. Features a 4 pole motor eliminating rumble and wow. Full size 10" turntable has molded rubber pallet to cushion records. Base size, 10⅞" x 12¾". Tone arm is counter balanced to assure minimum record wear. Changer features the Ronette super high fidelity ceramic cartridge with separate sapphire stylii for microgroove and standard records and response to 13,500 cps. Our famous 12" coaxial PM speaker, model CU-14Y is described on the opposite page. Only two wires to connect speaker to chassis and plug pickup into phono input.
S-78A chassis, CU-14Y speaker and UA6H changer, Ship. wt. 45 lbs. All for only $86.95.
Separate large spindle for Monarch changer to play 45 RPM records automatically, $1.88.
S-78A, 11 tube Hallicrafters chassis only, Ship. wt. 22 lbs. Special sale price, $59.95.
S-78A chassis with 12" coaxial PM speaker, Ship. wt. 30 lbs. Both for only $69.95.

AIR KING FM-AM TUNER

SELF POWERED

Use with any Audio Amplifier

SALE PRICE $24.99

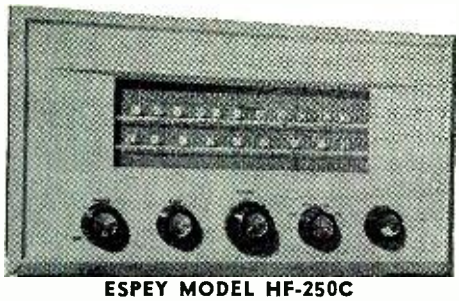
Air King factory built, 6 tubes self-powered FM-AM radio tuner. Receives broadcast 540 to 1620 kc and FM 88 to 108 mc. Use with any Hi-Fi audio amplifier or connect it to your TV set for FM-AM reception. Selector switch has 4 positions for TV-Phono-FM and AM. 3 other controls are volume-off-on, tone and tuning. With tubes: 12AT7, 2—6AU6, 6AL5, 6SQ7, and 5Y3 rectifier. Chassis size, 11½" x 7½" x 6¼" high. Illuminated slide rule dial 7½" x 2½", with escutcheon plate and knobs. Self-powered with its own power transformer. FM-AM tuner chassis No. 703 as used in Air King model 17K1C combination TV-Radio-Phono with power supply added. Note: A separate audio amplifier is required to operate a speaker. Stock No. AIR-K6, self-powered FM-AM tuner, complete. Ship. wt. 10 lbs. Sale price, $24.99.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY. SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 2-5092
1903 McGEE ST., KANSAS CITY, MISSOURI

14 TUBE ESPEY HI-FI CUSTOM FM-AM CHASSIS



ESPEY MODEL HF-250C

RESPONSE FROM 10-22,000 CPS—PUSH-PULL 6V6'S—TWIN TONE CONTROLS—WILLIAMSON TYPE CIRCUIT—INPUTS FOR V.R., CRYSTAL, TAPE, RADIO OR TV

SALE PRICE **$79.95** LESS SPEAKER

WITH MONARCH UA6U CHANGER $107.95

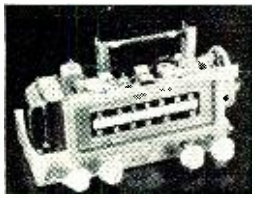
New 1956 model, 14 tube FM-AM chassis. A true Hi-FIdelity receiver built by a nationally famous maker of fine custom chassis. Espey Model HF-250C, 14 tube FM-AM chassis with push-pull 6V6, 10 watt audio. You could spend $200 to $250 for a separate tuner and amplifier and not have the quality of this receiver. Ultra-Linear output used in Williamson type circuit gives frequency response of 10 to 22,000 cps. Output taps of 4, 8 and 16 ohms. Separate RF stages for FM and AM assure high sensitivity. Temperature compensated FM front end for minimum drift. Separate bass and treble tone controls. Pre-amp for all types of magnetic cartridges. 2nd input for crystal phono, tape recorder or TV. 3 position equalizer for accurate reproduction of all records. Built-in antennas for both FM and AM. Response plus or minus 1 db from 10 to 22,000 cps. Harmonic distortion less than 1%. Sensitivity: FM, 8 mv for 30 db quieting; AM, 75 mv for 6 db signal to noise ratio. Off-on-volume and equalizer are combined on a concentric control. Has 2 AC outlets on rear of chassis. Beautiful edge lighted flywheel inertia slide rule dial. Size; 7¾"x13½"x10" deep. Ship. wt. 24 lbs. (not mailable). Model HF-250C. Sale price, $79.95. With heavy duty Utah 15" coaxial PM speaker, both for only $99.95.

Buy either of these new Phillips "Norelco" speakers with your Espey chassis. Made by Phillips of Holland. Features Ticonal magnet, improved cone design, built-in mechanical cross-over and copper ring fitted into air gap keeps voice coil impedance independent of frequency.

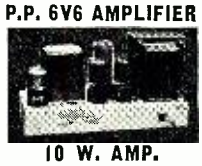
Model 9760M, $54.95 list 12" Phillips speaker, response 30 to 20,000 cps, rated at 20 watts with Model HF-250C Espey chassis, both for only $99.95.

Model 9762M, $99.95 list 12" Phillips speaker, response 22 to 20,000 cps, rated at 20 watts with Model HF-250C Espey chassis, both for only $114.95.

HI-FI FM-AM TUNER



AND 10 WATT P.P. 6V6 AMPLIFIER



10 W. AMP.

BOTH FOR **$44.95**

9 TUBES-PLUS 2 RECTIFIERS PHONO INPUT

New Hi-Fi self-powered FM-AM tuner with 10 watt amplifier (push-pull 6V6's) on separate chassis. All you need is a record changer and speaker to have a complete home music system. 3 ft. cable connects tuner to amp. Tuner has input for crystal phono. (If changer with v.r. cartridge is purchased, we will include the necessary pre-amp, no charge.) Tuner has 6 tubes: 12AT7, 6BE6, 2—6BA6, 6AT6, 6AL5 and 6X4 rectifier. Amp has 2—6V6's, 6SN7 and rectifier. Full superhet circuit with AVC, 3 position tone control, 9" illuminated slide rule dial, escutcheon and knobs. Stick loop antenna for AM. Radio-FM-AM, phono selector switch, tone control, volume control on tuner. Response 50 to 17,500 cps. Receives broadcast 540 to 1600 kc and FM 88 to 108 mc. Output matches any of the speakers shown above. No. FA9-2CR tuner and amplifier complete. Ship. wt. 22 lbs. Sale price, $44.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

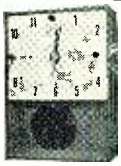
GOLDRING V. R. CARTRIDGE

WITH 2 SAPPHIRE STYLII $5.95

WITH 1 MIL DIAMOND, 3 MIL SAPH. $13.95

McGee offers the internationally famous Goldring variable reluctance phono cartridge, made in England and sold throughout the world to those who want the finest and most accurate music reproduction from 33⅓, 45 and 78 RPM high fidelity phono records. (Input gain and compensation similar to G.E. v.r. cartridge required.) Furnished as standard equipment with sapphire 1 and 3 mil styli. A regular $9.90 net item on sale at McGee for $5.95. For $13.95 with a diamond 1 mil stylus. These are the latest production, individually cartoned turnover cartridge with mounting bracket. Fits tone arms on most changers. Made for and bearing the famous Wilcox-Gay Recordio name. No. 546 Goldring V.R. (Wilcox-Gay) cartridge, Net $5.95. No. D546-DS, Goldring V.R. (Wilcox-Gay) cartridge with diamond 1 mil stylus, $13.95. 1 mil diamond stylus for Goldring V.R. cartridge, purchased separately, $9.95.

6" SESSIONS CLOCK-TIMER



With Plastic Cabinet $3.95

6" Sessions Clock-Timer in plastic case 7" x 9⅝" tall, 3" deep. Was intended for a kitchen clock radio. Lower part of case was used for a small radio chassis. Lower portion has a usable space of 6¾" x 4" high and 2⅜" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green, Red or Yellow. Stock No. MCT-63, Sessions Clock Timer with case of your color choice. Sale price only $3.95.

25 WATT, 6-110 VOLT AMPLIFIER ONLY.... $69.95

COMPLETE 25 WATT, 6-110 VOLT P. A. SYSTEM

AMPLIFIER, MICROPHONE 2-TRUMPETS (AS ILLUSTRATED)

SALE PRICE **$149.95**

MG-625S, complete 25-watt, 6 volt DC and 110 volt AC sound system. Includes 2 model 848 Electro-Voice CDP coaxial horn projectors with drivers, a 25 watt push-pull 6L6, 6-110 volt amplifier, plus a $24.50 list Turner high impedance dynamic hand mike with off-on switch. McGee's special sale price, $149.95. Amplifier is not a kit, but our latest 1957 model, 25 watt 6-110 volt amplifier that operates equally well on a 6 volt storage battery or 110 volts AC. Amplifier features push-pull 6L6 output tubes, inputs for two high impedance mikes, 3 speed phono with crystal pickup built-in top. Phono top is packed separately for shipment. Only a few minutes required to plug-in phono and attach top cover to amplifier. Amplifier size, 13½x10x9½" high. Stock No. MG-625 amplifier only. A $100.00 net value, Sale price, $69.95. Complete 6-110 volt system as described above, Stock No. MG-625S complete with 2 Model 848 Electro-Voice speakers and Turner mike, Sale price, $149.95.

TIMEX MAGNETIC RECORDER

CRYSTAL PICKUP TO PLAY PHONO RECORDS, MICROPHONE AND 18 RECORDING BLANKS INCLUDED AT NO EXTRA CHARGE

SALE PRICE **$24.75**

MODEL 40 TIMEX

RECORDS AND PLAYS BACK PLAY 16⅔ AND 45 RPM RECORDS

A product of United States Time Corp. (Timex). A multiple purpose machine made to retail for $59.95. McGee bought a large quantity of these at a saving. Now you can save by buying this unit for only $24.75 complete with a pickup for playing 16⅔ and 45 RPM records, plus 18 additional recording blanks at no extra charge. Records and plays back at 16⅔ RPM on a wafer thin flexible disc. Up to 3½ minutes on each disc. Make recordings of your family—use for office dictation—dictate records that may be mailed without breaking. Don't overlook the possibilities of using this machine as a record player for 16⅔ RPM talking book records and regular 45 RPM records. Attractive brown plastic case, 9½x11½x4⅞". Turntable speeds of 16⅔ and 45 RPM. Response 100 to 4000 cps. Amplifier has neon level indicator, volume control and selector knob with playback, record and phono positions. Uses 12AX7, 50C5, 6C4 and 35W4 tubes. Built-in 4" speaker. Complete with Shure variable reluctance microphone, crystal pickup head for playing records and 18 recording blanks. Provides faithful reproduction at low volume of voice or music recorded through the microphone supplied or direct from your radio or TV. As simple to operate as a record player. Stock No. TIM-RIX recorder complete. Ship. wt. 13 lbs. Sale price, $24.75. Extra recording blanks, package of 6 for 99¢.

FAMOUS STANDARD COIL CASCODE TUNERS

SALE PRICE **$12.95**

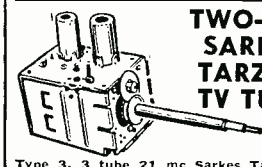
TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 27/8" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.

2 FOR $25.00

Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59¢ a pair.

STANDARD COIL PENTODE TUNERS $7.95

SC-948, Standard Coil, 21 mc Pentode tuner with 6BC5 or 6AG5 and 6J6 tubes. Popular 12 channel, 2 thru 13, used in millions of TV sets. Why spend time repairing an old tuner when it may be easier to just replace it. Shaft can be cut to desired length. Available with 27/8", 3", 4¼" or 4½" shaft. Specify length of shaft. Sale price, $7.95 ea., 2 for $15.00. Matched knob set 59¢ extra.



TWO-TUBE SARKES-TARZIAN TV TUNER WITH TUBES

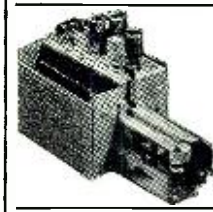
21MC OR 41MC $7.95

No. TT-3A, 2 tube Sarkes-Tarzian 12 channel TV tuner for 21mc. Used in CBS, Arvin, Crosley, etc. Ideal for general replacement. 3½" shaft. With tubes, $7.95 each, 2 for $15.00.

No. TT-2C, 2 tube Sarkes-Tarzian 41 mc Cascode tuner with tubes, 4½" shaft. Smallest cascode tuner made. Popular in many sets. $7.95 each, 2 for $15.00.

Either of the above tuners with 9" shaft, $1.00 extra.

Type 3, 3 tube 21 mc Sarkes Tarzian tuner with tubes. Rotary switch type complete with 6C4, 6BH6 and 6AG5 tubes. Regular cost is several times our new low price of only $4.95. Wired, ready to hook-up to video and sound I.F. strip. Use with either separate sound or inter-carrier. Built-in fine tuning. 27/8" shaft. Net, $4.95.

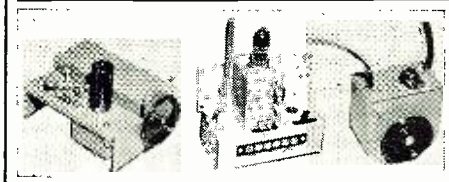


RCA KRK-12 TV TUNER Brand New—with Tubes

SALE PRICE **$6.95**

2 for $13.00

RCA Model KRK-12, UHF-VHF TV tuner with tubes: 2—6BQ7A, 6AF4 and 6S4. A complete tuner with all 12 VHF strips, but with blank strips in the UHF positions. This tuner fits many RCA sets using 40 megacycle I.F's. 27D382 also KCS-66, etc. Original tuner list was about $50.00. We offer them new at about the value of the tubes. Ship. wt. 10 lbs. McGee's sale price, $6.95 each, 2 for $13.00.



UHF CONVERTER TUNERS $2.95

3 FOR $7.50

Take your choice of any of these three UHF converter-tuners at $2.95 each, 3 for $7.50. (1) Mallory inductotuner with 6AF4 and 1N72 diode. This is a complete UHF osc-tuner similar to the one used by Mallory in a converter and by many set manufacturers in their UHF TV sets. (2) CBS-Columbia single channel UHF converter intended for use in UH11 and UH12 CBS TV sets. Complete with 6AF4 tube. (3) Small compact UHF converter tuning assembly with 6AF4 tube and diode. Many applications for this in UHF. Your choice of any of these for only $2.95 each, or 3 assorted for $7.50.

MINIATURE BROADCASTING STATION FOR MICROPHONE AND PHONO WITH CRYSTAL MICROPHONE

SALE PRICE $9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

Portable Amplifier System

(*Continued from page 67*)

ization within 1.2 db of the standard curve from 30 cps to 15 kc. The chart shown on the schematic diagram for the preamplifier lists the parameters for equalization of the LP, AES, and European 78 curves. It is important, in wiring V_7, that pins 2, 6, and the center post on the tube socket be grounded if low hum is to result.

The Microphone Mixer

Inasmuch as a "universal" preamp would be universal only if a microphone input were provided, the circuit to be described was incorporated. The first half of V_9 is used as a conventional voltage amplifier feeding the second half which is a cathode follower. The low impedance output is coupled by C_{43} to the arm of the mixer control R_{40}. The output of the equalizer (or from the auxiliary source) is high impedance and is further isolated by R_{39}. With the arm of R_{40} at the high end (counterclockwise), the low impedance output from V_9 is in shunt with R_{40} and the high impedance of the equalizer stage is shorted out, applying only the microphone signal to the tone control stage. If R_{40} is turned fully clockwise, the output from V_9 is connected to ground, allowing the full equalizer output to be coupled to the tone control stage. Any intermediate position of the arm of R_{40} results in mixing of the two signals in proportion to the position of the arm. Hence, the signal from the microphone may not only be mixed with the auxiliary and equalizer stages, but may be faded from one to the other with only a single control. Greater microphone sensitivity may be had by substituting a 12AX7 for V_9 and replacing R_{27} by a 3300-ohm resistor. Should a microphone input not be desired, R_{40} may be wired as shown in the inset and R_{39} may be shorted out. Transfer contacts on J_3 are used to disconnect the equalizer when an auxiliary input, such as a tuner or TV, is used. If space is no problem, a switch may be used instead.

Tone-Loudness Controls

The tone controls were designed around standard circuitry and the first half of V_8 was used to compensate for the insertion loss of the tone controls.

The loudness control was selected so that it could also be used as a volume control should that function be desired. S_3 is a d.p.d.t. slide switch which disconnects the frequency-sensitive components C_{27}, C_{28}, and C_{30}. The loudness control is coupled to the second half of V_8 through R_{51} which isolates the plate-to-grid feedback around V_8. The output stage is a conventional RC coupled amplifier, whose output impedance is reduced by feedback, rather than a cathode follower since greater voltage output at lower distortion is then possible.

The interconnecting cable between

the preamplifier and main amplifier was made as shown on the preamplifier schematic. Twisted-shielded pairs are used both for the heater and signal circuits. The heater-lead shield is grounded to the preamplifier ground bus and the signal-circuit shield is grounded at the main amplifier. Only one ground lead connects the units. A ground jack was provided on the preamplifier for the purpose of connecting an external earth ground (seldom necessary) or to the phonograph motor frame (frequently necessary).

Both units were housed in steel enclosures to minimize the effects of stray magnetic fields. The preamplifier was constructed on an aluminum chassis to minimize chassis currents.

The frequency response and harmonic distortion measurements were made with a *Hewlett Packard* Model 206A audio oscillator and Model 330B distortion analyzer.

The frequency response of the main amplifier is flat within 0.7 db from 30 to 15,000 cps. The harmonic distortion is 1% or less above 45 cps. Since the 1% specification selected originally is exceeded only below 45 cps and since few recordings carry these frequencies, the design was not altered to further improve the low end. The hum and noise is 72 db below 10 watts output.

The intermodulation distortion was measured with an *Altec Lansing* TI401 generator and TI402 intermodulation analyzer using frequencies of 60 and 2000 cps mixed 4:1. The preamplifier IM is 1% while the main amplifier IM is 5% at 10 watts output.

The preamplifier characteristics are shown in the accompanying curves. The harmonic distortion is less than 1% at all frequencies. The level required at the auxiliary input for the rated 1 volt r.m.s. output is 2.2 volts r.m.s. when the mixer circuit is used or 1 volt r.m.s. when modified for use without the microphone. The hum and noise level is 72 db below 1 volt at the output. At the phono input, .022 volt at 1000 cps is required for 1 volt output with the mixer while .010 volt will drive the preamplifier to 1 volt output when modified for use without the microphone.

Listening tests, using a *G-E* magnetic cartridge and a *G-E* A1-400 speaker in a distributed port enclosure, were extremely gratifying. The violinist's fingers sliding on the strings; the clear, vibrant ring of the chimes; and the staccato roll of the snare drum all point out that a simple, straightforward, and universal approach can result in a pleasing design.

REFERENCES

1. *Sivian, Dunn & White: "Absolute Amplitudes and Spectra of Certain Musical Instruments and Orchestras," Journal of Acoustical Society of America, Vol. 2., pp. 330-371, January 1931.*
2. *Mitchell, James A.: "Loudness and Power in Audio Systems."* RADIO & TELEVISION NEWS, *February 1951.*

—30—

Within the Industry

(*Continued from page 26*)

sales facility at 100 Sixth Avenue, New York City will be maintained and enlarged to accommodate in-person shoppers . . . **FEDERAL TELECOMMUNICATION LABORATORIES** has broken ground for a new building in the San Fernando Valley, California and is constructing a new laboratory and office building on its Nutley, N. J. site . . . **HENRY LAVIN ASSOCIATES,** New England electronic components representatives, has moved into its own building on U. S. Route 5A, Meriden, Conn. The quarters house general offices, display rooms, conference room, technical library, and warehouse. Ample parking space has been provided . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has opened a modern 87,000 square foot warehouse and sales office at 6505 East Gayhart Street in Los Angeles. The new facility will service Southern California and nearby western states . . . The New York district sales office of **P. R. MALLORY & CO. INC.** has been moved to 545 Cedar Lane, Teaneck, New Jersey . . . **ALPHA WIRE CORP.** has moved its general offices, part of its factory, and warehouse facilities to new quarters occupying a full city block at 200 Varick Street, New York 14, N. Y. . . . Ground has been broken in Englewood, Colorado for a new production facility by **THE RAMO-WOOLDRIDGE CORPORATION** of Los Angeles. The plant will cover 140,000 square feet and will be used to produce electronic systems as well as house development and liaison facilities . . . **LAND-C-AIR SALES CO.,** manufacturers representatives, 42 Oak Avenue, Tuckahoe, New York has opened a new warehouse and office at 154 Marbledale Road in Tuckahoe . . . **CALIFORNIA CHASSIS CO.** has added 6000 square feet of floor space with the construction of a third factory structure adjacent to its present facilities at 5445 E. Century Blvd., Lynwood, California . . . **AUDIOGERSH CORPORATION** has opened new executive and sales offices at 514 Broadway, New York 12, N. Y. . . . **TRIAD TRANSFORMER CORPORATION** has opened a 16,000 square foot plant in Venice, California which will house the jobber sales and inventory, machine shop and shipping departments. This is the firm's third plant building . . . **SANGAMO ELECTRIC COMPANY** has moved the sales department of its electronic capacitor division from Marion, Illinois to the company's home office in Springfield, Ill. . . . **KINGDOM PRODUCTS, LTD.** is now occupying enlarged sales and executive offices at 514 Broadway, New York 12, New York. The new quarters provide for increased sales, warehousing, and service facilities . . . **TELEMETER MAGNETICS, INC.** has moved to new quarters at 2245 Pontius Avenue in Los Angeles. New plant capacity is 24,000 square feet including a 13,000 square foot second story addition planned for completion in October . . . **RYE WHOLESALE COMPANY** has just completed construction of a 25,000 square foot building at 118 Maple Street, North Little Rock, Ark. The building will house offices and showrooms in addition to providing warehouse space for the company's distributor lines of electronic products . . . **RAULAND CORPORATION** has purchased a 60,000 square foot factory building at 4321 N. Knox, immediately adjacent to its Chicago operation. The new plant will be used to expand its CR tube manufacturing operation.

* * *

DR. HANG C. LIN has been appointed senior engineer in charge of the Semiconductor Applications Laboratory at *CBS-Hytron.*

In 1947, Dr. Lin came to the United States, following graduation from Chiaotung University, Shanghai, China. He received his Master's degree in electrical engineering at the University of Michigan and his doctorate at Polytechnical Institute of Brooklyn.

Dr. Lin has wide experience in the field of transistor applications and has written numerous articles on semiconductor applications. He holds a number of patents in the field. He is a member of Sigma Xi and the IRE.

* * *

RETMA has announced that manufacturers have sold over one million entertainment and non-entertainment type transistors in June and nearly five million units in the first six months of this year.

Sales of the semi-conductor device during the first half of 1956 totaled 4,758,603 units as against 1,260,827 units in the same period of 1955, an increase of nearly 400 per-cent.

Dollarwise, sales were $13,728,110 this year *versus* $4,741,958 in the first six months of last year. June 1956 sales alone accounted for $3,645,293 of the six month total.

* * *

STANLEY E. GUZZY has been appointed assistant sales manager of High Fidelity Consumer Products of the Special Products Division of *Stromberg-Carlson.*

He will have charge of the nationwide sales of the firm's "Custom Four Hundred" equipment, including both components and the new console line of phonographs and radio-phonograph combinations.

Mr. Guzzy has had wide experience in the appliance and radio field dating from 1928. He joined the company in 1949 and was, until recently, district manager of the Western New York territory of the firm's radio-television division.

He will make his headquarters at the Rochester, New York office of the firm. —30—

OLSON RADIO FOR GREATEST BUYS IN RADIO AND TV SUPPLIES

Famous VM 15 WATT AUDIO SYSTEM

With Jensen 10" Speaker

Stock No. RP-13 **$39.87** Complete Set

YOU GET **59%** OFF

IDEAL FOR HOME USE OR PUBLIC ADDRESS

HERE'S WHAT YOU GET

	List Price
Dual Input VM Amplifier with 5 GE tubes	$69.95
Jensen 10" Alnico 5 PM Speaker	12.95
Comb. Portable Carrying Case and Speaker Baffle	14.50
Total Value	$97.40
Your Discount	57.53
Your Cost	$39.87

EXCLUSIVE FEATURES:

Built-in Mixer. Dual Input, Dual Volume Controls. Jewel Light Indicator. Shielded Output Transformer. Built-in Automatic Shut-off for Phono. 60-12,000 cps. UL Approved. A Complete Public Address System. Ideal for use in the home for record playing (any record player with crystal cartridge can be connected), auctions, lectures, public address, carnivals, taverns or traveling orchestras. Fine for use with electric guitars. Will handle areas up to 10,000 sq. ft. and audiences up to 2500 people. Amplifier is UL approved and employs 5 General Electric tubes (2 of the tubes are dual purpose, hence results are equal to a 7 tube amplifier). Tubes are 2—12AX7's, 2—6V6GT's, and 1—5Y3GT. Two inputs—one for high impedance microphone and one for phono. Built-in electric mixing of phono and microphone as desired. Delivers 15 watts of audio. Tone control gives complete range from treble to bass. Jewel light on front shows when amplifier is on. Also equipped with an AC outlet for record player. When amplifier is turned off, player motor will stop at same time. Amplifier size 11½"x6½"x6". Operates on 110-120 volts AC 50-60 cycles. Jensen's fine 10" Gold Label Alnico 5 PM speaker is mounted in the combination baffle and portable case which measures 13½"x9"x15". The luxurious case is covered with beautiful maroon leatherette and trimmed with gold piping to VM's exacting specifications. The case is so built that amplifier can be slid out or in on its shelf and used or carried in that position. The speaker is equipped with a 25 ft. cable and plug so that it can be used at a distance from the amplifier if desired. A second plug and socket are provided for an extra speaker. Any crystal or dynamic high impedance mike can be used. Shipping wt. 30 lbs.

Little Champ Remote Speaker

with Volume Control

Reg. List Price $9.95

Stock No. S-233 **$3.99 EA.**

3 for $11.00

From your easy chair control volume or shut off either the speaker in TV set or the speaker built into the "Little Champ." Connects in one minute to any TV set, radio or record player regardless of make or model. Precision engineered PM speaker delivers all necessary volume at your chair or bedside. Completely assembled and supplied with 20 ft. of cable. Ready to operate—complete with hook-up instructions. Shpg. wt. 3 lbs.

POCKET RADIO KIT

With Hearing Aid Type Earphone

STOCK NO. KB-32

$4.95 EACH

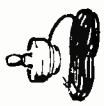
3 FOR $14.00

Now no need to miss your favorite program. Take this highly sensitive portable with you. Small enough to fit in your pocket. Latest regenerative circuit design. Plenty of volume and good selectivity. Covers 540 to 1700 KC. Complete with tube, earphone, plastic case and instructions. Less only wire, solder and batteries.

Batteries for above 1 each needed.

Stock No. BA-15 Burgess U10 ....ea. 77c
Stock No. BA-32 Burgess Z .....ea. 10c

HEARING AID EARPHONE



CRYSTAL TYPE

STOCK NO. PH-2

$1.95 EACH

3 FOR $5.50

Worth at least twice this price! A quality crystal, high impedance earphone. Fits comfortably in either ear. Weighs less than ½ oz. Super sensitive, flesh colored. With 3 ft. flex-cord. Ideal for hearing aid, crystal sets, pocket radios, etc. May also be used as a crystal microphone.

5 LB. PARTS KIT

A Pleasant BIG Surprise!

Stock No. AS-137 **$1.98**

Money Back Guarantee

We just bought out the entire inventory of a prominent midwest jobber. To clear the shelves in a hurry, we made up these kits. It's all brand new merchandise. Assorted plugs, wire, transformers, resistors, condensors, cable, sockets, strips, insulators, switches, tubes, vibrators, mounts, cushions, hardware, grommets, etc. No two kits are the same, but OLSON guarantees that each box will be worth 3 times the cost, or we'll take it back for full refund. Quantity limited—one to a customer.

"GOLDEN GATE" 8" SPEAKER

With "Whizzer" Sound Disperser

STOCK NO. S-229

List Price $12.50
Olson's Price, Ea. **$4.95**
2 for $9.50

Finely finished in all gold lacquer. Dealers, order these speakers for installation where space is a factor. Will outperform many 12" units. Employs two concentrically mounted cones for extremely smooth reproduction at high or low volume. Small cone in center of large cone is called a "Whizzer" and provides extended treble response, good overall balance and wide dispersion angle. Equipped with heavy Alnico 5 magnet and cover. Power handling capacity 8-10 watts, response 40-12,500 cps. Speaker cone 8" diameter, voice coil 8 ohms. Shpg. wt. 5 lbs.

BROADCAST TYPE MICROPHONE

With Double-Cartridge Crystal

STOCK NO. M-102 **$8.87 EACH**

Ideal for PA, recording, etc. A high impedance crystal microphone with essentially flat response from 40 to 8000 cps—output level 50 DB. Shielded against RF. Double xtal cartridge for full non-directional response when in vertical position. Chrome plate brass case, molded bakelite trim. Rubber mounted, shock resistant. Standard ⅜"—27 bushing for mike stand. Heavy duty 5 ft. shielded cable. A $50.00 value.

TELEPHONE PICKUP

STOCK NO. M-80

$2.95 EACH

3 FOR $8.00
10 FOR $25.00

Records both sides of telephone conversation. Use disc, wire, tape recorder or amplifier. Simply lay pickup under any cradle type telephone and connect lead to recorder or amplifier. Operates by induction. Regular $5.95 value.

HI-QUALITY RECORDING TAPE

PLASTIC BASE

1200' on 7" Dia. Reel

STOCK NO. X-249	Lots of 12, Ea.
Single, ea.....$2.19	$1.59
Lots of 6, ea....$1.79	

This famous brand tape regularly sells for $5.50—but Olson gives you a 71% discount. Perfect in every respect, this quality tape is famous for its low noise level and uniform output. Freq. response 50-15,000 cps—red oxide base—¼" wide. Reg. $1.25 seven inch plastic reel included—fits all recorders. Stock up now during this Giant Sale and get the Tape Buy of Your Life. Shpg. wt. (one doz.) 10 lbs.

NEW L-O-N-G-E-R PLAY
1800' TAPE ON 7" REEL

STOCK NO. X-583	Lots of 12, Ea.
Single, ea.....$2.99	$2.45
Lots of 6, ea...$2.59	

50% more recording time on a 7" reel. Shpg. wt. (one doz.) 12 lbs.

CUSTOM RADIO CHASSIS

While They Last

For Installation Anywhere

Stock No. RA-245

$14.92

With Matched Set of Tubes

A 5 tube superhet of the latest design. Features two IF transformers, 2-gang condensor, jumbo slide rule dial, built-in loop antenna, Centralab couplate, resonant filter, bypass input for crystal phono, AC outlet on rear for phono motor, generous size output transformer, dual panel lamps and many other fine features. Olson bought all the manufacturer had for cash and now you can take advantage of this deal. Chassis is 12" w. x 6" high and is finished in high lustre (shines like platinum). Entire front is glass finished in attractive green and gold. This is a big feature since no bezel is required and any size panel opening from 2"x7" to 4"x11" can be made. Frequency range is standard 550 to 1600 KC. Audio response is 40 to 12,000 cps. Output impedance is 8 ohms. Operates on 110-120 volts. Shpg. wt. 12 lbs.

CUSTOM WALL RADIO

Complete Master Set With Built-in Speaker and 2 RCA Sub-station Speakers With Wall Baffles

Stock No. AS-206 **$19.95**

Regular Price **$49.95**

Has Provision to Connect Up To 5 Additional Speakers

Now you can have music in every room piped in from this custom wall set. This brand new radio is a special high efficiency 5 tube superhet which mounts flush with any wall. Speaker is built-in. Up to 5 additional speakers (any size or style of PM is fine) can be connected for music in every room in the house. Also fine for offices, stores, shops, etc. Size: 11" w. x 10" h. Equipped with jack on panel so that phonograph or tape recorder can be plugged in to supply recorded music to all outlying speakers as well as the master. Controls on front panel are: Volume Control, Station Selector, and Phono Switch. Tuning range is standard 540 to 1620 KC. Has built-in loopstick antenna and noise filter. Operates on 115 Volt AC. Shpg. wt. 15 lbs.

AUTOMATIC RECORD CHANGER

FAMOUS COLLARO INTERMIX

STOCK NO. RP-11

$28.88 Each

DELUXE 3-SPEED

Made in England. Highest Quality. Complete with Shure Ceramic Turnover Cartridge and Dual Sapphire Needle.

Powerful 4-pole motor and balanced rubber covered turntable. Changes discs in 7 seconds. Jamproof! Output .6 volts, response to 7000 cycles. AUTOMATIC SHUT-OFF after last record. INTERMIXES 7", 10" and 12" discs. 33⅓, 45 and 78 RPM. AUTOMATIC MUTING SWITCH eliminates sound during change cycle. Has STYLUS ADJUSTMENT and speed selection and "on-off-reject" CONTROLS. Size: 12" x 13½". Clearance required 2⅝" below, 5¼" above.

3 SPEED MOTOR AND ARM

Stock No. AS-205

$5.78

Monarch (Famous Made-in-England Brand) 3 speed motor and turntable plus a genuine Webster tone arm with turnover cartridge and dual precious tipped needles. Brand new 100% guaranteed. Reg. $15.00 Value.

POWERFONE WALL TELEPHONE

Stock No. PH-3

$3.93 Pair

3 pair for $11.00

Two station telephone set. Talk back and forth for up to one mile. Powerfone is guaranteed to give as good tonal quality as your telephone. Built in buzzer and push button on each instrument. Also has push-to-talk button. Sensitive enough to hear a whisper. Uses flashlite batteries. Complete with 2 batteries, 2 wall hangers, and 50 ft. of wire.

Extra 2-conductor cable for above

Stock No. W103 100 ft. $1.19
Stock No. W104 250 ft. $2.50

1¼ METER TRANSCEIVER

Build Your Own

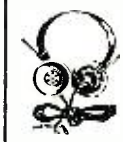
Stock No RA-252

$3.93

2 for $7.00

A Brand new complete RT-92/AM unit designed to receive and transmit signals from 215 to 225 MC. Contains a wealth of parts all built into an aluminum case, 3½" x 9½" x ¼" with removable cover. Included are 5 tubes (worth over $8.00 wholesale), 1—995, 3—1L4, and 1—6C4, 16 resistors, 10 condensors, SPDT Toggle Switch, 4 mica filled sockets, chokes, a variable condensor, a potentiometer, 2 dipole antennas, battery box, battery plugs and a removable chassis. Wiring diagram included. Can be rebuilt into a transceiver, receiver, field strength meter, etc. Shpg. wt. 5 lbs.

QUALITY DOUBLE HEADSET



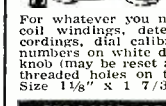
Stock No. PH-6 **$1.95 pair**

3 pairs for $5.60

2000 Ohm Impedance, large magnet, removable bakelite caps, Spring steel headband fully adjustable. Flexible braid covered cord, 3½ ft. long, with standard phone tips. Extremely light weight—only 4½ ounces. Original factory boxes.

VEEDER-ROOT COUNTER

Counts From 000 to 999



Stock No. X-637 **$1.59 ea.**

For whatever you need to count. Ideal for coil windings, determining length of recordings, dial calibrations, etc. Big white numbers on white dial, large knurled reset knob (may be reset at any time). Four 4-40 threaded holes on top for easy mounting. Size 1⅛" x 1 7/32" x 2". Brand new.

CERAMIC CONDENSOR KIT

100 CONDENSORS

Stock No. K-90 **$1.99 kit**

100 tubular and disc condensors rated at 600 V. or better. All popular values, marked and color coded. Leads are tinned 1¾" long. Terrific value. Stock up now.

TELEPHONE SET

Sound Powered

Includes Headset and Microphone

Stock No. M-98 **$3.95 SET**

2 Sets for $7.50

Brand New—original cost $30.00. No batteries needed—self powered. Permits 2-way talking up to 25 miles over any two-wire conductor. Each set contains a pair of sound powered high impedance dynamic headsets with felt padded rubber cushions and leather covered head-band. Both microphone and earphones have cone diaphragms and are extremely rugged and sensitive. Units may be removed from headsets to make efficient high powered miniature speakers. Useful for Antenna Installations where beaming of antenna is critical. Shpg. wt. 5 lbs.

ATTENTION MANUFACTURERS: If you have large quantities of surplus electronic parts you wish to sell, call or write OLSON at once. We pay top prices!

HOW TO ORDER

Mail your order to 274 E. Market St., Akron 8, Ohio. Send remittance with order (add for postage 5c for each dollar's worth ordered—10c for each dollar's worth if you are more than 1000 miles away). OLSON REFUNDS EVERY CENT NOT USED. Or—send no money—we'll ship C.O.D. and you pay mail or expressman for merchandise and postage. ALL MERCHANDISE 100% GUARANTEED. PLEASE —MINIMUM ORDER $5.00.

SEND FOR NEW FREE CATALOG

SEE YOUR OLSON CATALOG FOR COMPLETE LISTING OF BARGAINS ON THOUSANDS OF NATIONALLY ADVERTISED ITEMS.

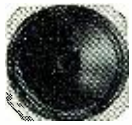
OLSON BARGAIN STORES IN:

CHICAGO—623 W. Randolph St.
CHICAGO—123 N. Western Ave.
CLEVELAND—2020 Euclid Ave.
PITTSBURGH—5918 Penn Ave.
MILWAUKEE—423 W. Michigan
BUFFALO—711 Main Street

OLSON RADIO WAREHOUSE 274 EAST MARKET ST. • AKRON 8, OHIO

VA UES GA ORE AT CONCORD

FAMOUS MAKE UTILITY SPEAKERS



4" ALNICO V
1 Oz.* P.M. 3.2 Ohm Voice Coil*

$1.29 ea. Singly — $1.19 ea. Lots of Ten

Perfect for replacing speakers in portable radios, intercoms, extension speakers, etc.

Stock # S4-AV-RN
Shipping Wgt. 2 lbs.

5" ALNICO V

Heavy Duty Slug. P.M.
3.2 Ohm Voice Coil*

Use it as a hi-fi tweeter. Replacement in radios, TV sets, intercoms, extension speakers.

Stock #S-5-AV-RN
Shipping Wgt. 3 lbs.

$1.39 ea. Singly — $1.29 ea. Lots of Ten

4 x 6 ALNICO V

Heavy Duty Magnet P.M.
3.2 Ohm Voice Coil

1.99 ea. Singly — 1.95 ea. Lots of Five — $1.89 ea. Lots of Ten

Rugged construction makes it perfect for auto radio replacement. Vibration will not affect it.

Stock #S-4x6-RN — Shipping Wgt. 3 lbs.

Famous Make 6 x 9 P.M. Speaker

$2.69 each Lots of 12

Lots of 3.....2.80 ea.
Singly .....2.95 ea.

FEATURES:
Heavy Duty 1.47 oz. Alnico V Magnet.
3.2 Ohm Voice Coil.
Cadmium Plated Frame.
Heavy Rim Gasket makes it ideal for Rear Deck Speaker.
Handles 5 Watts.

Stock #S-6x9-RN
Ship. Wgt. 3 lbs.

10" HEAVY DUTY P.M. SPEAKER

WE ARE NOT ALLOWED TO MENTION THE MANUFACTURER'S NAME

$2.49 each Lots of 10

FEATURES:
Heavy Alnico V Magnet.
Can handle 6 to 8 Watts full Audio Power.
Convert your TV Set or Console Radio to Hi-Fi.
Normally Sold at $8.95 each

Stock #S-10PM-RN
Shipping Wgt. 5 lbs.

CONCORD'S CLOSE OUT PRICE
Lots of 5 .....2.70 ea.
Singly 2.99

FAMOUS MAKE 12" P.M. SPEAKER

FEATURES:
Massive Construction.
8 to 10 Watts Audio Output.
Heavy Duty Magnet delivers Full Range Response.
Ideal for use as Basic Woofer for your Hi-Fi Ensemble.

Stock # S-FAM 12-RN
Shipping Wgt. 6 lbs.
CONCORD'S DEALER PRICE
$3.95 each Lots of 10

Lots of 5.....4.20 ea.
Singly .....4.45 ea.

WHY PAY MORE? WE DEFY COMPETITION CONCORD OFFERS THE FINEST IMPORTED

12 COATED SURFACES
ALL BINOCULARS HAVE DELUXE LEATHER CARRYING CASE!
PRISMS HELD RIGID WITH STEEL STRAPS

6 x 30 FIELD OF VISION—420 FT. at 1000 YARDS—Fig. B.
Perfect ALL AROUND binoculars. Feature coated lenses, light weight alloy bodies. Center focus.
Shipping Wgt. 3 lbs.—Stock No. B1-RN — $17.50

7 x 18 FIELD OF VISION—300 FT. at 1000 YARDS—Fig. D
Here's the right glasses for use at RACE TRACK, for ALL SPORT USE, and at the OPERA or THEATRE. Center Focusing.
Shipping Wgt. 2 lbs.—Stock No. B2-RN — $14.75

7 x 35 FIELD OF VISION—300 FT. at 1000 YARDS
WIDE ANGLE FIELD OF VISION—499 FT. at 1000 YARDS—Fig. A
Use these binoculars for HUNTING, BIRD STUDY, SPORTS. The wide angle glasses are wonderful for horse racing. Center Focusing.
Shipping Wgt. 3 lbs. — Specify Type — 7 x 35— $20.90
Stock No. B3-RN — Wide Angle— 29.45

7 x 50 FIELD OF VISION—372 FT. at 1000 YARDS—Fig. C
The most wanted binocular, will give good service in SPORTS VIEWING, HUNTING, OUTDOOR USE.
Shipping Wgt. 3½ lbs. Specify Type — Individual Focus— $21.45
Stock No. B4-RN — Center Focus— 24.90

8 x 25 FIELD OF VISION—315 FT. at 1000 YARDS—Fig. B
An ideal glass for GAME SPOTTING, BIRD WATCHING, SPORTS.
Shipping Wgt. 3½ lbs. Specify Type — Indivjdual Focus— $15.25
Stock No. B5-RN — Center Focus— 16.95

16 x 50 FIELD OF VISION—183 FT. at 1000 YARDS—Fig. C
A high power binocular for LONG DISTANCE VIEWING, as PLANE SPOTTING, MARINE USE, MOUNTAIN VIEWING.
Shipping Wgt. 3½ lbs.—Stock No. B6-RN — $31.30

All Prices Include F. T.

CONCORD'S FANTASTIC CARTRIDGE SALE

Famous GC-J Ceramic Series Astatic Cartridge Complete W/Stylus

Precious Tip Needle. Ceramic, Universal Mounting

Light weight—Minimum needle pressure—6 grams. General replacement for all phonograph arms. Exact replacement for all RCA "45" players. Has dual mounting centers ½ inch plus ⅝ inch.
Ceramic cartridges unaffected by temperature or humidity.

For all three speeds 33⅓—45—78 rpm
Lots of Five $2.29 ea.—Lots of Ten $2.15 ea.

Concord's Price $2.35 each
Normally Sold at 7.50

DUAL-SAPPHIRE TURNOVER CARTRIDGES
Ceramic Element
SONOTONE

Lots of 3 $3.49 ea. — Singly $3.89

Humidity-proof ceramic retains shape in all kinds of weather; cuts distortion, adds response range. Now used in VM, Columbia 360, Webcor, Crescent changers. Replaces many others.
Stock #A6-2T-S.
Wt. 8 ozs.....Net $3.89

Electro Voice Hi-Fi Flip Cartridge

Lots of 5 $2.65 each
Regular Price $8.50

Has dual precious metal stylii.—Has 33⅓—45 rpm needle and 78 rpm needle.—Used only in high quality phonographs.—Will give response 50 to 12,000 cycles.—Complete with ½" centers mounting bracket and turnover mechanism.
We used this item on a check and were so surprised we grabbed all we could.
A ridiculous low price for these. — Singly — $2.75

SEWING MACHINE REPLACEMENT MOTOR

• 115 V. AC. 1/15 HP • 1½" pulley • Vert. or horiz. mtg. • Replaces over 90% of existing units.

Stock No. SEW-MOT-10-6 — 3.79 Singly — 3.35 Each Lots of 3

Model A7M-5 Sim. to Mod. AX

$2.95

Exceptionally lightweight two-needle cartridge furnished complete with removable twist mechanism. Ideal replacement cartridge fits most tone arms of leading manufacturers of record changers and players.
Stock No. 99-K-HAS3RN.....Reg. $8.25

FACTORY CLOSE-OUT

Shure Wire Recording Head Record—Playback—Erase—#812
Regular $15.00 Concord's Price $1.19

Lots of Five ..1.09 each

Mounted in hum-shielded case. Uniform Output. Excellent Frequency Response. Prong Contact.

CONCORD RADIO • 45 Warren Street, N.Y. 7, N.Y.

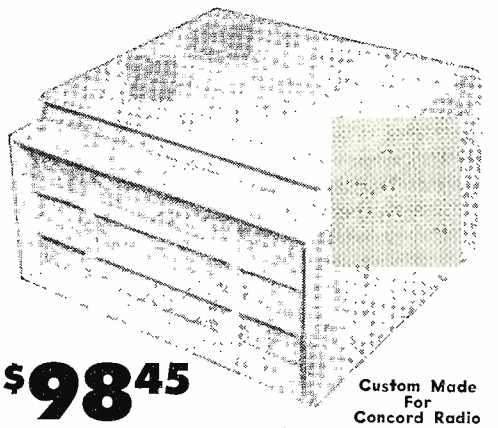
CONCORD's *HI-FI Bargain Corner*

GARRARD MUSIC SYSTEM
A CONCORD HI-FI SPECIAL

WE PROUDLY PRESENT THE 1957 CONCORD HI-FI MUSIC SYSTEM FEATURING THE GARRARD DELUXE RECORD CHANGER!

ONLY FOR THE MOST DEMANDING MUSIC LOVER. THIS WONDERFUL MUSIC SYSTEM INCLUDES FEATURES FOUND ONLY IN SYSTEMS COSTING HUNDREDS OF DOLLARS.

- World famous Garrard Deluxe 3-speed automatic changer plays all speed, size records, with jamproof mechanism.
- Plays intermixed records at same speeds.
- Finest hi-fidelity cartridge with dual sapphire needles.
- Climatized cartridge resists temperatures and humidity.
- THREE balanced speakers, 2 woofers plus 1 tweeter.
- Built in cross-over network.
- Amplifier custom designed to reproduce faithfully 20-20000 cps.
- Printed circuits used in amplifier for sturdy service.
- Negative feedback circuit for low distortion.
- Extended bass & treble controls.
- Over 5 watts undistorted output.
- Automatic shut-off for amplifier when record load is completed.
- Dimensions 19¼ x 18⅛ x 11¾".
- Cabinets are custom made of finest wood and veneers.



$98.45

Concord's Famous Price . . . $98.45 in Rich Mahogany $105.00 in Limed Oak

Stock # GAR-RN-10-6
Shipping Wgt. 32 Lbs.

Custom Made For Concord Radio
3 Balanced Speakers with Crossover Network!
FREE 45 SPINDLE

Concord's Commander Crystal Microphone

You will quickly recognize the famous manufacturer who sold this microphone at a much higher price . . . only through Concord's great buying power can you get so much value. Freq. response is better than 70-7000 cps. Output —52 db. Complete with shielded cable. Nationally Advertised Price $10.85.

(STOCK # MIKE-100-RN-106)

CONCORD'S PRICE..... **$5.25**

CONCORD'S LEADER CRYSTAL MICROPHONE

Another good buy from a famous manufacturer and the price is fantastic! Freq. response is better than 70-6500 cps. Output —52 db. Complete with shielded cable. Fine for use in mobile rigs, recorders, ham stations, paging systems.

Nationally Advertised Price..$7.95

CONCORD'S PRICE..... **$4.25**

SAVE OVER 55%

HERE'S A CUSTOM HI-FI SYSTEM
At a Truly Unbelievable Price!!

Close Out Price! $14.95 Reg. $22.50

Four inputs including reluctance or magnetic cartridge input! 7 Watt peak output.

Heavy duty AC power transformer—Four tubes—Separate bass, treble and volume controls—Decal markings on all controls —Frequency response is 50-18,000 cps—Tubes: 7C5, 7F7(2), 7Y4, or 5Y3—Chassis painted modern gray hammertone—Manual included with each unit—Size: 12" wide, 6¼" deep, 4½" overall height—Dial light—Fuse holder.

Close Out Price! $22.50 Reg. $39.50

Plus . . . Webcor 3-Speed Changer with Hi-Fi Flip-Over Cartridge

- Plays 33⅓, 45, 78 RPM records.
- Shuts off after last record.
- Famous make crystal cartridge with 2 sapphire stylii.
- Balanced tone arm and turntable.

Close Out Price! $10.95 Reg. $24.95

Plus . . . Famous Make 12" Coaxial Speaker

- Built in cross over network.
- Response uniform 50-13,000 cps.
- One piece molded cones in both woofer and tweeter.
- Extra heavy Alnico V magnet.

AMPLIFIER	$14.95
WEBCOR CHANGER	22.50
COAXIAL SPEAKER	10.95
REG. TOTAL PRICES	$48.40

CONCORD'S COMBINATION PRICE..... **$46.50**

CONCORD FINE TONE ARMS

Counter balanced tone arm with "low pressure" cartridge. Full three volt output. Output better than 50-5000 cps. Each unit cartoned. (Less needle.)

Stock # Midge-RN-96
LIST PRICE $8.50.
Concord's Famous Price **$2.99**

Concord's Bargain on Webster Gold Tone Arm With Flip-Over Cartridge

- Hi-Fi flip-over crystal cartridge (AX)
- 1 mil & 3 mil. Precious metal double stylii
- Fully balanced tone arm
- Exact replacement for Webcor Midge
- Complete with all hardware

Stock # Web-RN-96
Shipping Wgt. 2 lbs.
Lots of 3 $12.00
Concord's Close-out Price **$4.49**

Concord's Famous Amplifier

$9.99

Concord's Bargain Price

Concord's Famous Amplifier includes the following fine features:

Reg. Price $31.50

10 WATT HI-FI CUSTOM AMPLIFIER

- Extended response better than 30-13000 cps.
- A full 10 watts with PP 6V6 output.
- Full chrome plated chassis.
- Three inputs including pre-amp stage for reluctance cartridges.
- Output transformer for 4 or 8 ohm speaker.
- Built in fused line.
- Complete with tubes, 2—6SL7's, 2—6V6's, 1—7Z4.

Concordia RECORDING TAPE
the best for less

manufactured for Concord Radio by one of America's most highly respected Recording Tape Manufacturers. Frequency response at 7½ IPS is 40 to 15,000 cycles with extremely low distortion and maximum signal-to-noise ratio. Wound facing in. Output will not vary more than ¼ db within any given reel, and not more than ½ db within any 2 reels. No risk is involved. If you are not completely satisfied, all of your money will be returned, no questions asked!! Shpg. wt. 14 oz. ea. 1200 ft.

1800-ft. $2.21 each — FREE REEL

1200-ft. $1.69 — BAKER'S DOZEN

600-ft. $1.24

Buy 12 and get 13—one free

FREE! ½ more tape time!

UNCONDITIONAL MONEY BACK GUARANTEE

Stock #TE-1-RN.....single 600 feet reel, $1.24
Stock #TE-2-RN.....single 1200 feet reel, $1.69
Stock #TE-3-RN.....single 1800 feet reel, $2.21

SNAP 'EM UP
3 TUBE PHONO AMPLIFIER

- With wide range tone and volume controls.
- Easily attached to any phono and speaker.
- A fine replacement for earlier units.

(Less tubes, 12AT6, 35W4, 50B5)

Stock # Phamp-RN-10
Shipping Wgt. 3 lbs.

SINGLY .....$3.25 EACH
LOTS OF 3..... 2.99 EACH
SET OF TUBES FOR ABOVE $1.94

Concord's Close-out Price . . . **$2.99** lots of 3

ORDER YOUR *FREE* CATALOG NOW

DIgby 9-1132

CONCORD RADIO CORP.

45 WARREN ST., N. Y. 7
DEPT. RN-9-6

RUSH THE FOLLOWING ITEMS:

1—.....

2—.....

3—.....

4—FREE CATALOG

☐ I AM ENCLOSING $.....

☐ SEND C.O.D. I ENCLOSE 20% DEPOSIT

NAME .....

ADDRESS .....

Certified Record Revue

(*Continued from page 74*)

ating scores for violin and orchestra, and it is certain that with the excellent performance and splendid sound this disc will find many buyers. Menuhin plays the works with obvious verve and zest, his tempi are brisk and his tone clean and unforced. His technical brilliance never fails to amaze one, even in these days of the super-virtuosi. There is understanding in his reading and considerable warmth, but it is here where I must defer to the old but inspired reading of the Heifetz/Beecham version of the "4th" concerto and the mastery of Oistrakh in the "5th" concerto.

These values aside, there is little to quibble about and with the superior sound that the engineers have afforded Menuhin, this is an infinitely more pleasurable disc to listen to than those earlier efforts. Pritchard has done an excellent job in maintaining balance and generally exercising a firm hand on the proceedings. Good spacious acoustics combined with sharply defined inner detail and superlatively quiet surfaces are all plus virtues in a highly recommended disc.

SCHUMANN
DAVIDSBUNDLER DANCES AND SYMPHONIC ETUDES
Rudolph Firkusny, pianist. Capitol P8337. RIAA curve. Price $3.98.

The second Firkusny recording since he signed with *Capitol,* and every bit as good as the first. This is the first recording of the "Davidsbundler Dances" that really sounds like a modern hi-fi disc. As far as the performance is concerned Firkusny plays it fairly straightforward and, although he has some deeply expressive moments, there is a sort of reticence to his playing that one finds slightly disconcerting. The Gieseking reading on *Urania* is probably closer to the true intent of the work, but the sound is so frightfully bad as to remove the disc from any consideration. The "Symphonic Etudes" are more Firkusny's metier and they receive a wholly sympathetic and convincing reading. The piano sound here is vibrantly alive and big-toned. There is no apparent transient ringing or percussive harshness and the recording is a sensible balance between sharply accented detail and spacious but not overdone acoustics. The realism of the piano is enhanced by the usual quiet *Capitol* surfaces.

MARCHING ALONG
Eastman Symphonic Wind Ensemble conducted by Frederick Fennell. Mercury MG50105. RIAA curve. Price $3.98.

Every recording by these superlative musicians has been outstanding and this is no exception. This is one of the zingiest most rip-roarin' collection of marches ever recorded With six Sousa sizzlers and six other favorites like Meacham's "American Patrol," Goldman's "On the Mall," and Alford's "Colonel Bogey," etc. the dynamic punch and sheer sonic impact is tremendous. As a hi-fi demonstration disc this can take its place alongside of the best. Owners of big speaker systems will flip when they hear the cone-crackin' transients in the "King Cotton" march. Man, this is really a buster! In addition to a larger than life bass drum, a savage snarly snare and the impact of massed trumpet and trombone there are some cymbal smashes of such overwhelming intensity that it is only possible to reproduce them through a big power amplifier with plenty of reserve wattage if clipping is to be avoided.

As usual Fred Fennell elicits wondrous performances from his young players. There is knife-sharp precision to the attacks and releases in all the choirs, there is a huge clean sumptuousness of tone quite unlike the ordinary "band" sound . . . and above all that bravura spirit in the organization which seems to imbue every piece with new life, no matter how hackneyed the work might be. With the ultra-wide frequency and dynamic range, the liveness of the acoustic perspective and the accuracy of the close-up sharply detailed recording, this is about the ultimate in monaural disc recording and with devotees of band music will live in their memory for a long while. Don't miss this one!

KODALY
SONATA FOR UNACCOMPANIED CELLO
REGER
SONATA #2 FOR UNACCOMPANIED CELLO
Zara Nelsova, cellist. London LL1252. RIAA curve. Price $3.98.

These may look like particularly uninspiring works, but don't let the titles fool you! The Reger is a pleasant exercise in cello sonorities, with Reger's adulation of Bach strongly in evidence. The Kodaly is very strong red meat indeed. This is an incredibly complex work wherein Kodaly has exploited literally every technical resource of the cello and the result is an amazing outpouring of sound you are not likely to forget for a long time. Even as a strictly hi-fi vehicle this is impressive and with the superb performance of Nelsova as an added plus, this is a recording of unusual distinction. Recorded quite properly close-up, the sound of the cello is outstanding. From the smooth soaring, stratospherically high register passages to the rich throbbing gutty resonance when Kodaly plumbs the lowest depths of the cello, there is naught but the cleanest delineation of the sonic contours. Janos Starker, the performer in the old *Period* recording of this work still has a slight edge in the warmth of his projection, and the sound of his disc was remarkable for its day, but Nelsova is more than satisfactory and this sound is quite a few notches above the *Period* recording. Try this and be surprised.

TCHAIKOVSKY
PIANO CONCERTO #1 IN B FLAT MINOR
LISZT
HUNGARIAN FANTASIA
Julius Katchen, pianist with London Symphony Orchestra conducted by Pierino Gamba. London LL1423. RIAA curve. Price $3.98.

London Records has the reputation of making discs with consistently high quality of sound. Almost as equally well known is that they generally do not go in for extravagant claims about their sound. So when one picks up a *London* record . . . this disc for instance . . . and across the top of the disc cover is the statement, "a degree of perfection, startlingly realistic, never before achieved by recorded sound," one hastens to listen and see what all the fuss is about! No more than the first few bars is necessary to dispel the notion that *London* might have been trying to "pre-sell" the 20th version of the Tchaikovsky warhorse. For this is, indeed, one of the most persuasively live sounding recordings of a piano concerto I have ever heard. And it is not so much in the super-spectacular realm of whomped-up frequency and dynamic response that it is outstanding but rather it is the sense of extreme naturalness that prevails.

The piano is ultra-smooth and liquid-toned, a great fat roundly-rich sound. When per-

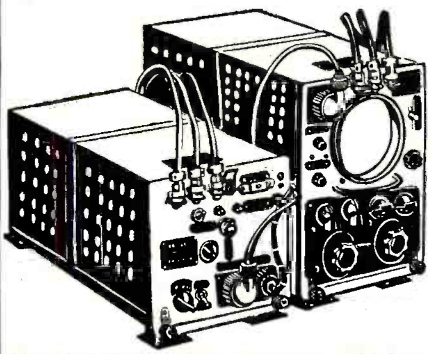
PRICES SLASHED ON BEST ELECTRONICS SURPLUS

50 W. 6-CHANNEL RADIOTELEPHONE for BOATS, MOBILE, or FIXED STATIONS

THE BIGGEST BARGAIN IN PLEASURE OR FISHING BOAT RADIOTELEPHONES!! Big-power ship-to-shore Radiotelephone. This Transmitter-Receiver (BC-669, part of SCR-543) is beautifully and ruggedly built. Designed for rough military service and engineered for maximum efficiency, it will provide trouble-free long-range communications from boat, vehicle, portable or fixed station installations. Both Transmitter and Receiver operate in the frequency range of 1680 to 4450 KC, and both are **crystal-controlled on all six channels** in this range. Manual tuning of the receiver is also provided. **Power Output (Phone) is 50 to 60 watts with 12 V. DC Power Supply.**
Transmitter operation is performed with a minimum of controls, after installation adjustments have been made. The BC-669 is type approved by FCC for marine band use. Operation of the 50 Watt Radiotelephone may be from 110 V. AC, 110 V. DC, 32 V. DC, 24 V. DC, or 12 V. DC. Complete constructional data and diagrams are furnished for building any of the above power supplies at minimum cost. Each set is supplied with 12 crystals (6 for X-mit, 6 for receive) which were used by the military. Receiving crystals differ by 385 KC (IF frequency). Most of these crystals can be reground to marine band frequencies. Receiver uses high-efficiency 10 Tube Superhet circuit with RF Stage for maximum selectivity, built-in loudspeaker. Static Filter (Noise Eliminator) Circuit with Switch, and RF Gain Control. Transmitter uses 8 Tubes (2-807's in Final) with 100% Plate Modulation, and Metering Switch with multi-range milliammeter for instant checking of any part of transmitting circuit.

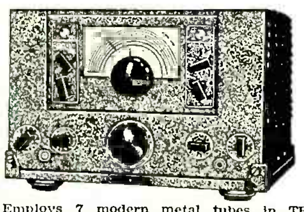
50-WATT RADIOTELEPHONE (BC-669A, B, or C Models), complete with all tubes, crystals (as specified), Inst. Book, Connecting Cord CD-515 (to Power Supply), Modification and Power Supply Constructional Data. **USED, GOOD CONDITION.** Shp. wt. 185 lbs. **EACH** **$99.50**
SAME AS ABOVE, NEW UNUSED CONDITION . . **$139.50**
MODELS BC-669 D or E, Same as Above, but provides also CW (telegraphy) transmission and reception (incorp. BFO). **NEW, EACH** **$169.50**
TS-11 HANDSET, with appropriate plug connector. **EACH** **$14.50**
CUSTOM BUILT 12 V. DC POWER SUPPLY FOR ABOVE. EACH **$125.00**
PE-110 A, B, or C, 110 V. AC POWER SUPPLY. EACH **$89.50**
PE-110 D, 110 V. AC POWER SUPPLY. EACH . . **$99.50**
12 V. DC POWER SUPPLY KIT, complete with transmitting and receiving dynamotors, relay, filter capacitors, choke, switches, fuse holders, etc., plus undrilled chassis and wiring diagram. **EACH** **$45.00**
RM-21 REMOTE CONTROL. Permits transmission & reception (by handset) from remote position. **EACH** . . **$6.95**

LORAN RECEIVING EQPT., APN-4, AT LOWEST PRICE EVER!!!



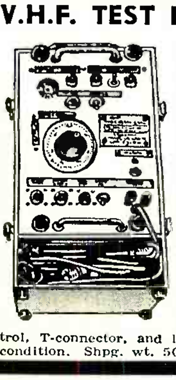
We made a "buy" on this popular model **APN-4** Loran unit, used on Fishing and Pleasure boats and Aircraft for navigational purposes. All are Used but in **Very Clean** condition, complete with tubes and crystal. Each set consists of an R9/APN-4 Receiver and an ID-6/APN-4 Indicator. Originally sold in surplus for $100.00 or more per set, it would be wise to buy an extra set for "Spare" while available at this real low price! Sorry, no accessories or inverter (80 to 115 V. AC, 400 to 2400 cycles, required) available at this time. Inverters for this equipment are easily available from many surplus houses.
PRICE PER SET, each consisting of one Indicator and one Receiver, as above. Not Tested. Excellent—Used. Shpg. wt. 80 lbs. **$29.95**

15-600 KC RECEIVER



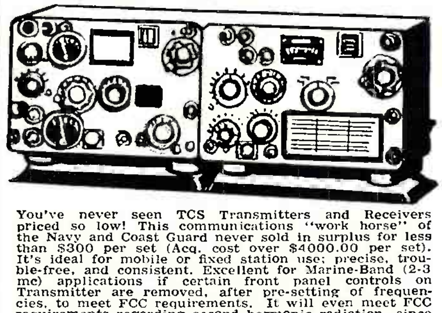
Navy Model RBL, mfd. by National and Wells Gardner—(both types available) for ship and shore application. Designed for 110V. AC. 50-60 cycle operation. Receives CW. ICW and Phone signals. throughout the entire range of 15 to 600 KC in 6 bands. Employs 7 modern metal tubes in TRF circuit with regeneration, plus two audio filters to allow choice of two band widths, 600 or 3000 cycles at 20 db down with peak response occurring at 750 and 1000 cps respectively. Also incorporated audio limiter stage which reduces noise and interference. This is an excellent receiver for wireless operators, hams, and all others interested in the long and intermediate wave bands. Dim: $17\frac{5}{8}$" L. x $15\frac{1}{2}$" D. x $10\frac{1}{2}$" H. (less shock mounts). Supplied complete with tubes, instruction sheets and diagram. Shpg. wt. 135 lbs.
PRICE, EACH, . Excellent—Like New Condition **$79.50**
PRICE, EACH, Used—Good Condition **$64.50**

V.H.F. TEST EQPT. 150-230 MC

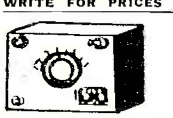


A Complete Test Instrument covering 150 to 230 mc, operating from 110 V. 50/70 cycles AC, mfd. for Navy, Model OAP. Permits following functions: (1) Tune a transmitter to given frequency. (2) Tune a receiver to a given frequency. (3) Adjust antenna system for best performance. (4) Measure power output of a transmitter. (5) Check wave shape of transmitter's output with auxiliary oscilloscope. (6) Monitor a transmitter during operation. Incorporates: Calibrated Tuned Absorption-Type Wavemeter; Signal Generator; a detector-amplifier circuit with electric-eye indicator which shows exact resonance with applied signal, plus an untuned VTVM Input connection so that this circuit will serve as a tube voltmeter. All housed in a metal cabinet, with cover, $15\frac{1}{8}$" L. x $8\frac{1}{2}$" W. x $10\frac{1}{2}$" H. Includes calibration chart, separate receiver gain control, T-connector, and line cord. LIKE-NEW condition. Shpg. wt. 50 lbs. **EACH** **$39.95**

SENSATIONAL BARGAIN!! TCS TRANSMITTERS, RECEIVERS, AND ACCESSORIES

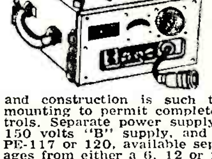


You've never seen TCS Transmitters and Receivers priced so low! This communications "work horse" of the Navy and Coast Guard never sold in surplus for less than $300 per set (Acq. cost over $4000.00 per set). It's ideal for mobile or fixed station use; precise, trouble-free, and consistent. Excellent for Marine-Band (2-3 mc) applications if certain front panel controls on Transmitter are removed, after pre-setting of frequencies, to meet FCC requirements. It will even meet FCC requirements regarding second harmonic radiation, since the transmitter uses a Buffer stage, plus (variable) link coupling between the final RF Tank and a pi-network which couples to the antenna, all of which reduces harmonic radiation to absolute minimum. Other features of TCS Transmitters and Receivers are: * complete coverage 1.5 to 12.0 mc, all band-switching. * 4-channels crystal-control, plus one channel manual tuning (in transmitter precision VFO). * uses 1625 instant heating filament tubes (equivalent to Type 807) in RF Amp and Mod. sections of Transmitter to minimize drain. * Rated at 40 watts CW and 20 watts phone output when transmitter plate voltage is 425 V., but this power can be easily doubled by using 600 volts plate supply. * Transmitter or Receiver designed to operate from either 12, 24, 110 V. DC, or 110/220 V. AC power supplies. Power Supply Diagrams furnished. * Receiver is super-sensitive superhet. with excellent sensitivity & selectivity characteristics, and includes BFO circuit for CW reception. Units priced below are complete with tubes, good clean condition but untested.
TCS-5(to 9) TRANSMITTER, with all tubes, schematic diagram and power supply diagrams, as outlined above. Shpg. wt. 60 lbs. **PRICE EACH** **$39.95**
TCS-9(to 14) TRANSMITTER, same as above but has minor modifications which make these models more desirable. **EACH** **$59.95**
TCS-5(to 14) RECEIVER, complete with tubes and schematic diagram, as described above. Shpg. wt. 50 lbs. **EACH** **$69.95**
WRITE FOR PRICES ON OTHER TCS ACCESSORIES.



TCS ANTENNA LOADING COIL. Used with above equipment to obtain maximum performance with short whip antenna. Has 6-position tapped switch for various lengths of antenna. In metal housing 6" H. x $9\frac{1}{2}$" W. x $6\frac{3}{4}$" D. Shpg. wt. 6 lbs. **EACH** **$7.95**

FM TRANSCEIVER 28-39 MC

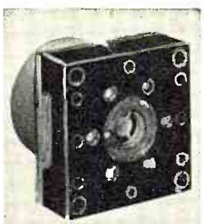


Signal Corps BC-659, part of popular SCR-609/610 Vehicular eqpt. Combination Transmitter and Receiver for FM communications, 2-channels both crystal-controlled. Transmitter use not recommended except for military or special applications, but receiver is ideal for monitoring 28 to 39 mc (can be extended by removing a few coil turns. Incorporates built-in loudspeaker, and construction is such to permit easy under dash mounting to permit complete access to front panel controls. Separate power supply required to provide 90 to 150 volts "B" supply, and 1.5 volts "A" supply. The PE-117 or 120, available separately, supplies these voltages from either a 6, 12 or 24 volts DC source, but batteries or other supply can be easily adapted. Dim. of Transceiver 16" L. x 13" W. x $7\frac{1}{2}$" H. Supplied complete with all tubes and Instruction Sheets with Schematic Diagram. Shpg. wt. 50 lbs.
PRICE PER SET, Excellent Condition **$49.50**
Price, PE-120 Power Supply for above. Used—Good **$25.00**

All Above Material Subject to Prior Sale. 25% Minimum Deposit with All C.O.D.'s. Min. Order —$5.00. All Prices F.O.B. Our Address.

— TELEMARINE —
COMMUNICATIONS CO.
3030 W. 21st Street, Brooklyn 24, N. Y.
Cable Address: Telemarine N. Y.
Phone: ES 2-4300

50-60 W. SPEAKER UNIT



Western Electric Speaker units, for horn or baffleboard mtg. NEW units, removed from above speaker. Shock and blast proof diaphragm, will handle up to 60 watts. Response to 7,000 cps. favoring high freq. Impedance 13 ohms. Dim.: 6" x 6" x $4\frac{1}{2}$" deep. Throat opening—$1\frac{3}{8}$" dia. Alnico 5 slug wt. 6 lbs.
Shpg. wt. 20 lbs.
EACH, SLASHED TO **$11.95**

LIMITED QUANTITY BARGAINS

GENERAL ELECTRIC 10 KW RF POWER AMPLIFIER, model BF-3A, designed to increase RF power output of FM Transmitters (88-108 mc) to 10 KW. Can be modified to operate on other frequencies. Available NEW, less Rectifier Power Supply and Tubes. **EACH** . . **$795.00**
COLLINS MODEL MBF 5 METER TRANSCEIVERS, covers 60 to 80 mc single channel crystal-controlled Transmitter & Receiver. Full 3 watts RF output. Ideal as 5 meter Walky-Talky. Used—Good Condition. With tubes and cable less other accessories. Operates from 110V. AC-DC. Shpg. wt. 50 lbs. **EACH** **$32.50**
3-RANGE SIGNAL GENERATOR. Well built and highly engineered, this test signal generator is a rare bargain for laboratories, service shops, and for production testing in factories. Known as the OAV-1 Test Generator, it provides any one or all of 3 outputs: (1) a V.H.F. output variable from 150 to 250 mc.; (2) a 15 mc. output (which can be changed to another nearby frequency for TV-IF alignment); and (3) Multivibrator output of .1, 1.0, 10.0 and 100 KC by means of a selector switch. Frequency stability is excellent and calibration at least as good as any excellent service signal generator. Includes following tubes: 1—5Y3GT, 1—6SK7, 1—6AG7, and 2—9002. Operation is from 110 V. 60 cycles, 1-phase AC. Dimensions are L—$19\frac{1}{2}$", H—$13\frac{3}{4}$", D—$7\frac{1}{2}$". Shpg. wt. 85 lbs. NEW units, with operating instructions and Schematic. **ONLY** **$24.95**
CONDENSER MICROPHONE, WITH 2-STAGE PRE-AMP. Real, Precision quality construction, double Helmholtz Resonator type, with combination microphone and amplifier built-in cylindrical brass case 16 x 6 ins. Uses types 30 and 32 tubes in amplifier. Employs acoustical low-pass filter plugs (removable) for 5-25 cycle response; removing plugs (threaded) and venting cylinder case will result in high-quality, wide-range studio-type microphone. As is, excellent for vibration testing, percussion noises, shock sounds, oil exploration work. Original use—Sound (Artillery) Ranging Eqpt. Model T-21/6R-3-C. NEW UNITS. Shpg. wt. 25 lbs. **EACH** **$11.95**
RCA 1P25 INFRA-RED IMAGE CONVERTER TUBE, used in American Snooperscopes and Sniperscopes. All NEW, UNUSED Condition. Shpg. wt. 8 lbs. **EACH** **$49.50**
BRITISH-TYPE INFRA-RED IMAGE (SNOOPERSCOPE) TUBES. Used in British "Tabby" for seeing in the dark for "snooper" or "sniperscopes." Will detect objects at night illuminated by "dark" infra-red rays. Requires power supply of 8000 to 4000 volts at a few microamperes. Screen size is $1\frac{3}{8}$" dia. All tubes checked before shipment. **Price** .... **3 for $10.00**
FRONT END LENS ASSEMBLY. For above. Speed F1.9 f.1., 91.44 mm. Outside dia. at one end 60 mm. Length of mount 64 mm. **Each** **$7.00**
STEP-UP OR DOWN 120/240/460, 3KVA, TRANSFORMER. Heavy-duty transformer, single phase. 50/60 cycles mounted in oil immersion type can approx. 22" high x 14" dia. Can be removed from can and operated air-cooled with negligible drop in KVA rating, due to rugged overdesign. **NEW—UNUSED** units, less oil. Shpg. wt. 300 lbs. **EACH** **$44.50**
PE-218 INVERTERS. 24-27.5 V. DC Input. 110 V./400 cycles/1 phase, 1500 VA. Output. NEW UNITS. **EACH** **$14.95**
PAE-2 ELECTRIC MEGAPHONE. Mfd. by Remler for U. S. Navy to give concentrated directional sound over a long distance. Consists of a Horn Assembly which includes Microphone, Reproducer, trigger Switch, and Connecting Cable; and, a Portable Amplifier with self-contained Power Supply and 6-Volt Storage Battery. Will beam voice over 500 yards or more outdoors. Charger and Storage Rack for 110 Volts AC or DC operation, (charging) available separately. Portable Megaphone Dim: 20" H. x $13\frac{1}{2}$" W. Portable Amplifier Dim: $13\frac{3}{4}$" H. x $12\frac{3}{4}$" W. x $9\frac{3}{4}$" D. Complete with tubes, connecting cables, Inst. Book, UNUSED cond. Shpg. wt. 85 lbs. **PER SET** **$79.50**
STOWAGE & CHARGING RACK, for above. Operates from 110 V. AC or DC to charge storage battery at tapering rate. Dim: $15\frac{1}{2}$" H. x 18" W. x $11\frac{3}{4}$" D. Unused condition. Shpg. wt. 55 lbs. **EACH** . . **$19.50**
RMCA MODEL DAE-1 DIRECTION FINDER. Deluxe type DF eqpt. designed for commercial vessels, but excellent for the large pleasure boats. Freq. Range 240 to 2,000 KC, in 3 bands. Employs super-sensitive superhet circuit, with BFO that permits taking bearings on CW signals, and built-in AC power supply which can be operated from 6, 12, 24, 32, or 110 V. DC converters. Rec. Dim.: 14" L. x $8\frac{3}{8}$" H. x 15" deep. Loop Dim.: Length from deck to handwheel—23". Overall Length—41", Loop Dia. 15". All NEW Eqpt., with all cables, tubes, Instruction Book. Shpg. wt. 125 lbs. **EACH** **$149.50**
RMCA MODEL ET-8012 75 Watt MARINE RADIOTELEPHONE. Provides 10 channels, crystal-controlled, transmission and reception in the 2 to 3 MC band. Popularly used in commercial vessels, excellent also for the larger type of pleasure craft or fishing boat. Self-contained power supply, for 110 V. DC operation but can be used on 110 V. AC with appropriate converter. Dim.: $34\frac{1}{2}$" H. (with shock mounts) x 20" W. x 20" Deep. Shpg. wt. 300 lbs. Used-Excellent condition. With tubes & Instruction Book. **$500.00**
PIONEER GEN-E-MOTOR. 5.6 Volts Input at 22 amps; Output 400 V. DC at 175 ma. Dim.: $6\frac{1}{2}$" L. x 4" dia. Used-excellent. For Ham mobile, marine radiotelephones, etc. Limited Supply! **EACH** **$11.95**
WESTERN ELECTRIC VHF AM TRANSMITTER, A3 emission. 132 to 156 mc freq. range, 1 band, 1 channel freq. of individual channels preselected; crystal controlled; 12 W. A3 emission: 107, 115 or 122 V. AC, 50 to 60 cycles, single phase; enclosed in metal cabinet; 18" lg, 32" wd, $64\frac{1}{2}$" h o/a; new—unused. Ideal for small airports. Shipping weight 450 lbs. **PRICE EACH** . **$295.00**
PE-104, 6 or 12 V. DC VIBRATOR POWER SUPPLY. For SCR-284 Receiver, or other transceivers or mobile receivers. Uses synch. vibrator, no tubes, fully shielded. Dim. 3" x $4\frac{5}{8}$" x $6\frac{1}{8}$". Shpg. wt. 12 lbs. **NEW UNITS. EACH** **$14.95**
SPARE, VIBRATOR, for above. **EACH** **$3.75**
BC-745 POGO-STICK TRANS-RECEIVER. Single freq. crystal controlled trans. and recvr. Freq. range 2-6 Mc. Output ¾ watt. Range approx. 5 miles. For emergency communications, etc. Complete with tubes, connecting cord CD-571, and 1 BC-746 Tuning Unit. **USED, GOOD CONDITION.** Shpg. wt. 15 lbs. **EACH** **$39.50**
SAME AS ABOVE, NEW CONDITION—EACH **$59.50**
CHEST-UNIT T-39, Excellent Condition. Shpg. wt. 5 lbs. **EACH** **$15.00**
POWER SUPPLY PE-157, with Internal 2 Volt Storage Battery. Exc. Cond. Shpg. wt. 15 lbs. **EACH** **$24.50**
ADDITIONAL BC-746 TUNING UNITS, with crystals. Specify preferred frequencies. NEW. **EACH** **$2.95**
SPARE TRANS-RECEIVER CHASSIS, NEW, BC-745, less tubes. Shpg. wt. 8 lbs. **EACH** **$12.95**

cussiveness is demanded in the score, the response is sharp and clean with no trace of harshness and ringing. The orchestral accompaniment is equally successful in projecting the feeling of presence. The string tone is smooth and edgeless, the horns, trombones, and trumpets, bright and brazen with power nor cracking. The woodwinds, especially the are effortlessly reproduced with no forcing flute and oboe, are lambent in the purity and cleanness of their tone. Percussion is very sharp and accurate but never overblown for "effect." Now wrap all this with nigh perfect balance between piano and orchestra, add acoustic perspective which is spacious for compelling liveness but still allows for crisp definition of all the various voices and you have the reasons why *London* is so proud of this recording.

The performance is quite good, too. Not what might be termed definitive but with its own particular values. Here is youthful ebullience, a reveling in the quick-fingered proficiency of technical mastery, a sparkling, scintillating performance that many will like after so much heavy-handed pedantry on the part of so many other artists. But everything has its penalties and those who would desire more warmth and passion, more grandiloquence, will not find it in full measure here. Suffice that Katchen and conducting prodigy Gamba (who incidentally does a first rate job) have given us a vital vigorous performance with a sound that will not be surpassed for a long time to come.

The Liszt work fares equally well in sound and gets a good competent reading from Katchen, but the prize on this disc is definitely the Tchaikovsky. You should make it a point to hear this and compare it with your own version. I think you will find that it's a worthwhile buy even if you have to duplicate.

VERDIANA
New Symphony Orchestra of London conducted by Salvador Camarata. London LL1385. RIAA curve. Price $3.98.

As the title implies, this is a collection of various selections from Verdi operas, and includes such famous potboilers as the "Anvil Chorus," "La Donna e Mobile," and the quartet from "Rigoletto." All are in orchestral transcription and, in general, this disc will mortally offend the purists. But taken for what it is, it is a job well done. The transcriptions are tasteful, the playing of very high character and the sound is spectacularly good. For many folks, this will be right up their alley. In fact, orchestral opera is getting a big play currently, as witness the success of the Kostelanetz "Opera for Orchestra" series, which is probably the inspiration for this disc.

MOZART
HAFFNER SERENADE IN D MAJOR (K. 250)
INTRODUCTORY MARCH IN D (K. 249)
Vienna State Opera Orchestra conducted by Mogens Woldike. Vanguard VRS-483. RIAA curve. Price $3.98.

This is the sort of recording that really does do justice and pay proper homage to Mozart in this commemorative year. Far too much of the vast outpouring of Mozart recordings this year, have been hastily contrived and of indifferent quality. This is the 5th recording of the "Haffner Serenade" to appear on LP and it is incontestably the best. For one thing, this recording represents an entirely different and authenticated scoring of the work. A great deal of research was undertaken before the various "innovations" in the score were given permanent stature. Thus we now have the delightful

"Introductory March," missing in all previous editions, the addition of tympani in the score as well as various re-written parts for woodwind and strings. The structure as a whole has been changed to give the work a more properly symphonic outline rather than the heretofore "thinner" scoring typical of the serenade form. I, for one, feel the work has gained immeasurably by these changes.

Woldike does his customarily fine job of conducting, and elicits some splendid playing from his obviously enthusiastic orchestra. In keeping with the revised score, the sound here is far bigger than any of the previous recordings. As is usual with *Vanguard,* they have achieved a splendid balance in the various choirs, the string tone is very clean and live, the woodwind are bright and pure sounding, the trumpets and horns sound out heroically and are quite free from distortions, the tympani add their punctuation in a sharp and accurate manner but are never obtrusive. Acoustic perspective was almost too spacious, but the day was saved by the crisp definition of the inner orchestral voices.

CHADWICK
SYMPHONIC SKETCHES
Eastman Rochester Symphony Orchestra conducted by Howard Hanson. Mercury MG50104. RIAA curve. Price $3.98.

Everything about this recording is fantastic, from probably the most striking album cover yet issued (a nightmarish color photo of a grotesque "hobgoblin" character) to the offbeat "modern" character of music from the staid Boston of the 1890's, to the stunning realism of the sound. In four sections, or sketches, entitled "Jubilee," "Noel," "Hobgoblin," and "A Vagrom Ballad," this is music that runs the whole gamut of orchestral colors. Chadwick was that rare bit of musical Americana in the 1890's . . . a composer uninfluenced by the musical forces of Europe, who dared to dream and write music in his native idiom. It is not difficult to detect in the various sections of the work, some material which is definitely folk-derived and which has a familiar ring. Yet this is certainly not a derivative work, rather the folk material was inspirational. The sections vary widely in content . . . "Jubilee" is bright and spirited, full of dynamic contrast and most likely the most folk material . . . "Noel" is a very lovely slow movement, with some beautiful solo writing for English horn and oboe . . . "Hobgoblin" is a lively scherzo, full of rollicking good humor, and impish deviltry . . . "A Vagrom Ballad" is the strangest piece of all with more than a hint of atonality and dissonance . . . it is biting satirical music and its harsh contours must have shocked the Boston of those days! Dr. Hanson turns in a spirited vigorous performance and, as always, is ably supported by his superb orchestra. With modern scores and especially modern American scores, this Rochester Orchestra is doing a fabulous job. The sound is typical *Mercury*. Huge big-hall liveness with the crystal clarity of detail always in evidence. String tone has the usual bright sheen, brass is of tremendous weight and sonority, there are sections in "A Vagrom Ballad" where the percussion is earthshaking. Wait until you hear the snare drum and xylophone speaking full *forte* in this section!

This is a work noted for dynamic contrasts and the engineers have put it on the record in fulsome measure. Through a big speaker system this disc is quite an experience!

Tape Reviews

BARTOK
CONCERTO FOR ORCHESTRA
Chicago Symphony Orchestra conducted by Fritz Reiner. RCA Victor "stacked"

stereophonic. 7" reel, 7½ ips. ECS-9. Price $14.95.

I reviewed the disc issue of this work last month, and if you recall, I made comment that although a good recording, I thought the acoustics as used monaurally were not suitable, and I stated that I thought the deficiency of detail would be made up in the stereo recording. Immodestly, I must report that I was right. The whole character of the score has changed with the stereo, and now it is really possible to appreciate the wonderful performance of Reiner. Now even the most minute wisp of orchestral detail is readily and audibly apparent. This is definitely one of the most thrilling stereo tapes yet. The sense of directionality here is startling, with the Bartok score being particularly rich in interplay between various choirs in the orchestra. With your speakers in perfect balance, the change between first and second violins and celli is easily discerned, and that section for massed trumpets in the first movement is played *forte* and there is no mistaking where those trumpets are located.

I have long maintained that directionality *per se,* is not all-important in stereo, but there is no use denying that it does add its extra dimension of realism along with the over-all depth and all the other factors. Depth effect here is quite good as is the instrumental discrimination. In fact, this is one two-channel stereo tape where the "hole-in-the-middle" effect was quite minimal and certain of the woodwind and the horns were right in the middle where they should be. (I know their location having recorded stereo with the Chicago Symphony myself on numerous occasions.) Having these woodwinds and horns sound out rather disembodied between the two speakers is a bit disconcerting but very welcome just the same!

I can't emphasize to you strongly enough the fantastic difference between the disc and the stereo. I just wish it were possible for everyone to enjoy the incredible realism and enhanced musical perception the stereotape affords. For those who have the means of playback, this tape should be a must.

DEBUSSY
NOCTURNES
Boston Symphony Orchestra conducted by Pierre Monteux with women of Berkshire Festival Chorus. RCA Victor "stacked" stereophonic. 7" reel, 7½ ips. CCS-12. Price $10.95.

You know, in some ways this stereo thing could be bad business for reviewers! By this I mean that everything sounds so darn good, that it is difficult to retain one's objectivity and perception. When I reviewed the disc of this work a short while ago I gave it a pretty good rating, but opined that I thought the Stokowski version was still a few notches above this recording. After listening to this stereo version I am prepared to fight to the death defending its virtues! Seriously it is a fine performance, and I still think Stokowski's conception of the score is more to the point, but in matters of sound it is strictly no contest. This is simply fabulous! All the subtle nuances and pastel colorations that give this score its interest are here newly revealed. The shimmering gossamer string textures, the ethereal woodwind, the sharp pungency of the brass and percussion in the "Fetes" section are heard cleanly, full-rounded and pure of tone. Directionality is also good in this recording as is the depth effect created by stereo.

The most amazing part of the work is the wordless women's chorus in the "Sirenes" section. In most disc recordings this is never a particularly clean nor articulate part of the score . . . there is always some fuzziness and blur and while I mentioned in my review of the disc of this performance that the chorus did good work and sounded as well as I've ever heard it sound on disc . . . it is but a pale shadow compared to this stereo. The voices are spread out before you, and with the greatest of ease you can pick out the sopranos from the contraltos, etc. The effect of presence is astounding (choral work in stereo generally is) and for the first time it is possible to appreciate the skillful Debussyian scoring from a recorded media. Truly a big advance in the enjoyment of this work, and it clearly points the way to what one can expect when things like the Bach "B minor Mass" and Handel's "Messiah" are available with the glory of stereophonic sound. —30—

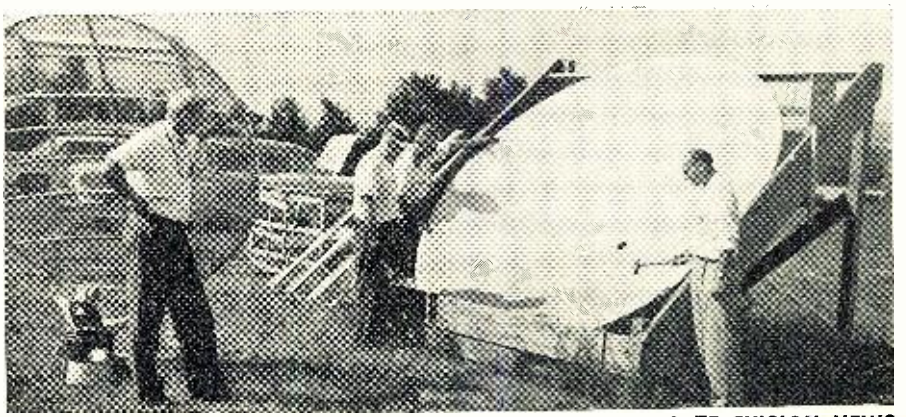
16 RPM DISCS

Audio Book Company, St. Joseph, Mich. has just introduced a compatible 16 rpm record which can be played on any four-speed phonograph. The new 7-inch discs provide a full 40 minutes of music.

Prior to this new development, existing 16 rpm discs were playable only on the special equipment designed for automobile phonograph systems.

The catalogue will consist of a variety of classics, pop standards, light classics, and show tunes and are designed to supply "mood" or background music.
—30—

Crew of Stromberg-Carlson engineers uncrates large parabolic antenna that is to be used in experimental work on tropospheric scattering, in cooperation with Cornell University's Radio Astronomy Laboratory. This antenna will be installed at the 30-foot level of the radio relay tower on Hathaway Hill, east of Rochester, N. Y., and will transmit signals toward the Cornell laboratory near Ithaca, N. Y., 72 miles away.



LIFETIME GUARANTEED TUBES

SAVE

BRAND NEW

PICTURE TUBES

- RCA Licensed
- One Year Unconditional Guarantee

Type	Price	Type	Price
10BP4	$11.90	17BP4	$20.63
12LP4	$14.38	19AP4	$24.81
14BP4	$16.86	21AP4	$28.79
16RP4	$19.38	21EP4	$28.79
16LP4	$19.38	24AP4	$42.50

Picture Tubes shipped F.O.B. Harrison, N. J. Above types are most popular. However, you may order any equivalent size at the same price.

SAVE

USED

TV SETS

Picture Tube Guaranteed To Work!

- Emerson
- RCA
- Philco
- GE
- Motorola
- Zenith
- Capehart
- Others

10" SET
Table Model ...$16.95
Console $19.95
12" SET
Table Model ...$22.95
Console $24.95
14" SET
Table Model ...$27.95
Console $31.00
16" SET
Table Model ...$32.00
Console $34.95
17" SET
Table Model ...$37.00
Console $39.00

All prices F.O.B. Harrison, N. J. Prices on request for 19", 20", 21" and 24" sets.

SAVE

NEW INDOOR

ANTENNA

Both UHF and VHF. Brings better reception than most outdoor antennas. Use on top of TV.
List Price $9.95

YOUR PRICE

Lots of 3 **3.29**

$3.99 each

LOOK WHAT YOU GET FREE!

FREE BONUS BOX
- 1 RCA Cheater Cord
- 10 Assorted resistors
- 10 Assorted 2 color "blank" tube cartons

With Every $25 Order
- 1 6BQ6GT tube
- 1 6AU6 tube
- 1 6CB6 tube

FREE CLOCK RADIO

With Every $125 Purchase Within 30 Days

Wakemaster clock radio with famous Sessions clock movement wakes you to music or alarm. May be purchased outright from MAJOR BRAND for $17.95. In ivory or rust.

HERE'S HOW LIFETIME GUARANTEED TUBES SAVE YOU MONEY!

- **We Guarantee to Replace ALL TUBES Purchased From Our Firm Forever**
- **Each Tube Individually Boxed and Guaranteed**
- **Over A Half Million Tubes Always in Stock**
- **Immediate Shipment**
- **Free Postage On All Orders With Full Remittance**
- **There are fewer "call backs"**
- **There are no "out of date" tubes**
- **"Peak Performance" testing in our fully equipped Testing Department before shipment guarantees quality**

0Z4	.43	3BN6	.70	6AV6	.39	6K8	.65	7C6	.43	14B6	.38
1A7GT	.43	3CB6	.52	6AX4GT	.60	6L6	.68	7C7	.45	14Q7	.50
1A7G7	.43	3Q4	.46	6AX5GT	.57	6L7	.42	7E5	.45	19BG6G	1.15
1B3GT	.65	3Q5GT	.57	6B4G	.52	6N7	.60	7E6	.55	19T8	.65
1C5GT	.41	3S4	.47	6B8	.69	6Q7	.40	7E7	.70	24A	.39
1D5GP	.43	3V4	.47	6BA6	.47	6S4	.40	7F7	.59	25AV5GT	.78
1E7GT	.41	4BQ7	.89	6BA7	.58	6SA7	.45	7F8	.70	25BQ6GT	.78
1G6GT	.41	4BZ7	.95	6BC5	.47	6SC7	.48	7G7	.75	25L6GT	.47
1H4G	.43	5AW4	.75	6BC7	.80	6SG7	.41	7H7	.50	25W4GT	.43
1H5GT	.47	5BG6G	1.15	6BE6	.45	6SH7	.43	7J7	.75	25Z5	.37
1J6GT	.47	5J6	.63	6BF5	.40	6SJ7	.43	7K7	.75	25Z6	.37
1L4	.45	5T4	.69	6BF6	.50	6SK7	.45	7L7	.75	27	.25
1L6	.55	5U4G	.43	6BH6	.50	6SL7GT	.55	7N7	.50	35A5	.46
1LA4	.57	5U8	.74	6BJ6	.47	6SN7GT	.55	12AT6	.37	35B5	.50
1LA6	.47	5V4G	.59	6BK5	.68	6SQ7	.39	12AT7	.66	35C5	.50
1LB4	.57	5Y3	.31	6BK7	.76	6SR7	.42	12AU6	.41	35L6GT	.47
1LC5	.49	5Y4G	.36	6BL7GT	.75	6SS7	.41	12AU7	.53	35W4	.34
1LC6	.47	5Z3	.41	6BN6	.58	6T4	.95	12AV6	.35	35Y4	.34
1LD5	.57	6A7	.57	6BQ6GT	.78	6T8	.68	12AV7	.67	35Z3	.39
1LE3	.57	6A8	.45	6BQ7	.78	6U8	.75	12AX4GT	.65	35Z5GT	.34
1LG5	.57	6AB4	.43	6BY5G	.58	6V3	.80	12AX7	.58	37	.29
1LH4	.64	6AC7	.67	6BZ7	.88	6V6GT	.46	12AZ7	.63	50A5	.46
1LN5	.47	6AF4	.79	6C4	.37	6W4GT	.39	12B4	.68	50B5	.50
1N5GT	.50	6AG5	.50	6C5	.35	6W6GT	.53	12BA6	.46	50C5	.50
1R5	.50	6AG7	.69	6CB6	.49	6X4	.34	12BD6	.48	50L6GT	.43
1S5	.42	6AH6	.69	6CD6G	1.15	6X5	.34	12BE6	.46	75	.42
1T4	.50	6AJ5	.70	6D6	.48	6X8	.73	12BH7	.60	76	.42
1U4	.47	6AK5	.54	6E5	.44	6Y6G	.55	12BY7	.65	77	.38
1U5	.42	6AL5	.39	6F5	.37	7A4	.45	12BZ7	.61	78	.38
1V2	.65	6AQ5	.46	6F6	.38	7A5	.53	12CU6	.95	80	.34
1X2	.61	6AR5	.46	6G6	.40	7A6	.45	12SA7	.45	84/6Z4	.44
2A3	.55	6AS5	.48	6H6	.38	7A7	.43	12SJ7	.45	117L7GT	1.09
2A5	.57	6AS6	1.70	6J4	1.79	7A8	.45	12SK7	.45	117N7GT	1.09
2A7	.55	6AS7G	2.19	6J5	.39	7B5	.39	12SN7GT	.56	117P7GT	1.09
3A4	.51	6AT6	.39	6J6	.47	7B6	.42	12SQ7	.37	117Z3	.35
3A5	.50	6AU4GT	.65	6J7	.43	7B7	.41	12SR7	.45	117Z6GT	.63
3AL5	.45	6AU5GT	.59	6J8G	.85	7B8	.45	12V6GT	.45		
3AU6	.46	6AU6	.42	6K6GT	.37	7C4	.39	12X4	.37		
3BC5	.54	6AV5GT	.65	6K7	.39	7C5	.42	14A7	.42		

WE PAY ALL POSTAGE on receiving tubes orders shipped in USA, Territories and APO's. Send only purchase price of merchandise. Please include approximate postage on foreign shipments. All orders subject to prior sale. Add 25c handling on orders under $5.00. Quantity users write for special discount.

Write for FREE Tube List—Order Blank—and FREE Sample Tube Carton. We want Y-O-U on Our Mailing List!

SPECIAL SURPRISE

Mention where you saw our ad and we will send you FREE three 6SN7GT's with any order of $10 or more.

FREE GIFT CERTIFICATE*

worth $5 toward the purchase of any of our merchandise on future orders will be sent with any order of $50 or more.
* Free Gift Certificate cannot be used to obtain another certificate unless order is $55 or more.

MAJOR BRAND TUBE CO.

Romano Bldg.
WRITE DEPT. RN-10

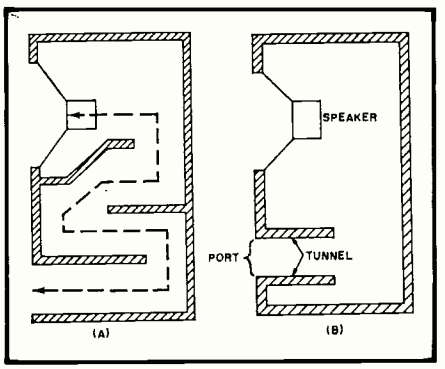
Harrison, N. J.
ESsex 4-1106

Patent No. 1869178, July 1932). Since the patent expired the design has appeared in many forms, but in some cases there is evidence that the basic principles have not been clearly understood, with unsatisfactory results in the quality of reproduction. When properly designed and correctly applied, the acoustic phase inverter (a title which describes its function exactly) improves the bass response and increases the power handling capacity of the speaker at low frequencies. With this goes a decided flattening of the bass resonance peak in the impedance curve. These advantages result from reduction of the travel of the voice-coil at resonant frequency by accurate loading of the diaphragm at that frequency; in other words, the resonant frequency of the air in the enclosure must be the same as that of the speaker. It follows that the enclosure must be carefully tuned to the frequency of the speaker resonance.

I should explain that what follows refers to *acoustic phase inverters*. This type of enclosure *must* be accurately matched to the speaker. Other enclosures which are not so matched resemble the genuine bass reflex but their effect is different. Some notes will be added later on this type.

Fig. 26B shows a cross-section of the acoustic phase inverter with the essential elements—the speaker, the enclosed air, the tunnel, and the port. The volume of enclosed air equals the total internal volume of the cabinet *less* the volume of the speaker unit and any internal bracing, *but not* the sound-absorbing lining, since this latter is virtually part of the air space. For a given volume of air the frequency of resonance in the port is modified by the size of the speaker diaphragm and the length of the tunnel. The larger the speaker the greater must be the volume of air; the longer the tunnel the smaller the volume. Bass reflex enclosures can be found with and without tunnels; the purpose of the tunnel is to reduce the size of the cabinet for a given resonant frequency. As a result of this you can assume that any enclosure offered to you of compact size, housing a large speaker, and having no tunnel, will not perform as an acoustic phase inverter unless the normal bass resonant frequency of the speaker is so high as to make it unsuitable for high-grade reproduction.

Fig. 26. (A) Section of an acoustic labyrinth. Length of air column is taken along dotted line. (B) Cross-section of acoustic phase inverter. All interior surfaces must be lined with a sound absorbing material.



Herein is the fallacy of buying a speaker which you fancy and fitting it into a reflex enclosure which also appeals to you. The two may not be compatible. The information required by an engineer to enable him to design an acoustic phase inverter for any particular speaker includes the equivalent piston diameter of the speaker cone, the bass resonant frequency of the speaker, and its total volume. There is an optimum length of tunnel for any given enclosure volume, neither too long nor too short. The end of the tunnel should not be nearer the back of the cabinet than the radius of the speaker diaphragm. The area of the port should equal the area of the speaker opening (or more accurately the area of a circle whose diameter equals the diameter of the equivalent piston). If there are errors in design the system can be "tuned" by altering the port area, but doing so conflicts with the "equal area" condition.

For the speaker of your choice you can assess the merits of the enclosure by visual inspection and electrical measurement. The cabinet should be strongly made and free from drumming when hit with the fist. The interior should be well lined with sound absorbing material to prevent the formation of standing waves. The port area should equal the area of the speaker opening. The rear end of the tunnel should not be nearer the back of the cabinet than half the diameter of the speaker opening. These points checked, the speaker is then mounted in the cabinet and its impedance measured at low frequencies by one of the methods given in Part 3 of this series of articles.

If you had previously taken a curve of the unenclosed and unmounted speaker from 1000 down to about 20 cps you would get something like the solid curve in Fig. 27, with the characteristic single peak produced by the bass resonance of the speaker. Below this peak the response falls off rapidly. Now with the speaker properly mounted in the enclosure, take another curve. This should look like the dashed curve in Fig. 27, with two peaks, one on either side of the original peak. It is obvious that the response is much closer to linearity and the bass cut-off is lower. This is the advantage of the matched acoustic phase inverter and mismatching will not give the desired results.

I can almost hear you say, "Why should I go to all this trouble?" There is no "must" about it. You are quite free to do the job properly or improperly, but if you want the undoubted merits of this type of enclosure to im-

GREATEST VERSATILITY!

NEW Altec 342A
AMPLIFIER with the
"input-matcher" feature

typical specification

Gain:	110 db
Input Sensitivity:	.0042 volts rms for rated output
Power Output:	20 watts at less than 2.0% thd, 40—20,000 cps
Frequency Response:	±1db, 20—20,000 cps
Input Impedance:	Nominal 100,000 ohms
Source Impedance:	30/50, 250/300, 500/600 with 4665 plug-in transformer
Load Impedance:	4, 8, 16 ohms and 70 v line
Output Impedance:	Less than 20% of nominal load impedance
Noise Level:	Equivalent input noise—123 db, output noise −13 dbm
Controls:	4 mixer controls, 1 master volume control, 1 each bass treble equalizer control; all cont. variable composition
Power Supply:	117 volts, 60 cps, 110 watts
External Power Available:	117 volt AC receptacle at rear of chassis
Tubes:	3—12AX7, 1—6CG7, 2—6L6GB, 1—5U4GB
Dimensions:	7" H, 19⅝" W, 8⅛" D overall
Color:	Green
Weight:	22 lbs.
Accessories:	4665 Plug-in Transformer 12227 Assembly—plug-in phono equalizer 12210 Assembly—rack mounting assembly Cannon XL-3-12 straight cord plug.

The new Altec 20 watt public address amplifier is truly outstanding in its flexibility of function. Pick any combination of four inputs, plug in the convenient "input-matcher" for each source and the Altec 342A amplifier is matched to your exact circuit needs. In minutes the 342A can be input-matched to any high or low impedance microphone, crystal or magnetic phono pickup, tuner or tape recorder—merely plug in the proper "input-matcher."

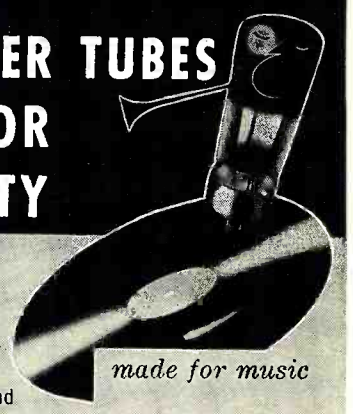
The 342A has individual volume controls for each of four inputs, a master volume control and separate bass and treble tone controls. DC operation of the heaters of the input tubes insures hum-free performance and eliminates the need for tube selection. The quality, reliability and amazing flexibility of the new Altec 342A amplifier make it ideal for every public address use either permanent or portable.

ALTEC LANSING CORPORATION — Distributed by Graybar

ALTEC FIDELITY IS HIGHEST FIDELITY

Dept. 10-T
9356 Santa Monica Blvd., Beverly Hills, Calif.
161 Sixth Avenue, New York 13, New York

Mullard
AUDIO POWER TUBES DESIGNED FOR HIGH FIDELITY



made for music

Many years of research and development have been spent in producing a range of Audio Tubes to meet the requirements of High Fidelity sound reproduction in all respects. This is why MULLARD Audio Tubes are accepted in Great Britain as a standard by which others are judged, and why leading High Fidelity manufacturers in the United States also use MULLARD tubes in their equipment.

EL-34—Recognized as the finest high power output pentode, up to 100 watts in push-pull. Exceptionally linear, requires low input voltage.

EL-37—The specialized manufacture of MULLARD high fidelity tubes, particularly the EL37, assures balanced audio power output. Replaces the 6L6, 5881, KT66 without circuit changes.

EL-84 — 9-pin miniature AF power pentode, combining high gain and linearity. Up to 18 watts in push-pull.

Other MULLARD recommended types for equipment and replacement:

ECC81/12AT7	ECC83/12AX7	EZ80/6V4	GZ30/5Z4
ECC82/12AU7	EF86/6267		GZ34/5U4GA/B

MULLARD TUBES are available at leading audio distributors throughout the United States. For detailed technical data and application information, write to:

INTERNATIONAL ELECTRONICS CORP.
81 Spring Street • New York 12, N. Y.

TRADE MARK MULLARD, LTD., LONDON

Mullard

DEVELOPED FOR HIGH FIDELITY

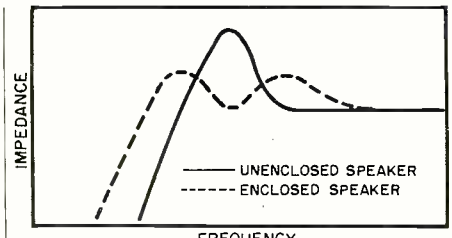


Fig. 27. Impedance curve of an ideal acoustic phase inverter compared with curve of an unenclosed speaker. Refer to text.

prove your audio reproduction, then you can't expect to get them by hit and miss methods, otherwise there would be no need for engineers at all. If you don't get the proper double hump curve, then the dimensions of the enclosure must be altered until you do; but it is just possible that you would get the desired results by placing the cabinet in another part of the room. The room acoustics influence the impedance of the speaker, as I have explained in an earlier part. You might be lucky!

Unmatched Vented Baffles

Such can be home-constructed or bought ready made, and are an easy way of dodging the technical requirements of the true acoustic phase inverter. They do not work with the precision or efficiency of the genuine article, but they are better than a casually constructed box baffle. As before, they must be strongly constructed and properly lined. No tunnel is used as this introduces difficulties in adjustment. The port area should be greater than the speaker opening, so that tuning can be carried out over a fairly wide band.

The speaker should have as low a bass resonance as possible and the volume of air within the cabinet should not be less than 6 cubic feet. With alteration of the port area, the air resonant frequency is changed, in general, raised as the area is increased. This affects the impedance curve of the speaker and some simulation of the characteristics of the true phase inverter is possible, but the transient reproduction will not be so good as the condition of optimum loading is never reached.

If a small cabinet is insisted on, then the speaker should have the more conventional value of bass resonance, but if adjustment of the port to give a reasonably flat impedance curve involves raising the resonance of the system to something on the order of 80 to 100 cps is necessary, the reproduction will not be satisfactory as a whole, even allowing for the loss of bass.

In short, the properly designed vented baffle can neutralize some of the defects of the ordinary sort of speaker, but the best results are only obtained when the enclosure is properly designed to do the job. It is curious that keen audio fans often give their speakers a very raw deal.

(To be continued)

Room Acoustics for Hi-Fi

(*Continued from page 53*)

Determining Reverb Time

Reverberation time of a room is best measured by introducing a sound wave into the room, shutting it off, and recording the decreasing level as a function of time, using a suitable recorder. The decay of sound can then be measured. This method requires extensive apparatus and measuring equipment. However, by means of a simple formula, it is possible to calculate the reverberation time of a room which is adequate for all practical purposes. The formula states that reverberation time of a room is in direct proportion to the volume of that room and in inverse proportion to the total amount of absorption caused by the surface areas of walls, floor, ceiling, and all objects in the room. It is as follows:

$$T = .05\ (V/A)$$

where: T = reverberation time in seconds

V = volume of the room in cubic feet

A = total room absorption (in Sabine units)

The total absorption of the room is calculated by multiplying each exposed surface area (in square feet) in the room by its respective absorption coefficient.

Absorption Coefficient

The surface of every object in a room which is exposed to sound waves, *i.e.,* walls, floor, ceiling, chairs, tables, drapes, rugs, etc., will absorb some sound wave energy. Some materials absorb sound waves better than others. For example, a cloth drapery absorbs sounds better than a marble table top. The ability of the surface of a material to absorb sound is known as its absorption coefficient. Absorption coefficient is defined as the ratio of sound wave energy absorbed by the surface of the material to sound wave energy incident upon the material. Therefore, if a material has an absorption coefficient of 0.9, it is an excellent sound absorber and little sound wave energy is reflected from it. On the other hand, if a material has an absorption coefficient of 0.05, it is a poor sound absorber, and 95% of the incident sound waves will bounce back from its surface. The surface of all objects in a room have sound absorbencies which can be measured and rated between 0 and 1.00. The absorption coefficients for common materials are given in Table 1.

Calculating Total Absorption

The total sound absorption of a surface depends upon its area and the absorption coefficient of the material. For example, if a panel measuring 4 square feet has an absorption coefficient of 0.1, the total absorption is 4×0.1 or 0.4 Sabine unit. If another panel has an area of 1 square foot, but

has an absorption coefficient of 0.5, the total absorption would be 0.5 Sabine unit. Therefore, although the area of the latter panel is smaller, it has greater sound absorbency. A person's clothes and exposed parts of his body, such as face and hands, also absorb sounds. The total absorption of a person in a room has been measured and found to be approximately 5.0 Sabine units. The unit of total absorption is the "Sabine," so named in honor of W. C. Sabine, who developed the formula given earlier.

Determining Reverberation

To illustrate application of the formula, let us first consider an empty living room 16 ft. long by 12 ft. wide by 9 ft. high, having plastered walls and ceiling, two window panes, each 2 ft. wide by 5 ft. high, and parquet hardwood flooring. The total absorption of each surface in the room is found by multiplying each surface area in square feet by its respective absorption coefficient obtained from Table 1. The total absorption of common objects in the room such as a person, a chair, a sofa is also listed in the table so that no multiplication by surface area is necessary for these objects. The total absorption of the various parts of the room is given in Table 2.

Substituting the figure 43.34 Sabine units (Table 2) for A in the formula, we find that the reverberation time of the empty room with the windows and door shut and one person in the room is:

$$T = .05(V/A) = .05 \times \frac{16' \times 12' \times 9'}{43.34}$$

$$= 2.0 \text{ seconds}$$

Let us now consider this same living room only furnished with wall-to-wall carpeting on the floor, heavy drapes hung over the windows, a sofa of medium size, two club chairs fully upholstered, two end tables, and three people in the room. The total absorption of the various exposed surfaces in this room is given in Table 3. The reverberation time of the room so furnished is:

$$T = .05(V/A) = .05 \times \frac{16' \times 12' \times 9'}{145.3}$$

$$= 0.6 \text{ second}$$

Furnishing a Listening Room

1. Cover bare walls and windows with drapes and curtains over as large an area as practical.
2. Use heavy drapes and curtains rather than those of lighter weight materials.
3. Cover floors with carpeting where possible and have the carpeting as heavy and as deeply napped as possible.
4. Furniture should be distributed uniformly around the room rather than concentrated in one area, to insure uniformity of sound distribution.
5. Large rooms require more draperies, carpeting, and furniture in proportion to small rooms, to decrease their reverberation times. —30—

TV Remote Control

(*Continued from page* 69)

bursts which produce a voltage at the discriminator output are of short duration; in some cases—jingling coins or keys, for example, many bursts of different frequency follow each other rapidly. Such noises may well contain frequency components which would operate the control if they were sustained; but they are over before the integrating network has had a chance to charge up to the required level.

Both triodes contained in each 6CM7 do not have equal transconductance. The smaller triode sections of the 6CM7's, V_{5B} and V_{8B}, operate small relays which close 117-volt a.c. power circuits to the turret motor. This is a reversible capacity-start motor having two windings, one for each direction. V_{5B} operates the relay for starting the turret in a clockwise direction; counterclockwise direction is controlled by V_{8B}. Once the motor has started its rotation continues, even though the relay drops out, because of contacts on the turret drive assembly which are parallel to the relay contacts. These contacts remain closed until a tab on the index wheel causes the switch to open. The desired channel stops are selected by turning the corresponding tab from a tangential to a radial position. An index tab turned to the radial position causes a link lever and pawl to open the contacts and stop the motor. A brake counteracts rotor inertia to eliminate the possibility of over-travel and assures positive channel selector indexing.

The power triode sections of the 6CM7's, V_{5A} and V_{8A}, operate larger relays. These are of a bi-stable type having a toggle switch operated by a plunger which is attached to the relay armature. When the relay is energized once, the switch is thrown to the "on" position. It remains there until it is energized again; then it goes to the "off" position. One of these relays opens and closes the 117-volt a.c. power circuit to the TV receiver; it is operated by the "On-Off" key on the control box. The other relay, operated by the "Mute" key, opens and closes the loudspeaker voice coil circuit. Discriminator output "C" operates the "Mute" and output "D" the "Off-On."

In the simpler model "200" with only one discriminator, the lower section of the relay control tube corresponds to V_{5B}, while its upper section corresponds to V_{8A}; a bi-stable relay is used for the "Mute" operation, and clockwise rotation of the channel selector results when the "Tune" key is pressed.

The authors wish to thank Dr. Robert Adler of the Research Department of *Zenith Radio Corporation* who initiated and directed the work on this project. Credit also goes to Mr. Karl Wossidlo for his many valuable suggestions and construction of experimental equipment.

–30–

Two-Meter Preamp

(*Continued from page 47*)

tight as possible for maximum signal transfer. This is one of the critical points; if you don't get the signal out of the last stage the fans are just blowing hot air around the shack.

The r.f. chokes are self-supporting $\lambda/4$ chokes. If desired they can be bifilar wound, as long as the insulation of the wires is adequate. Each tube is connected to a separate filament winding, only because two windings were available with the power supply; otherwise, one winding will be sufficient. R_5 and R_6 were put in to help isolate the "B+" lines. The filament lines, "B+" lines, and 117 volt a.c. lines for the fans are all shielded. Possibly, complete shielding would not be necessary, but after the barn door is closed you can't put the hay in, or is that the way it goes?

The construction of the metal contact fingers for the plate and grid is a very simple task (see Fig. 3). A round disc of beryllium copper, spring bronze, or any stiff thin metal, other than steel or high resistance metal, can be used. First, cut out the discs to size and then drill a small pilot hole in the center of each disc. If an old pair of scissors is available it will make it easier to cut the small slits in the metal. Cut the slits back only far enough so that when they are bent down the whole ring will fit snugly over the contact surface of the tube. Solder the contact fingers to the mounting ring, being careful not to allow the solder to run in between the fingers and stiffen them. The next step is to trim the bottom of the fingers off for neatness. If you happen to have a silver plating bath around the house you're all set; if not, just clean the metal fingers of any grease or oxidation that would prevent good contact to the tube.

The filament-cathode contact fingers are a little more difficult but having access to a set it made it easier on my part. Looking at Fig. 3 you will notice that both the outer and inner contact fingers were machined from brass tubing and brass rods. A little ingenuity on the part of the builder can bypass this problem if you can't get to a metal lathe. Somewhere around the ham shack you can usually find some thin wall copper or brass tubing that will be a near fit over the outer cathode surface. Place the tubing in a vise and cut some even slots with a small jeweler's saw; then form the fingers so they make a snug contact to the tube. A similar arrangement can be made for the inner filament contact by using a brass or copper rod. If no source is available for the plate, grid, or filament connections, the wires can be soldered directly to the tube.

The photographs show the mechanical details of the preamp chassis. The complete preamp is built on a 8" x 5½"

x 3½" aluminum chassis. The top deck is a removable 8" x 5½" sheet of aluminum just in case you drill in the wrong spot. Of course, these extra holes are always good for ventilation. The shield between the two tubes can be any convenient piece of aluminum or copper sheet. The wall and front panel are made from four separate pieces of aluminum bolted together.

The author's location is not the best in the world; it is almost at sea level and blocked in by high, thick foliage pine trees to the south. This made a difference of one to two "S" units on the weak ones in most cases.

In over a year of steady use on the 2-meter band, this preamp has made the difference between no signal and a readable signal many times. Besides that, it helped warm up the ham shack on cold nights.

A final reminder on prolonging the life of these tubes is to make sure that the cooling is adequate on the cooler and seals of the tubes. A quick check to see if the tube is running cool is to turn off the "B+" and remove the tube from the socket and hold it in your hand; if you don't have burned digits you're safe, otherwise, don't be surprised to see the solder melt out of the center of the cooler and the tube will gas up after using it for a week or so. —30—

A HINT FOR HAMS

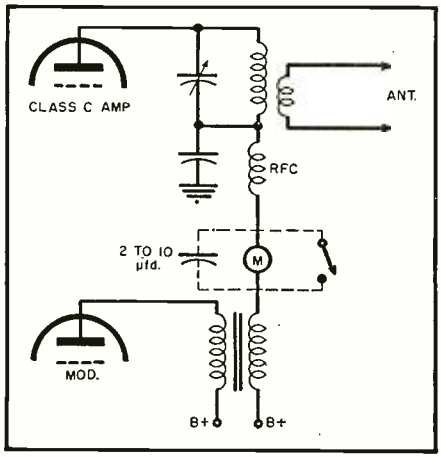
By ROBERT J. MURRAY, W1FSN

SEVERAL instances have been uncovered where Novices and, in some cases, not-so-Novices have used a milliammeter that has a moving vane type of movement in the plate return circuit of a modulated amplifier.

Reports from other hams indicate that the carrier is quite strong but that modulation is practically non-existent, irrespective of the setting of the audio gain control. We have found that this particular type of movement acts as a very good audio choke and effectively keeps modulation from reaching the final.

It is recommended that the meter be shunted after tuning up or that the meter terminals be bypassed with a heavy paper capacitor of from 2 to 10 microfarads, as indicated in the diagram. —30—

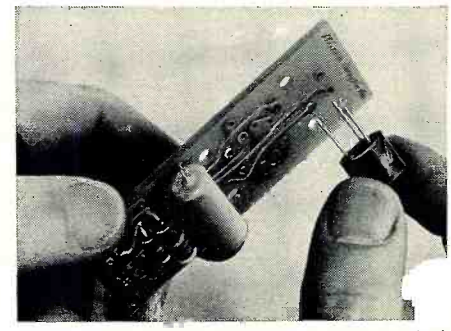
Method for shunting or bypassing the test meter when it is of the moving vane type that will suppress modulation of signal.



PRINTED-CIRCUIT POT

George-Held, Inc., 1020 N. La Brea, Los Angeles 38, California has developed a wirewound potentiometer which has been especially designed for printed circuit applications.

Because it mounts directly on the board by its own round leads, the new



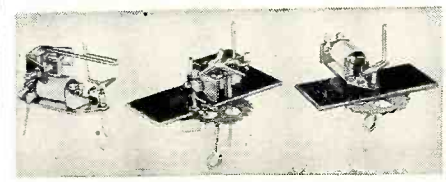
PC-5 eliminates the use of screws and lugs. The environmental-resistant construction, light weight, and small size (½" dia. by ¼" high) make the unit suitable for airborne and other compact equipment. The cylindrical shape is easily adaptable to automatic installation techniques. Resistance range is from 10 to 35,000 ohms. Dissipation is 2 watts.

For full information, write the manufacturer direct.

R/C ESCAPEMENTS

Lafayette Radio, 100 Sixth Avenue, New York 13, N. Y., is now offering a new line of radio-control escapements featuring a two-arm, self-neutralizing model; a four-arm, self-neutralizing compound design; and an engine control escapement.

All three units are of rugged construction and maintain low current



drain. Ratchet governor wheels are used to maintain smooth rotating speed.

The company will supply full details on any or all of these units upon request.

TV TEST EQUIPMENT

Winston Electronics, Inc., 4312 Main Street, Philadelphia 27, Pa., has just released two new pieces of television test equipment designed for the service industry.

The Model 825 dynamic a.g.c. circuit analyzer provides a simple and systematic method for locating a.g.c. trou-

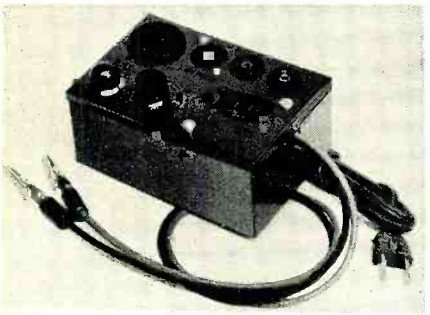
bles. The instrument incorporates a standard a.g.c. test signal which is fed to the antenna of a TV receiver. Monitor circuits are arranged for rapid connection to the a.g.c. test points to

determine whether the trouble is due to a.g.c. and to isolate the a.g.c. troubles.

The second unit is a wide-band field strength meter, the Model 330, which tests antennas for bandwidth as well as signal level with special provision being made for color TV antenna testing. The instrument will align an antenna for color in the absence of a color transmission. It reads directly in microvolts and provides five meter ranges for readings from 10 to 100,000 microvolts on color or monochrome TV signals.

DUAL SERVICE AID

Seco Manufacturing Company, 5015 Penn Avenue South, Minneapolis 19, Minn., is making available a new dou-



ble-purpose servicing aid for black-and-white and color television, radio, and industrial uses.

Tradenamed the "Fil-Pak" Model FP-1, the unit is a filament continuity checker of the low ohms type and a 90-volt bias supply pack. As a continuity checker it will handle 7-pin, 9-pin, octal, and loctal type tubes. Test leads are in the continuity or bias circuit. The bias pack supplies up to 90 volts of filtered and isolated d.c.

A data sheet on this inexpensive test unit is available from the manufacturer on request.

ALUMINUM SOLDERING FLUX

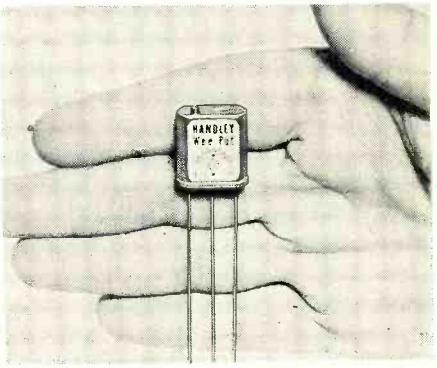
E. Lampe, P. O. Box 371, Lindenhurst, N. Y., is now offering a specialized soldering flux which permits the soldering of parts direct to an aluminum chassis.

Flux is applied to the point being soldered and a 50/50 tin-lead solder applied. A low wattage iron can be used in this application. Since the flux is active, surplus flux should be re-

moved by washing. If the joint is subjected to moisture or dampness, a lacquer or plastic sealer should be used after the soldering operation.

PRINTED CIRCUIT POT

Designed especially for printed circuit use, *Handley Electronics Inc.*, 14758 Keswick Street, Van Nuys,



Calif., is now in production on a miniature wirewound trimmer pot which features resistances from 100 to 40,000 ohms.

The standard units have a resistance tolerance of 5% and a temperature coefficient of .002% per degree C. Maximum operating temperature is 120 degrees C. For reliability, movable contact surfaces are of precious metal and internal connections are welded to the terminal leads.

Special designs are also available on a custom basis. Write the company for full details on either standard or special units.

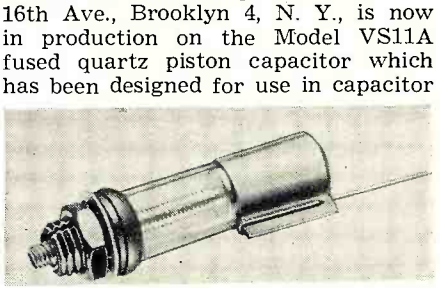
SOLENOID-WOUND CHOKES

A complete line of solenoid-wound chokes in values ranging from 1.1 to 120 μhy. has been announced by *National Company*, 61 Sherman St., Malden 48, Mass.

These chokes are impregnated with fungus-resistant varnish and are designed specifically for performance and durability in applications such as filament chokes, peaking coils, and resonant elements in high frequency r.f. or i.f. circuits.

LOW-LOSS QUARTZ TRIMMER

JFD Manufacturing Co., Inc., 6101 16th Ave., Brooklyn 4, N. Y., is now in production on the Model VS11A fused quartz piston capacitor which has been designed for use in capacitor



networks requiring low-loss and high leakage resistance for 400 cycle operation. The unit is also recommended for ultra stable oscillator circuits and as a tuning element in high frequency, low power tank circuits.

The coaxial construction utilizes an invar tuning slug and adjustment screw that is individually fitted to the precision bore cylinder. A silver clad

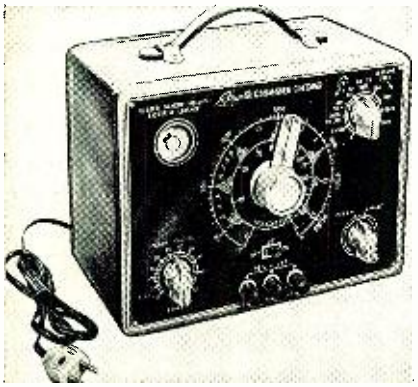
invar band serves as the fixed electrode.

Complete data on this new component is available from the manufacturer. Address requests to the attention of the Electronics Division of the firm.

LAFAYETTE TEST GEAR

Lafayette Radio, 100 Sixth Avenue, New York 13, N. Y., is now offering a line of test equipment, completely assembled but at "kit" prices.

Among the units in the line are the LSG-10 signal generator, the LC-4



capacitance-resistance tester, and the LC-15 capacitor-resistance checker.

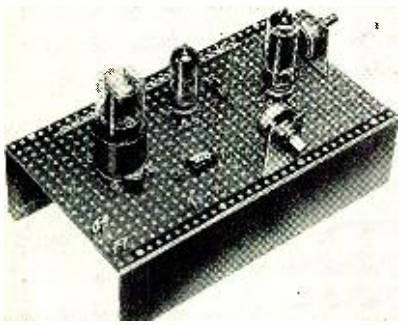
The signal generator has a frequency range of 120 kc. to 260 mc., up to 130 mc. on fundamentals. The capacitance-resistance tester has four direct-reading scales from .00001 to 1000 μfd., two resistance ranges from 100 ohms to 5 megohms. A magic eye is used as the null detector.

The capacitor-resistance checker tests for opens, shorts, leakage, and intermittents. It covers the ranges from .00001 to 1000 μfd. and from 100 ohms to 5 megohms.

EXPERIMENTER'S CHASSIS KIT

Vector Electronics Company, 3352 San Fernando Road, Los Angeles 65, Calif., has recently released an "Experimenter's Chassis" which provides quick set-up of electronic circuitry with simple hand tools.

Although intended mainly for mock-



ups, the structure is also suitable for more permanent use and may be mounted on racks or in cabinets with added adapter plates. The construction is highly flexible and parts can be readily cut to make other sizes than those supplied.

The main wiring deck consists of a sheet of phenolic board having a uniform hole pattern and is mounted on

aluminum channels. A data sheet supplying full details on these chassis is available on request.

TWIN-UNIT VARIABLE

The Electronic Components Division of *Stackpole Carbon Company,* St. Marys, Pa., has introduced a new twist-tab mounting variable resistor which contains two control elements and shafts mounted side-by-side on a common base, ⅞" x 2".

In addition to the lower cost of the control itself, the new unit offers important savings in mounting and wiring time for television and other electronic equipment manufacturers. Known as the Type TU61, the new resistor has two ¼" diameter phenolic shafts which may be adjusted from either side of the control. The shafts on the panel side are screwdriver slotted and cut flush with the phenolic mounting plate thus making the control suitable for use in printed circuits when it is desired to adjust the control through the chassis. Shaft extensions from the rear are ⅜" and are knurled for finger adjustment.

Complete specifications are available from the manufacturer on request.

"MONISCOPE"

American Electronics Enterprises, 3603 East 10th Street, Long Beach, Calif., is now in production on a compact instrument which provides for the continuous monitoring of both transmitted and received signals.

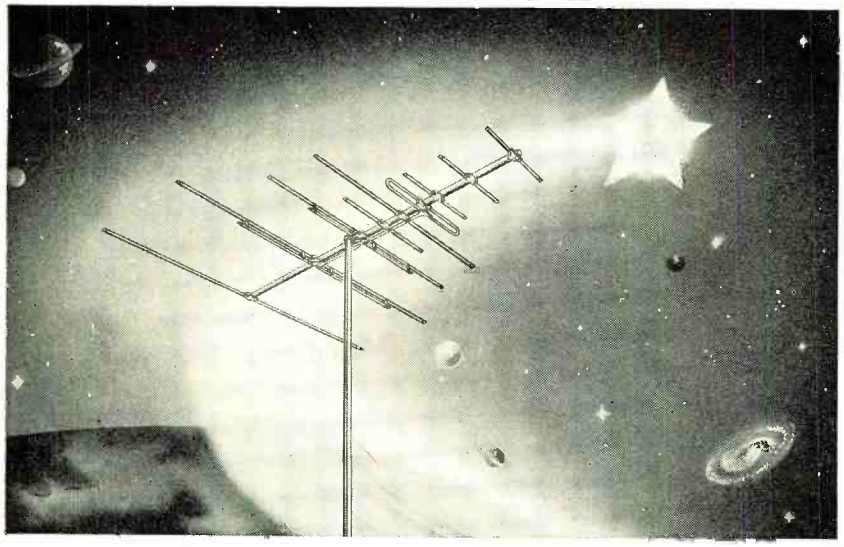
Known as the "Moniscope," the new instrument has been designed especially for radio amateurs and others in the field who must have such information. The modulated signal being measured may be viewed directly on the face of a 2" CR tube, either in the form of a wave envelope pattern or as a trapezoid. A switch converts from trapezoidal to wave envelope pattern and back again at will.

PRINTED CIRCUIT KIT

Photocircuits Corporation, Glen Cove, N. Y., has developed a complete kit for accurate and simplified production of engineering or prototype models of printed circuit parts.

A completely etched electrical circuit ready for assembly may be had in about 30 minutes. A newly developed drawing pen is used to draw the pattern, obviating the use of paints, tape, photosensitive coatings, negatives, etc. The kit consists of a drawing pen and

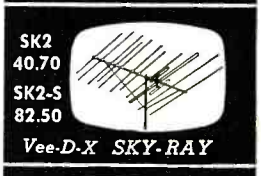
ANNOUNCING the VEE-D-X SKY-STAR



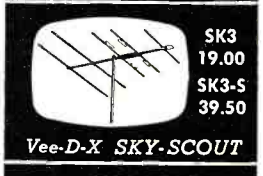
THE NEW **STAR** OF *FRINGE* AND *SUPER FRINGE AREAS*

MODEL		LIST
SK7	SINGLE	$23.10
SK7-S	DOUBLE	47.50

Vee-D-X SKY-RAIDER



Vee-D-X SKY-RAY



Vee-D-X SKY-SCOUT

Vee-D-X SKY-STREAK

Vee-D-X SKY-CHAMP

Vee-D-X SKY-FLASH

THESE OUTSTANDING FEATURES MAKE THIS ANTENNA OUR NEW STAR

- ★ *Compact inline yagi construction*
- ★ *1⅛" heavy wall crossarm*
- ★ *All aluminum construction—quality controlled in our own aluminum mill*
- ★ *Heavy duty bracketing*
- ★ *Completely Snaplock construction*
- ★ *Approved for color and black and white TV*
- ★ *Uniform phasing terminations (300 ohm) Channels 2-13*

La Pointe ELECTRONICS INC. ROCKVILLE, CONN.

INTERNATIONAL SALES OFFICE—19 WEST 44TH ST., NEW YORK 36, N. Y.

40¢ FOR ANY TUBE

we will not be undersold

FREE POSTAGE in U.S.A. and Territories on orders over $5.00. 25c handling charge on orders under $5.00. 25% deposit required on C. O. D.s. Please send approximate postage or freight on Canadian and foreign orders. Subject to prior sale.

SEND for our **FREE** complete TUBE & PARTS LIST and order blank.

We Have OVER 1000 USED TV SETS

At All Times In Our Huge Warehouse

Buy one or more of these WORKING TVs to sell or use as your own second set! All Sets in GOOD WORKING condition! *Your Choice—Console or Table Model*

10"	$23.00	19"	$58.00
12"	$28.00	20"	$64.00
14"	$33.00	21"	$72.00
16"	$40.00	24"	$99.00
17"	$46.00		

When ordering TVs, state whether table model or console is desired. Also preference on make of set. All TVs sent railway express F.O.B. Newark. On any quantity WIRE or CALL today!

FREE BONUS ANTENNA GIVEN WITH ANY TV SET ORDER!!

FREE RCA "CHEATER" CORD GIVEN WITH ANY TUBE ORDER OF $7.00 OR MORE!!

PROMPT SHIPMENT ON ALL ORDERS

$37.00 Per Hundred

DON'T PAY MORE FOR SET TESTED LONG LIFE DEPENDABLE RADIO & TV TUBES • BUY VIDEO INDIVIDUALLY BOXED • ALL GUARANTEED FOR ONE YEAR OR YOUR MONEY BACK

Some Standard Brand—Others With Famous VIDEO Brand

0A2	2X2	6AC7	6BK5	6SG7	7F8	12V6GT
0A3	3A4	6AG5	6BK7	6SH7	7N7	12X4
0A4	3A5	6AF4	6BL7GT	6SJ7GT	7Q7	14A7
0B2	3AL5	6AH4GT	6BN6	6SK7GT	7Y4	14B6
0C3	3AU6	6AK5	6BQ6GT	6SL7GT	7Z4	14Q7
0Z4	3BC5	6AL5	6BQ7	6SN7GT	12A6	19BG6G
1A7GT	3CB6	6AM8	6BY5G	6SQ7	12AH7GT	19T8
1B3GT	3Q4	6AN4	6BZ7	6SS7	12AT6	24A
1C7G	3Q5GT	6N8	6C4	6SV7	12AT7	25AV5GT
1F4	3S4	6AQ5	6CB6	6T8	12AU6	25BQ6GT
1H4	3V4	6AQ7GT	6CD6G	6U4GT	12AU7	25CD6G
1H5GT	4B27	6AS5	6CF6	6U7G	12AV6	25CU6
1J6GT	4B97	6AS7G	6CS6	6U8	12AV7	25L6GT
1L4	5AM8	6AT6	6CU6GT	6V3	12AX4GT	25W4GT
1L6	5AN8	6AU4GT	6E5	6V6GT	12AX7	25Z6GT
1LA6	5AQ5	6AU5GT	6H6GT	6W4GT	12AZ7	3SL6GT
1LC5	5AT8	6AU6	6J4	6W6GT	12B4	35W4
1LH4	5AW4	6BU5GT	6J5GT	6X4	12BA6	35Y4
1LN5	5AZ4	6AV6	6J6	6X5GT	12BE6	35Z3
1N5GT	5J6	6AX4GT	6K6GT	6X8	12BH7	35X5GT
1S4	5T4	6AK5GT	6L6	6Y6G	12BY7	50A5
1S5	5T8	6BA6	6N7GT	7A5	12CU6	50B5
1T4	5U4G	6BC5	6S4	7A7	12SA7	50C5
1U4	5U8	6BC7	6S7G	7B5	12SQ7	50L6GT
1U5	5V4G	6BE6	6SA7	7B7	12SH7	80
1V2	5V6GT	6BF5	6SB7Y	7C5	125J7GT	117N7GT
1X2	5Y3	6BG6G	6SC7	7C6	12SK7	117P7GT
2A7	5Y4G	6BH6	6SF5	7C7	12SN7GT	117Z3
2D21	6AB4	6BJ6	6SF7	7F7	12SQ7	

VIDEO ELECTRIC COMPANY

79 CLINTON PL. NEWARK, N. J.

Phone HUmboldt 4-9848

etchant resist ink, four bottles of etching powder, a drawing guide, ten copper laminated Bakelite sheets (five with copper laminate on two sides), ten of the most popular tube sockets, and detailed instructions for use. The entire kit is self-enclosed in its etching tray and cover.

Full information about this "Printed Circuit Model Makers' Kit" is available from the manufacturer on request.

RESISTANCE BRIDGE

The *Shasta Division, Beckman Instruments, Inc.*, P. O. Box 296, Station A, Richmond, Calif., is now offering its Model 605 wide-range resistance bridge which has been designed for production line and laboratory applications.

The unit provides a means for rapidly and easily checking resistances to an accuracy of ± .5%, + .05% full scale. Seven ranges from 100 ohms to 100 megohms full scale are selectable by front panel push-button switches. The lowest measurable resistance is 5 ohms.

In operation, the unknown resistance is connected to the appropriate terminals, the range switch set, a key depressed, and the *Helipot* precision pot turned to obtain a null indication on the 4" zero-center galvanometer. The value of the unknown unit is then read directly from the dial setting and multiplied by the appropriate factor of ten.

HIGH-POWER MOBILE RADIOPHONE

The Communications and Electronics Division of *Motorola Inc.*, 4501 W. Augusta Blvd., Chicago 51, Illinois has added a mobile two-way radio rated at 100 watts transmitter power output on any channel in the 25-54 mc. band to its line.

The unit incorporates the company's new dynamotor-vibrator power supply which, at a power intake equivalent to conventional 60-watt mobile radios, provides full rated transmitter output.

The transmitter is capable of up to 4-channel operation with each frequency crystal-controlled. The "Sensicon" receiver, transmitter, and power supply are housed in a compact steel case which measures approximately 6" x 15" x 20". The speaker, control head, and microphone are designed for convenient dash mounting. The unit

operates interchangeably between 6 and 12 volt vehicles without adapters or modifications. Models are available for both standard and "split" channel operation.

PIN STRAIGHTENER

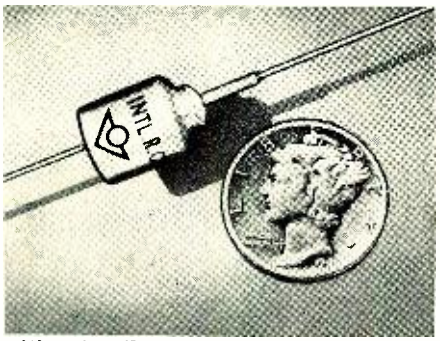
Star Expansion Products Company, 142 Liberty Street, New York 6, N. Y., is now offering a new combination subminiature tube pin straightener and cut-off tool which speeds the alignment and trimming of tube leads for both inline and round base subminiature tubes.

The JE-20 features stainless steel 303 inserts set in a black anodized aluminum base. Holes of the stainless steel inserts are precision drilled and countersunk to exacting specifications. Only four simple steps are required to operate the device.

1000-VOLT DIODE

International Rectifier Corporation, El Segundo, Calif., has announced the development of a 1000-volt silicon diode which is the newest item in the firm's line of high-voltage units available in production quantities.

The new unit is especially designed for power applications where high ambient temperature, reliability, high efficiency, and miniaturization are prime factors. They are available in peak inverse voltage classifications of 600, 800, and 1000 volts with half-wave d.c. output currents of 125 ma. at 75 degrees C. ambient temperature. The operating temperature range is from —55 degrees to +150 degrees C. ambient. The diodes occupy a volume of only 1/16 cubic inch and are provided



with pigtail leads to facilitate easy wiring into crowded chassis. The units are hermetically sealed.

For detailed data write the company's Product Information Department.

MINIATURIZED CONTROL

Clarostat Mfg. Co., Inc., Dover, N. H., is now offering a new series of miniature controls which are smaller than a dime.

The Series 44 is designed to meet the space limitations of transistorized assemblies such as hearing aids, pocket radios, portable radios, TV sets, portable test equipment, and printed circuits.

The control measures only 21/32" in diameter by 5/16" deep. It is rated at .2 watt at 40 degrees C. Available in resistance ranges of 200 ohms to 5 megohms linear and 1500 ohms to

2.5 megohms tapered, the resistance tolerances are ± 20%, and above 100,000 ohms ± 30%. Mechanical and electrical rotation is 300 degrees.

Write the company for full technical specifications.

"CONTROLA-TONE"

A remote volume control unit for television and radio receivers is now being offered by *Continental Manufacturing, Inc.,* 601 City National Bank Building, Omaha, Neb., as its "Controla-Tone."

The control allows the user to either raise or lower the volume from his viewing or listening position across the room. The unit may be quickly and easily installed on practically any receiver, without the use of elaborate tools or equipment.

For full information and delivery schedules on this unit, write the manufacturer direct.

TV TEST INSTRUMENTS

The Components Division of *Radio Corporation of America,* Harrison, N. J., has recently introduced two new instruments which have been especially designed for installing and servicing television receivers.

The Model WR-46A dot-crosshatch generator is designed for checking and adjusting static and dynamic convergence in color TV sets as well as vertical and horizontal deflection linearity of both color and black-and-white TV receivers.

The other instrument is an r.f., i.f., v.f. marker adder, Model WR-70A, which is designed for r.f., i.f., and video sweep-frequency alignment of both black-and-white and color television receivers. The instrument provides a choice of four sharp, narrow, easy-to-read differently shaped markers for the alignment of TV sets. It can be used with existing TV marker generators such as the WR-39 and WR-89 series and with sweep generators like the company's WR-59.

RESISTOR-CAPACITOR UNIT

A new single unit resistor-capacitor that occupies only the space of a tubular capacitor alone has been developed by *Centralab,* Division of *Globe-Union Inc.,* 900 E. Keefe Avenue, Milwaukee 1, Wis.

Known as the "Tube-R-Cap," the combination is a standard size CC32 tubular ceramic capacitor that also incorporates, on the same body, a ceramic base resistor in parallel. It is designed to permit greater performance and cost saving in applications where space is at a premium. Maximum length of the unit is .900 inch with an approximate diameter of .280". It is rated at 470 μμfd. and ½ megohm nominal, ½ watt.

REACTANCE SLIDE RULE

Shure Brothers, Incorporated, 222 Hartrey Avenue, Evanston, Ill., acceding to the demands of engineers, technicians, and students, has re-issued its Reactance Slide Rule.

The slide rule is a time-saver in calculating resonant frequency, capacitive reactance, inductive reactance, coil "*Q*," and dissipation factor problems covering a frequency range from 5 cps to 10,000 mc.

The rule is priced at 50 cents.

POCKET MICROSCOPE

Edmund Scientific Corp., Barrington 13, New Jersey is now offering a practical pocket microscope-telescope which has been especially designed for technicians, engineers, and design and research personnel.

This pocket instrument combines a 50 power microscope and a 10 power telescope. Approximating a fountain pen in size, when used as a microscope it will enlarge 50 times. When used as a telescope, it can be used for chimney and roof wire inspections, for reading meters at a distance, etc. —30—

Modularized Sets

(*Continued from page 41*)

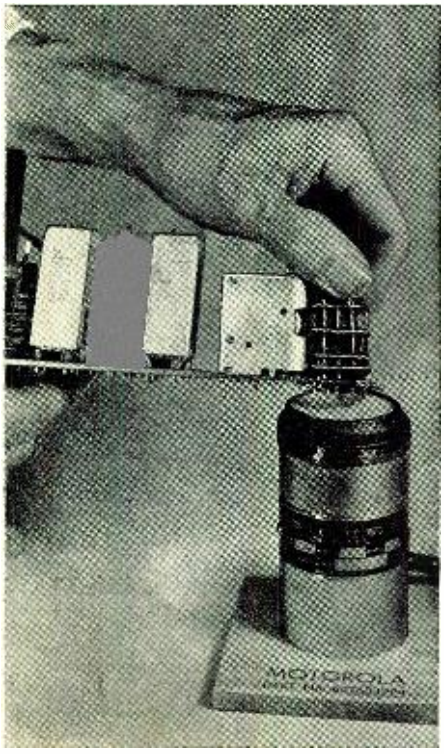
have been successfully repaired, the repair of modules probably will be confined to situations when replacements are not readily available or take too long to procure.

It is probable that manufacturers of radio and television receivers will make up troubleshooting charts to cover the tracing of defects in modules; these will be included in their service data. This undoubtedly will take the form of listing the various symptoms which may occur if a module becomes defective with information on where the defect is. This is similar to the troubleshooting charts now available in service data.

The service technician should find that the repair of intermittent defects will be less time consuming on equipment using modules than for those using conventional components. Instead of checking each component in a particular circuit, the technician now need only replace the complete module. The extra cost of the module will probably be much lower than the labor costs involved in tracking down an intermittent in sets using conventional components.

In all, the availability of these commercial radio and television sets using modules should furnish the field with a great deal of practical information on these new components together with some idea of what the future holds in the shape of radio and television. —30—

Small solder pot now available for simultaneously loosening all module connections on a printed-wiring board. It is useful for other components as well.



Admiral Color Set

(*Continued from page 42*)

color receiver. A few minutes spent here will cut down the number of profit-killing "nuisance" calls.

Circuits

In the triode high-level demodulator circuit used in the *Admiral* 27Z1 chassis (Fig. 2), *B-Y* and *R-Y* signals are demodulated at the plates of the 12BH7 demodulator tube. *R-Y* and *B-Y* are added in a common cathode load resistor to form *G-Y*. The output of the luminance (*Y*) amplifier is direct coupled to the cathode of the picture tube. Use is then made of the picture tube to add the chroma information received from the demodulator and the luminance information to obtain the final red, green, and blue signals.

The actual demodulation or detection of the chroma signal is accomplished by applying a 3.58 mc. sine wave from the crystal-controlled 6U8 3.58 mc. oscillator between the grid and cathode of each demodulator triode. This sine wave is of sufficient amplitude to cause the demodulator triodes to operate as class C amplifiers, thus allowing current to flow for only a short period of time during the positive-going portion of each cycle. Each demodulator triode then acts as a switch, turning on just once during each cycle. A phase-shifting network delays the 3.58 mc. sine wave applied to the *B-Y* demodulator to produce the correct relationship between the *R-Y* and *B-Y* outputs.

One tube, the 1st chroma amplifier, amplifies the chroma signal and also the color sync burst. It is necessary that the gain be kept constant for the color sync burst and, at the same time, the gain must be allowed to vary during chroma time. Also, for black-and-white programs, this tube must be cut off during video or picture time, but have full gain during horizontal blanking time. All these requirements are met by gating.

During black-and-white programs, a positive pulse of sufficient amplitude to cause grid current flow is obtained from the color killer tube and applied to the control grid of the 1st chroma amplifier. This grid current charges the grid circuit capacity to a high enough voltage to bias the tube to cut-off; the *RC* time constant of the grid circuit is long enough to hold the tube at cut-off until the next positive pulse. Thus, the 1st chroma amplifier is cut off except during horizontal blanking time on black-and-white programs.

On color programs, the color killer tube is cut off by a negative voltage applied to its grid and obtained from the color phase discriminator. Although the color killer can no longer supply a positive pulse to the 1st chroma amplifier, a positive-going pulse appearing across the color intensity control is still applied to the

chroma amplifier grid. This pulse develops just enough bias to cause the 1st chroma amplifier to cut off when the intensity control is fully counterclockwise. At any other setting of the intensity control, the pulse supplied to the 1st chroma amplifier grid is of lower amplitude and the tube will conduct during chroma time. By varying the intensity control setting and thus, the amplitude of the biasing pulse applied to the 1st chroma amplifier grid, the gain of the tube is controlled.

Also during color programs, a negative voltage is developed at the color phase discriminator which is dependent on the incoming color sync burst amplitude. This voltage is applied to the grid of the 1st chroma amplifier in the same manner as a.g.c. voltage is applied to the i.f. amplifiers. The use of this circuit provides automatic chroma control, which automatically increases the gain of the chroma amplifier should the strength of the color signal decrease.

Essentially, the operation of the color circuits in the 28Y1, 27Z1, and 29Z1 chassis is identical. The more obvious differences between the three chassis affect the power supply and the horizontal deflection-high voltage circuits. The 28Y1 is similar to the 27Z1 except that two 3A2 high-voltage rectifier tubes in the former have been replaced by one 3B2 in the 27Z1. The 29Z1 uses vacuum-tube rectifiers, rather than selenium rectifiers and electromagnetic static convergence.

—30—

HELP FOR SUNKEN SUBS

A MINIATURE radio transmitting buoy, developed by Servo Corporation of America for the U. S. Navy, offers new hope and security to submarine crews whose craft encounters difficulties.

The buoy which is 3 inches in diameter and 39½ inches long, weighs only 8 pounds and has a total cubic content of 282 cu. inches. The 20-inch antenna folds back against the buoy when placed in a launching tube. A spring snaps the antenna erect after launching.

The buoy, which automatically transmits the distress message, operates on a five-cell, 7.5 volt output magnesium silver chloride battery activated by sea water serving as the electrolyte. The transmitting system requires no maintenance and can be stored indefinitely before using.

Encased in a strong and light magnesium housing, the buoy has excellent flotation characteristics despite very rough seas. It has a frequency range of 115 mc. to 145 mc., but is preset at a frequency of 121.5 mc. This is the international and v.h.f. emergency frequency which is well suited for use with a small transmitting antenna.

The unit not only acts as a transmitter but is also a beacon that locates the exact position of the distressed craft. It can transmit the message "SOS Sub Sunk, SOS" over a radius of 60 miles and is not appreciably affected by unfavorable weather conditions.

The instrument can also be used by aircraft in distress over water. The buoy could be dropped prior to ditching and transmit any desired message. Only modification of the code wheel is required.

—30—

Use Those "Junk-Box" Chokes

By **SHERMAN H. HUBELBANK**

Connecticut Telephone & Electric Corp.

Salvage those unidentified parts by running these tests to determine their electrical characteristics.

WHEN designing or building a voltage-regulated power supply with a choke input filter, the average experimeter or ham usually casts a furtive eye at his "junk-box" when he reaches the stage for the selection of the proper choke. Usually he has a number of iron-core chokes that appear to be physically large enough to carry the current needed, but not enough data is known to identify them, in order to build a good ripple-free, voltage-regulated power supply.

As a result, unless the builder can identify the choke by manufacturer and part number, his only recourse is to go to a catalogue and buy a choke that will meet his requirements. However, by setting up a relatively simple circuit (see the schematic diagram) and following the procedures outlined, those "junk-box" chokes can be readily identified as to their electrical characteristics and, hence, can be salvaged.

To properly identify the electrical characteristics of an iron-core choke it is necessary that the basic characteristics of iron-core chokes and their effects upon power supplies be understood.

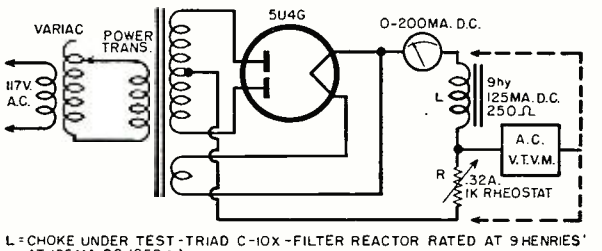
One of the most important characteristics needed to properly evaluate the suitability of a choke as an input filter for a voltage-regulated power supply is to know the relationship of inductance to the d.c. current flowing in the choke. This is important because as the d.c. current varies, so does the flux density of the core and, consequently, the inductance. This means that an iron core choke may have vastly different inductances under "load" and "no-load" conditions.

This characteristic may be utilized to good advantage in power supply filtering, because for most efficient filtering action the inductance should increase with a decrease in load current. It should be noted that a choke is called a swinging choke if the inductance is high at low values of direct current yet decreases markedly with increased direct currents. However, if the power supply has a bleeder resistor in parallel with the load, the importance of the ability of the choke to have its inductance increase with a decrease in load current diminishes, since there is always a minimum value of load current flowing through the choke.

At some point the choke will reach saturation as the current increases. This is due to the iron core becoming saturated, which decreases the permeability of the iron, and hence decreases the inductance of the choke. This, of course, determines the upper limit of usability of the choke under load conditions. In addition, it is important to know the maximum current the choke may carry without overheating.

It is also necessary to know the

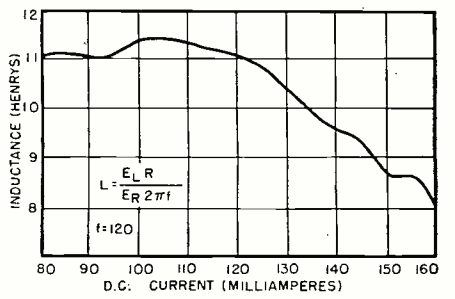
Method for checking "junk-box" chokes as described in text.



L = CHOKE UNDER TEST - TRIAD C-10X - FILTER REACTOR RATED AT 9 HENRIES AT 125MA. DC. (250Ω)

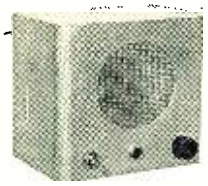
R = OHMITE RHEOSTAT - IK .32 AMP.

CURRENT D.C. MA.	E_L (A.C.)	E_R (A.C.)	RES. OF R	CALCULATED INDUCTANCE OF L
79	50	4.5	750	11.
86	60	5.4	750	11.1
94	56	3.4	500	11.
100	62	3.6	500	11.5
125	49	1.5	250	10.9
136	58	2	250	9.7
144	48	.7	100	9.4
150	54	.84	100	8.6
155	58	.9	100	8.7
160	60	1.0	100	8.0



110 V. POWER SUPPLY

For Army or Navy COMM. RECEIVERS:



Just Plug In—And Turn On . . . That's All!

Completely assembled unit which eliminates conversion of set; for use with BC-453-454-455-946 or any other Sets requiring 24 V @ 1 Amp and 250 V @ 50 MA. Has 4-inch Speaker, volume control with On-Off switch and C W Switch. Complete with Cord and Plug to fit rear of receiver. Gray hammertone finish. Wt. 8 lbs.
Brand NEW—Price.....Only: **$18.95**

TRANSFORMERS—115 V. 60 CYCLE PRI.:

600 VCT/100 MA—6.3 V/5 A.: 5 V/3 A. $4.95
240 VCT/35 MA—24 V/.9A; 6.3 V/.6 A; 6.3 V/.3 A 1.75
1300 VCT/350 MA—5 inches Sq. 6.95
700 VCT/150 MA—5 V/3 A.; 6.3 V/4.5 A. CSD.. 3.95
2500 V/.015 A.; 2.5 V/175 A.; 6.3 V/.6 A. 5.95
1890 V/12.6 MA—Tapped 2.5 V 2 A. 5.95
1100 V/80 MA—7.5 VCT/3.25 A. 5.95
720 VCT/50 MA—6.3V/2.5 A—5V/2 A. 2.50
662 VCT/110 MA—6.3V/2 A—5V/2 A. 3.95
800 VCT/300 MA—12.6V/10 A—5V/3 A. 6.95
16 Volt 35 Amp. 115/230....$24.95; 24V—1 Amp 1.50
9 Volt CT—35 Amp.—Tapped 4.5 V. 7.95
12 Volt—Two separate windings—4 amp each.... 5.95
5 V/2 A.; 5 V/2 A.; 5 V/2 A.; & 5 V/6 A. 2.95
600-0-600 VAC—200 MA. 12.5 V, 2 A.; 12.5 V. @ 2 A.; 5 V. @ 3 A.—#H-108—Price..... 8.95
250-0-250 VAC—50 MA. 24 V. 1 A.; and 6.3 V. 1 A.—#H-109—Price 4.95

Choke—12.5 Hy/100 MA.....$1.95
Choke—8 Hy/150 MA—200 Ohm—Open Frame.... 1.25
Choke—5 Hy/150 MA—85 Ohm..... 1.50
Choke—10 Hy/250 MA—2⅜" x 2" x 3" Potted.... 4.95
Choke—5 Hy/400 MA—4½" x 4" x 5⅜"..... 4.95
"A" Choke—1 Hy @ 1 A .7 ohm. Size: 2¼" x 2¼" x 2¼" .....Price: 1.95

METERS:

WESTON AC AMMETER:

(Pictured) In portable leather case, with Test Leads, 2½", 0-15 AC and 0-3 AC Scale..... **$5.95**

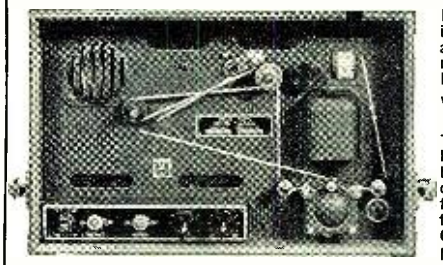
DC AMMETER HOYT: In portable metal case, with Test Leads, 4½", Fan Mirrored Scale 0-15 ADC.....$4.95
DB METER—10 to Plus 6, Westinghouse 3", NC-35 Imp. 600 ohms @ 1000 cycle..... 4.95
0-1 MA Weston 506; 2½" Rd. 3.95
0-3 RF AMMETER IS-128; 2½" Rd.....NEW: 2.95
0-8 Amp RF w/Thermocouple IS-89; 2½" Rd... 4.95
0-15 AC-DC—2½" Rd.; IS-122..... 4.95
0-500 MA DC—2½" Rd.; IS-22..... 4.95
0-150 V. 60 cycle; Simpson; 3½" Rd..... 3.95
0-250 MA DC—DeJur, 3" Sq..... 3.95
OUTPUT—5 Ranges, 4000 ohm imp.—Used..... 4.95

COMMAND EQUIPMENT:

(NAVY—274)	USED:	NEW:
520—1500 KC Receiver	$14.95	19.95
1.5—3.0 MC Receiver	9.95	
6—9 MC Receiver	4.95	
100—156 MC Receiver (R-28)	10.95	
2.1—3 MC Transmitter	5.95	7.95
3—4 MC Transmitter	6.95	
4—5.3 MC Transmitter	4.95	
7—9 MC Transmitter	4.95	7.95
100—156 MC Transmitter	14.95	
BC-456 Modulator	2.95	

Address Dept. RN • $5.00 Order Minimum, & 25% Deposit on C.O.D.'s • Prices are F.O.B. Lima, Ohio

PRACTICE CODE TAPE SETS



INKED PAPER TAPES—For Code practice and training—for Radio Operators, Hams, Amateurs, Beginners, and Telegraphers. 15 lessons to a set on 16mm 400 ft. reels that can be reproduced on TG-34A and TG-10 Keyers. Set of 15 Reels in wood case **$18.95**

◀ TG-34A KEYER:

Pictured at left—Automatic unit for reproducing audible code practice signals previously recorded in ink on paper tapes—complete with speaker and phone jack for plugging in headset. Variable speed motor control to 25 WPM, keying oscillator for use with hand key—Complete portable unit with Tubes and Manual .....NEW: **$16.95**

CLASSIFIED ITEMS:

BC-212G Amplifier—2/6C5 tubes.....NEW: $ 1.95
BC-216 Amplifier—6F7 & 39/44.....USED: 1.50
BC-229/429 Receiver—2500-7700 KC w/Coils. U: 6.95
BC-230 Transmitter—2500-7700 KC w/Coils..U: 8.95
BC-347 Amplifier—1/6F8G tube...N: $3.95; U: 1.95
BC-357 Beacon Rec.—75 MC.....N: $4.95; U: 2.95
BC-367 Amplifier—2/6V6 tubes....N: $4.95; U: 2.95
BC-375 Transmitter .....Used: 29.95
Tuning Units f/BC-375; TU-5-6-7-8-9-10-26. U: Ea. 3.95
Cables f/BC-375/BC-191, PL-61, 64 or 59, each end: Ea. 2.75
BC-442 Antenna Relay Box—w/Cond.....New: 2.95
BC-463 Trans.: 67-74 MC. 20 Watt. 16 Tubes.U: 16.95
BC-603 Receiver FM—20-28MC.....Used: 29.95
BC-604 Trans.: FM—30 Watt. 20-28 MC..Used: 18.95
BC-500 Trans. & Rec.: 25 Watt, 20-28 MC.New: 59.50
BC-617 Receiver Only. 30-40 MC w/Dyn..Used: 24.95
BC-654 Transceiver: 3800 to 5800 KC.....Used: 34.95
BC-709 Amplifier—Battery Operated.....New: 1.95
BC-745 Transceiver: 3 to 6 MC.....Used: 14.95
BC-924 Trans. FM—30 Watt. 27-38.9 MC. New: 24.95
BC-966 IFF—160-211 MC. 13 tubes.....Used: 5.95
BC-1158 Trans.: 50 Watt. 53.3-95 MC.....New: 39.95
RM-12 Radio-Telephone, Remote Control..Used: 19.95
RM-13 Telephone, Remote Control.N: $24.95; U: 19.95
RM-21 Remote Control Box for BC-669..... 4.95
SCR-625 Mine Detector—Reconditioned..... 39.95

SCR-522 Transceiver: 100-156 MC....Used: $34.95
Rec. Chassis only.....w/Tubes: 19.95
Less Tubes: 9.95
Trans. Chassis only.....w/Tubes: 22.50
Less Tubes: 9.95
Schematic & Conversion Information only.. 2.50

ID-60/APA-10 Panoramic Oscilloscope....New: 49.50
TBY Transceiver: 20-80 MC, 4 Bands, w/Tubes.U: 19.95
RI/ARR-1 Receiver—Converts to 2 or 6 Meters.. 2.95
RT-7/APN-1 Altimeter—440 MC.....Used: 9.95
RT-34/APS-13 Transcvr. Comp. less tubes...U: 3.95
R-74/CRW-2 Receiver—53-88 MC—6 Tubes..N: 9.95
TG-34A Keyer: 115/230 V 50-60 cy. w/Tubes.N: 16.95
TG-10 Keyer: Complete w/Tubes.....Tested U: 14.95
T-121 Transmitter—3-4 MC with Coder..... 7.95
Range Beam Filter, Navy Type $1.95; FL-8 Used: 1.49
EE-8 Field Telephones—Checked .....Used: 14.95
BD-72 Portable 12 Line Switchboard.....Used: 39.95
Sound Powered Head & Chest Set—Checked.... 3.95
Sound Powered Head & Handset f/Mark II.Used: 2.95
CD-874 Cord—f/HS-30—Low Imp., w/PL-55.U: .59
CD-515 Cable for BC-669..... 2.75
CD-605 Cord—F/HS-30—High Imp. w/PL-54.N: .79
CD-307 Cord—w/PL-55 & JK-26.....U: .59
CD-318 Cord—1/PL-68, JK/48, & SW-141...U: .89
GN-45 Handcrank Generator w/Legs & Seat... 9.95
R-4/ARR-2 Receiver—234—258 MC. w/Tubes.U: 4.95

TS-9 Handset w/Switch—No Plugs.N: $5.95—U: $ 3.95
TS-13 Handset w/Switch, PL-68 & PL-55.Used: 5.95
TS-15 Handset w/Switch, PL-68 & PL-55.New: 7.95
T-17 Microphone—Used. Checked..... 3.95
HS-30 Headset—Hearing Aid Type—L.N..... 1.50

NOW—OPERATE BEACON RECEIVER FROM 12 VOLT

BC-1206CM BEACON RECEIVER: 200-400 KC, 5 Tubes, 135 KC IF, operates from 24 VDC— **$9.95**
New .....
Used $5.95

For 12 Volt operation, use this PM DYNAMOTOR—12 VDC input, output 24 VDC. Size: 2½" x 4" x 7" Dyn.....Only: **$4.95**
Combination: New BC-1206 & Dynamotor.....$12.95

DYNAMOTORS & GENERATORS:

INPUT VOLTS:	OUTPUT: VOLTS:	MA.	STOCK No.	PRICES: USED:	NEW:
12 VDC	220	80	DM-34	$2.95	$ 4.95
12	625	225	DM-35	9.95	12.95
12	230	90	PE-133	4.95	6.95
12	540	450	DA-12		14.95
12	230	100	DA-14		8.95
14	220	70	DM-24	4.95	7.95
14	1030	260			
	515	215	DM-42	4.95	9.95
14	375	150	BD-83	3.95	4.95
14 VDC	330	150	BD-87	3.95	5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD-77	14.95	29.95
24	250	60	PE-86		8.95
28	1000	350	PE-73	8.95	

12 to 24 VDC PM Dynamotor—Supplies 24 VDC 2 A, from 12 VDC, also 500 V 50 MA: @ 6 VDC will supply 12 VDC & 250 V 50 MA.
#0515.....New: **$4.95**

BC-1158 TRANS. & MODULATOR:

Frequency coverage 53.3 to 95 MC. 50 Watt. RF Doubler, Amplifier, and Modulator Sections, using 4/815 and 10/12SN7 Tubes. Can be converted to 2-6-10- or 20 Meters. Complete with Tubes, Meter, Blower, etc.....NEW: **$39.95** Used: **$29.95**

WRITE US YOUR REQUIREMENTS:

Whatever your needs in Generators, Blowers, Inverters, Motors, etc.—write us. Chances are we have it!

FAIR RADIO SALES

132 SOUTH MAIN ST. LIMA, OHIO

YOUR TAPE RECORDER CAN MAKE MONEY FOR YOU

Make tape recordings of PARTIES • MEETINGS • SCHOOL CONCERTS & EVENTS • WEDDINGS and transfer to high-fidelity permanent records for very little cost. Then **resell at your own price!**

- **Records Imprinted With Your Copy**
- **Large or Small Quantities**
- **Exceptionally Low Rates**
- **All Speeds and Sizes**

CREST RECORDS, INC. Dept. R10
220 Broadway, Huntington Sta., N. Y.

Please send me brochure and rates on transferring tape to records.

NAME.....
ADDRESS.....
CITY.....ZONE....STATE.....

MAIL TODAY FOR BROCHURE AND RATES

Airex, the Electronics Supermarket, Now Introduces the All-New Complete Hi-Fi Unit . . . where utmost in compactness is desired

"The Miniature
MAESTRO"

The smallest, complete Hi-Fi System on the market. Another "AIREX FIRST" with True Hi-Fidelity Reproduction!

COMPONENTS include the new Harmon Kardon TA-10 FM-AM Tuner and 10 watt amplifier. Genuine Armstrong FM circuit with AFC. Sensitivity 3 microvolts for 20 db. AM terminal sensitivity 20 microvolts.
FREQUENCY RESPONSE on FM 20-20,000 cps ± ½ db., AM 3 db 20-5000 cps. Hum level −60 db. Power output 10 watts at 3% IM, Peak 15 watts. Response 20-20,000 cps ± 1 db. Damping factor of 6.2 position rumble filter, Bass & Treble control. 3 position loudness contour, 3 positions of equalization, 3 position speaker selector.
SPEAKER is the Stromberg-Carlson Hi-Fi to bring out the full range of the amplifier . . . the 6.8 oz. magnet will handle the full output of the amplifier without distortion.
CHANGER is the imported 3 speed English Monarch with 4 pole motor, intermix feature, and automatic shutoff at the last record . . . and a GE RPX 050A reluctance cartridge, with dual sapphire needles, to bring out full range of the recordings.
CABINETRY is heavy duty and compact, mitered and glued . . . Overall Size 30½" wide, 15" deep, 18" high, less legs. A regular $250.00 value, now featured at

$174.95 **Unfinished complete.**

$184.95 in Mahogany or Blonde. Wrought Iron Legs, extra at $4.95 per set.
Plexitone, non-scuff and stain resistant.
Deposit of 20% must accompany order. Balance C.O.D. F.O.B. N. Y.

AIREX RADIO CORP.
64 Cortlandt St., New York 7, N. Y.
Phone . . . COrtlandt 7-2137

critical inductance of the choke, that minimum value of the input-choke inductance which prevents the d.c. output voltage from rising above the average of the rectified a.c. wave. This minimum value, the critical inductance, must be maintained at all currents, in order to prevent the filter from acting as a capacitor-input filter.

Therefore, it becomes evident that to properly use a "junk-box" choke it is necessary to have a plot of inductance *versus* load current. Then if the inductance range of the "junk-box" choke is proper for the design range of the filter needed, it may be readily used.

A relatively quick and comparatively simple procedure may be employed to plot this curve, using only a vacuum-tube voltmeter and an ammeter as test equipment.

The test circuit should preferably be the full-wave rectifier of the power supply being built, with the choke and a high wattage rheostat in series across the output. (See schematic diagram.)

The test procedure is based on the following theory. An assumption is made that the d.c. resistance of the choke is small in comparison to its inductive reactance.

Hence, the normal equation for impedence: $Z = \sqrt{R^2 + X_L^2}$ becomes $Z = X_L$.

The current flow through L and R is equal, consequently; $I = E/Z = E_L/X_L = E_R/R$.

Solving for $X_L = E_L R/E_R = 2\pi fL$.

Therefore $L = E_L R/E_R 2\pi f$.

In actual use, vary the rheostat until the ammeter reads a low value of current. Measure the voltages across the rheostat and the choke with the vacuum-tube voltmeter, then measure the resistance of the rheostat. Substitute these values in the formula $L = E_L R/E_R 2\pi f$ and solve for L. (The value of f in a full-wave rectifier circuit is 120.)

Record this value of inductance and the current at which it was measured. Repeat this procedure until all the possible ranges of current that the power supply may require have been recorded.

When the curve has reached a point where the inductance starts to level as the current increases, the saturation point of the choke has been reached. Since this determines the upper limit of usability of the choke under load conditions, this is also the point at which the current rating of the choke should be checked. Leave the load connected for ten or fifteen minutes, carefully observing the case for signs of overheating. The choke may get warmer than body temperature, but should not burn the hand or get unduly hot. If the actual temperature of the choke is desired, fasten a thermometer to the case with putty. Be careful not to place the thermometer near the rectifier or any other heat producing tube. The temperature should be between 160° and 170° F.

The previously-described plot will

accurately show the point of saturation and how the inductance of the choke varies under different load conditions, and from this it can be readily determined if that "junk-box" choke can be used in the power supply and whether it meets the design requirements.

REFERENCES

Millman, Jacob & Seely, Samuel; "Electronics," McGraw-Hill Book Company.
"Radio Amateur's Handbook," The American Radio Relay League. —30—

HUM PRECAUTIONS IN PREAMPS

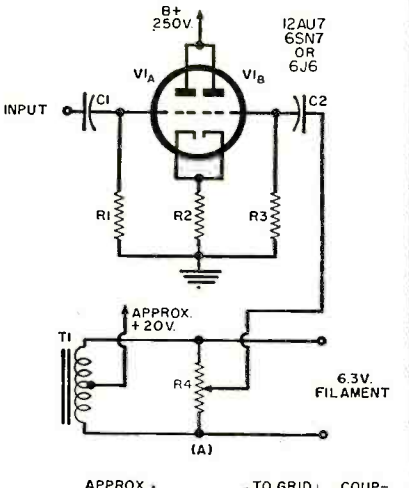
By RICHARD WILKENS, ET/2,USN

HERE is a novel circuit that can be applied as the final stage of a preamp when hum precautions have been adopted but without notable success.

R_1 selects the phase and amplitude of the 60-cycle voltage and applies it to V_{1B}. Hum cancellation occurs at the common cathode circuit of V_1. An absolute zero hum should be obtained. A 6J6 can easily be employed in the same socket where a 6C4 is used as a cathode follower. Similarly, a 12AU7 or 6SN7 can be used in their respective socket sizes or the circuit can be added to just about any preamp now on the market.

Frequency response is not affected in any way at zero hum conditions. —30—

Circuit for eliminating hum in a preamp (A) and alternate filament circuit (B). Positive bias on filaments can be obtained either from the cathode of output amplifier or high resistance voltage divider from "B+" to ground. Not more than +20 volts is advised. Refer to article.



R_1—*Normal cathode follower grid resistor or 470,000 ohm, ½ w. unit*
R_2—*22,000 ohm, 1 w. res.*
R_3—*470,000 ohm, 1 w. res.*
R_4—*5000 ohm pot*
C_1—*Normal cathode follower capacitor or .1 μfd., 400 v. unit*
C_2—*.1 μfd., 400 v. capacitor*
T_1*—*6.3 v. winding on power trans.*
R_5*, R_6*—*1000 ohm, 1 w. res.*
*For circuit of (B)

Combat Helmet Two-Way Radio

GI talks into a thumb-sized microphone that slips easily under his helmet when not in use. Inset shows the two small units that snap into a special plastic combat helmet. Top case holds the earphones, switches, and the 3 penlite-sized batteries used to operate the equipment. Lower case contains the transmitter and receiver circuits.

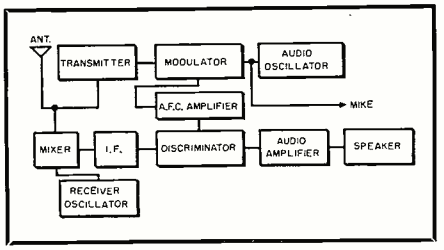
Lightest known military radio weighs less than a pound and has an operating range of up to one mile.

DEVELOPED by the Army's Signal Corps Engineering Laboratories, the AN/PRC-34 is the first two-way military radio small enough to fit into a helmet and light enough to make this feasible. It was designed to give a GI reliable short-range communications without loading him down with a shoulder-slung or back-pack radio.

The set's electronic components are packed into two flat aluminum cases measuring 3¾ x 2¾ x ⅝ inches. They snap as earpieces inside a special helmet. The first case contains three circuit units; the i.f./discriminator and audio, the mixer and r.f. output, and the transmitter. The second identical case holds the batteries, operating controls, earphones, and microphone jack.

The operating range of the set is several hundred yards from helmet-to-helmet or up to a mile from helmet to bigger radios. Three penlite-sized batteries are capable of powering the set for a full half day with continual receiving and occasional transmitting.

Block diagram of Army Signal Corps helmet radio AN/PRC-34. Completely transistorized FM superhet receiver and 1-tube e.c.o. used.



The set's antenna is built into the helmet and is not ordinarily visible. For additional range up to about a mile, an auxiliary vertical antenna is available that screws into the top of the helmet. Under these conditions, powerful stations may be received at even greater distances.

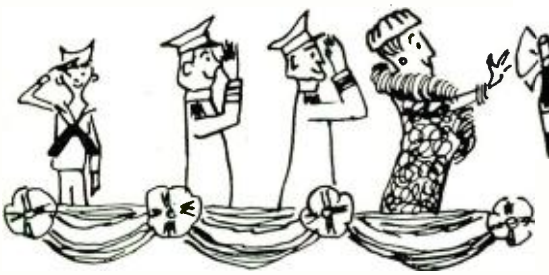
The receiver consists of an FM superhet with a sensitivity of 10 microvolts. It is completely transistorized. The transmitter consists of an electron-coupled power oscillator with a.f.c. for frequency stability. It uses one tube: a *Raytheon* 6051 pentode. Frequency modulated power output is 100 milliwatts. Twelve different channels can be used in the 38 to 51 mc. range by replacing two units.

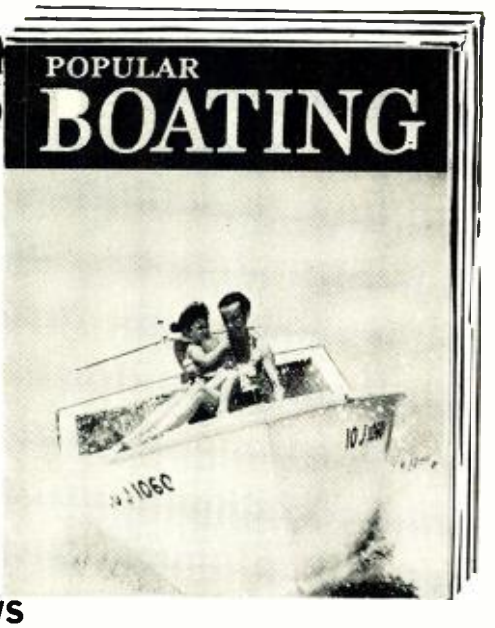
Provision is made for a soldier to transmit a short c.w. tone to acknowledge a message. This safety measure would be used when voice transmission might give away the GI's position.

The two-way radio set is mounted in a tough plastic helmet shaped somewhat like a football helmet. It provides about the same protection from shrapnel, bullets, and flying debris as the conventional steel helmet.

One possible military application of the helmet radio might be to provide radio communications for every member of a special combat unit. The little radio can "net in" with standard Army radios. Messages from a soldier's helmet set could be picked up behind the lines and leap-frogged over long distances to any point in the battlefield network. —30—

You're invited to a Launching!





SPECIAL OFFER TO
READERS OF RADIO & TELEVISION NEWS

5 months of POPULAR BOATING only $1.00

(a $1.90 single copy value!)

This is your special invitation to "sign on" as a Charter Subscriber to POPULAR BOATING—the new Ziff-Davis monthly for *everyone* who enjoys life on the water.

Whether you're a beginner or an "old salt" . . . prefer outboard, inboard or sail . . . you'll find this the magazine you and your family have been waiting for. POPULAR BOATING is the first new major boating publication in more than a generation—will bring you a completely fresh approach to the whole world of boats—from dinghy to power cruiser.

Published by the same firm that has made RADIO & TELEVISION NEWS tops in its field, POPULAR BOATING will feature money-saving how-to articles that point the way to more fun, greater safety afloat . . . new construction ideas . . . information on repairing, improving, fitting out your boat . . . monthly classes on seamanship and boat handling by expert boatmen . . . exciting boating yarns that will transport you to every corner of the world where there's fun and adventure on the water . . . regular features on new products, junior activities, maintenance, fishing, free aids to better boating, and much more!

The first issue of POPULAR BOATING will be launched October 2. Here are just a few of the exciting articles you'll enjoy in that issue:

* BREAKING THROUGH THE "WATER BARRIER"—America's best-known racing writer, Hank Bowman, describes the perils of high speeds afloat.
* SHOULD YOUR FIRST BOAT BE POWER OR SAIL?—Two top boating writers defend their favorite craft in a hot debate.
* OUTBOARDS UNLIMITED—There's no limit to the fun outboarding offers. Here's how to enjoy it more fully!
* GUY LOMBARDO'S GREATEST BOATING MOMENTS—In this exclusive article, the famed musician and boatman recalls the most thrilling moments in his racing career.
* ANN DAVISON'S NEXT BOATING VENTURE—An exclusive first-hand report by the only woman ever to sail the Atlantic alone!

As you can see, POPULAR BOATING will offer readers far more than any other publication in the field . . . yet *will cost less*. At regular rates, POPULAR BOATING will sell for 35c on newsstands (Special Show Numbers: 50c) and $4.00 a year by subscription.

SPECIAL $1.00 OFFER

But as a regular RADIO & TELEVISION NEWS reader, you can climb aboard POPULAR BOATING for a trial cruise at a not-to-be-repeated introductory rate—5 months for only $1.00. You get the big 50c January Boat Show Issue at no extra cost, too! All told, by taking advantage of this offer you save a whopping 47% over established rates!

And if you act now, your name will be entered as a Charter Subscriber. You'll be sent a special Charter Subscription Certificate . . . and, most important, you will be sure of receiving POPULAR BOATING's Volume I, Number 1—certain to become a real "collector's item."

So use the coupon below to subscribe now. See how much boating enjoyment a dollar buys you in new, exciting POPULAR BOATING.

Welcome aboard as a Charter Subscriber! Fill out and mail this coupon TODAY!

POPULAR BOATING 366 Madison Avenue New York 17, N.Y.

CHARTER SUBSCRIPTION ORDER FORM

Yes, please enter my Charter Subscription to POPULAR BOATING—starting with Volume I, Number 1, to appear in October—at the special rate of five months for only $1.00. Also send me my Charter Subscription Certificate. My dollar is enclosed.

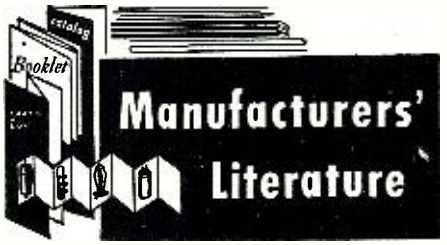
Name.....

Address.....

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

RN-10-6

A NEW MAGAZINE BY THE PUBLISHERS OF RADIO & TELEVISION NEWS



PICTURE TUBE GUIDE

The third edition of its "Reference Guide for Television Picture Tubes" has been announced by *CBS-Hytron,* a division of *Columbia Broadcasting System, Inc.*

Revised and brought up to date, this guide provides pertinent data on 258 magnetically deflected picture tubes, irrespective of make. As an additional aid to the TV service technician, boldface print indicates the differences among similar tube types.

This new edition can be obtained through *CBS* tube distributors or by writing the Advertising Service Department, *CBS-Hytron,* Salem, Mass. Ask for Bulletin PA-2.

"GUIDE TO GOOD BUSINESS"

The Merchandising Department of Electronic Product Sales, *Sylvania Electric Products Inc.* has announced a second printing of its booklet, "A Guide to Good Business."

The first 50,000 printing of this 20-page booklet was exhausted soon after its initial offering but another 50,000 copies are now on hand for free distribution. Write the *Sylvania* Central Advertising Distribution Department, 1100 Main Street, Buffalo, N. Y. for a copy or contact your local *Sylvania* distributor.

CRONAME BOOKLETS

Croname, Incorporated, 3701 Ravenswood Ave., Chicago 13, Illinois is offering two colorful booklets of interest to the electronics industry.

The first, entitled "CroRoto Embossed Pattern Metals for Contemporary Design," discusses the use of stock embossed patterns for decorative trim and functional metal parts and illustrates some of the many patterns available. This booklet is available from the *CroRoto Division,* Dept. #20, of the company.

The second booklet, "Primitive Art to Improve Today's Products," illustrates the applications of decorative glass. Dept #20 of the company's Glass Studios will supply copies of this publication.

Both booklets are available without charge.

C.R.E.I. COURSES

Capitol Radio Engineering Institute, 3224 Sixteenth St., N.W., Washington 10, D. C., has issued a colorful 64-page booklet which describes in some detail its residence courses for the 1956-57 school year.

Included in the brochure is information regarding the school and its faculty, details on its laboratories and physical equipment, an outline of the course, entrance and graduation requirements, diplomas and degrees, and miscellaneous data on housing, vacations, placement bureau, etc. and information on the city of Washington.

A free copy of this publication will be forwarded without obligation upon request.

GENERAL CEMENT DATA

A colorful 80-page catalogue which describes thousands of radio and television aids is now available from *General Cement Mfg. Co.,* 919 Taylor Avenue, Rockford, Ill.

Among the new products included for the first time are the firm's "Klipzon" self-holding prods and connectors, printed circuit repair kits, and phono drive kits. Copies of Catalogue No. 157 may be obtained either from the firm's distributors or from the company direct.

TEST INSTRUMENTS

The *Shasta Division* of *Beckman Instruments, Inc.,* P. O. Box 296, Station A, Richmond, Calif., is offering a new 4-page, 2-color catalogue describing its line of electronic test instruments, including expanded scale volt and frequency meters, v.t.v.m.'s, oscillators, resistance bridges, power supplies, wideband amplifiers, a WWV receiver, and a decade inductor.

Copies of this publication are available without charge upon written request to the manufacturer.

TRANSISTOR COMPONENTS

A four-page brochure containing technical information on 59 components designed especially for use in transistor circuits is now available from *Thordarson-Meissner* of Mt. Carmel, Ill.

Among the items listed are 36 audio transformers, 10 i.f. transformers, 7 ferrite antenna coils, 5 oscillator coils, and 1 midget variable capacitor. These parts are suitable for industrial applications or as replacements in radio and TV equipment and original parts in experimental and hobby circuits.

WESTON PANEL METERS

Weston Electrical Instrument Corp., a subsidiary of *Daystrom, Inc.,* 614 Frelinghuysen Ave., Newark 5, N. J., is now offering a new bulletin covering its more popular styles and ranges of panel instruments in sizes from 2½" to 4⅜".

The bulletin (A-7-F) contains complete specifications on all a.c. and d.c. instruments including rectifier type a.c. and thermo units, power level meters, vu and db meters, frequency meters, and wattmeters. Also included are dimensional diagrams, typical full-size scales, and detailed data on instruments for high frequency measurements.

CERAMIC CAPACITORS

Skottie Electronics, Inc. of Peckville, Pa., has just issued a six-page catalogue which describes its line of ceramic capacitors.

A complete selection of disc, tubu-

lar, and plate types of ceramic units is included in the listing which covers capacitors for temperature compensating, stable capacitance, high voltage, printed circuitry, and special customized applications.

ELECTRICAL INSULATION

An illustrated, 20-page catalogue on electrical slot insulations, wedges, and fabricated parts with selection guides and order data is being offered without charge by *Insulation Manufacturers Corporation*, 565 West Washington Blvd., Chicago 6, Ill.

Electric motor and equipment manufacturers, appliance designers, radio electronic and electrical engineers, and motor rebuilders will find this catalogue helpful as a reference and source book.

Write the Publications Department of the company for a copy of this book. Specify "Catalogue 19."

VARIABLE TRANSFORMERS

Standard Electrical Products Company, 2240 E. Third Street, Dayton, Ohio, has just issued a new 22-page catalogue covering its expanded and redesigned line of "Adjust-A-Volt" variable transformers in auto, isolated, and metered models for bench and panel mounting.

All single and ganged units are illustrated and described with photographs, dimension drawings, and wiring and circuit diagrams. Included for the first time are the new basic motorized variable transformers. A complete specification and application index is also included.

A copy of this catalogue is available without charge upon written request addressed to Mr. Solen M. Goffstein in care of the company.

GEE-LAR CATALOGUE

Gee-Lar Mfg. Co., 400 S. Wyman Street, Chicago, Ill., has just issued its Catalogue No. 57 which lists almost 200 different styles, shapes, and sizes of radio-television knobs.

In addition, the 16-page, red-and-black, fully illustrated brochure contains a large selection of the firm's switches, speaker kits, and other service aids.

Copies of the catalogue are available without charge either from the company's parts distributors or through the manufacturer direct.

REPLACEMENT CAPACITORS

The latest edition of its widely used "TV Replacement Capacitor Manual" has been issued in a new format by *Sprague Products Company*, 51 Marshall street, North Adams, Mass.

The 63-page booklet in its handy 5½" x 8¼" pocket size covers 6589 different TV sets made by 88 manufacturers. The tables are broken down into two sections. In the electrolytic section, each manufacturer is listed alphabetically with *Sprague* replacement capacitors fully described and cross referenced to original part numbers. The ceramic section also lists the sets alphabetically by make but the *Sprague*

replacements are grouped according to the section of the TV set in which they are used.

Copies of Manual K-102 are available without charge from the company's distributors or for 10 cents apiece from the firm direct.

MERIT DATA SHEETS

Merit Coil and Transformer Corp., 4427 North Clark Street, Chicago 40, Ill., has issued four new data sheets of interest to the industry.

Form No. 4 lists the company's correct output transformer for use with all popular output tubes. Both *Merit* exact and universal types are shown. The second publication, Form No. 459 gives specifications on new input, modulation, and plate transformers and a high inductance choke for audio and industrial applications.

Forms Nos. 453 and 458 cover the HVO-57, a horizontal and high voltage output transformer replacement for *Zenith* sets, and the MDF-77 *Admiral* replacement deflection yoke, respectively.

PRINTED CIRCUIT GUIDE

A replacement guide for printed circuits used in sets made by 95 different TV and radio maufacturers is being offered to service technicians by *Sprague Products Company,* 51 Marshall Street, North Adams, Mass.

Manual K-350 is a 12-page publication which measures 5½" x 8½". Tables are arranged alphabetically by set manufacturer with original part numbers and descriptions cross-indexed to the recommended *Sprague* replacements. The back pages of the manual show circuit diagrams of each of the firm's replacement items, along with the values of the resistors and capacitors in each circuit.

Copies of this guide are available without charge from the company's distributors or for a six-cent postage and handling charge when ordered from the manufacturer direct.

NEW RETMA STANDARDS

The Engineering Department of the Radio-Electronics-Television Manufacturers Association, 11 West 42nd Street, New York 36, N. Y., has issued three new standards covering the method for determining air gap flux density and energy (RETMA RS-157), battery socket patterns (RETMA RS-156), and mechanical considerations for transmission lines in microwave relay applications (RETMA RS-158).

The publications are priced 40, 60, and 25 cents a copy respectively. Single or quantity orders should be placed direct with the Engineering Department headquarters.

TUBE SELECTION CHART

A selection chart which lists the essential characteristics of 75 power rectifiers and control tubes is being offered by *General Electric* Tube Sales, 1 River Road, Schenectady, N. Y.

The chart classifies 46 thyratrons according to type, lists anode and cathode current and voltage ratings,

WHEN YOU ORDER BY MAIL . . .

please print your name and address clearly, be specific in your order, enclose proper amount, allow ample time for delivery.

and gives the average control characteristics of each tube. There are 29 ignitrons listed according to classification, welding-control tubes, frequency-changer welding tubes, and power rectifier tubes. Maximum ratings are given for each ignitron.

RCA TRANSMITTING TUBES

The *RCA Tube Division,* Harrison, N. J., has announced the publication of "*RCA* Transmitting Tubes," a new 256-page manual containing comprehensive and authoritative technical data on 112 types of power tubes having plate-input ratings up to 4 kw., and 13 types of associated rectifier tubes.

Included in the manual are maximum ratings, operating values, characteristic curves, outline drawings, and socket connection diagrams. Copies of Technical Manual TT-4 are available from the company's tube distributors or from the division for $1.00 each.

"POCKET CONTROL GUIDE"

Centralab, a division of *Globe Union Inc.,* 900 E. Keefe Avenue, Milwaukee 1, Wis., has announced the availability of its "Pocket Control Guide No. 4."

This handy control cross-reference guide is published semi-annually to make the latest and most up-to-date replacement control information available. As in the past, this 3¾" x 8½", 96-page guide will fit into a jacket pocket or tube caddy.

The Guide is available from either distributors or the company direct for 20 cents a copy. -30-

The latest word in a radiation detection instrument is displayed here by a radiation monitor at the Hanford atomic plant near Richland, Wash. At left is a new transistorized alpha radiation detection instrument developed at Hanford by General Electric instrument engineers. The new survey meter is smaller, lighter, more rugged, and not as sensitive to temperature and humidity changes as the vacuum tube-type instrument shown at right. In addition, the battery life of the transistorized units is many times greater than that of the vacuum tube unit.

Antenna News

MOBILE TV RESEARCH

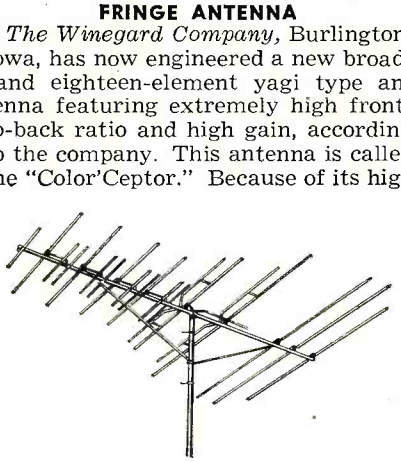
The Finney Company, 4612 St. Clair Avenue, Cleveland 3, Ohio, has announced the completion of its new mobile research laboratory unit. This truck, which took two years to design and cost over $35,000, was developed specifically for solving unusual and

difficult localized TV reception problems. It features a sixty-foot telescopic tower, twin TV antenna circuits for comparison purposes, and specialized test instruments. Among the latter is the "Antennascope" which is capable of plotting a complete electronic polar pattern and recording this pattern photographically.

The company will allocate field research study time, without obligation or charge, to reception problems presented by TV antenna distributors during a planned nation-wide tour. TV reception problems should be addressed to the Research Department of the company.

FRINGE ANTENNA

The Winegard Company, Burlington, Iowa, has now engineered a new broadband eighteen-element yagi type antenna featuring extremely high front-to-back ratio and high gain, according to the company. This antenna is called the "Color'Ceptor." Because of its high



uniform gain across the v.h.f. channels, this antenna is usable for color television.

Another new antenna marketed by

this company is the Model 303. This is a broadband v.h.f. antenna of the in-line type. Shipping weight is 8½ lbs. and the antennas are packed two to a carton with stacking bars. The antenna may be used as a single bay or two antennas may be stacked into a double-bay version if desired.

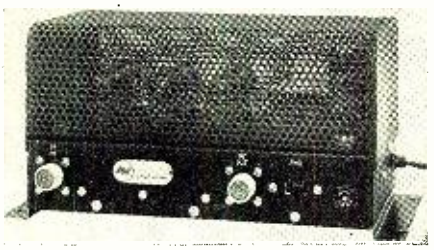
WEST COAST OFFICE

Snyder Manufacturing Company, Philadelphia, Pa., has just announced that Milton Schindler, administrative assistant to Ben Snyder, president of the firm, has been promoted to the post of director of West Coast sales. He will make his headquarters at the company's West Coast offices and warehouse in Los Angeles. In addition to the direction of sales, Mr. Schindler will also take charge of sales promotion, customer relations, service and liaison with the home office and plant in Philadelphia.

COMMUNITY TV AMPLIFIERS

Ampli-Vision Division of *International Telemeter Corp.,* 2000 Stoner Avenue, Los Angeles 25, Calif., is introducing two new r.f. amplifiers, the Models #111 and #116. These are broadband distribution amplifiers for use in community TV cable systems, master TV installations, and closed circuit TV systems. The Model #111 covers the entire v.h.f. band; the Model #116 covers the low v.h.f. band only (channels 2 to 6).

In conjunction with the release of



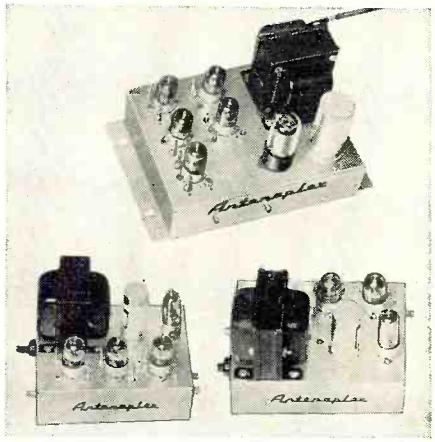
these two amplifiers, the company is sponsoring a local and national "Name the Amplifier" contest. The winner whose entry is judged the best locally will receive a *Bulova* watch. The national winner will be selected from the local winners and will receive a $500 grand prize. The contest closes October 15th and all entries must be in by that date.

MASTER ANTENNA AMPLIFIER

RCA Theatre and Sound Products Department, Camden, N. J., has developed three new "Antenaplex" broadband v.h.f. amplifiers. The new amplifiers (series 5300) are designed for small-to-medium sized TV distribution systems in motels, hotels, showrooms, office buildings, apartment houses, and department stores.

The series contains a high-band, low-band model (MI-5301), which amplifies channels 2 to 13 in two separate frequency bands. Separate input connections are provided for each band—the outfit can be combined without need for additional accessories. A low-band model (MI-5302) amplifies channels 2

to 6; and a high-band model (MI-5303) amplifies channels 7 to 13. The high-band model incorporates an output connector which facilitates combination with a low-band amplifier should any channel 2 to 6 stations be established in the area.

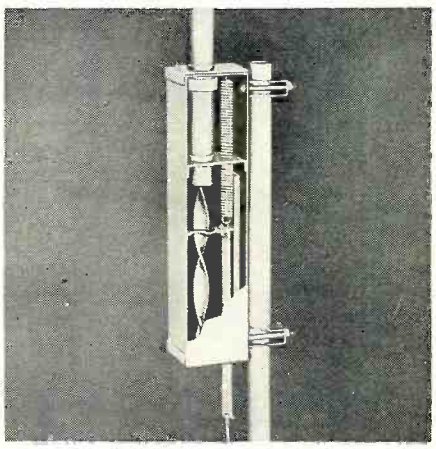


The new broadband amplifiers are factory aligned and are completely self-contained, with built-in power supply.

MECHANICAL ROTATOR

Helix Rotor Company, 220 Live Oak, Marlin, Texas, has announced the development of a new antenna rotator, model H-1, that requires no electric power. This rotator employs the age-old mechanical principle of a flat spiral helix to give full 360 degree rotation.

A slotted crossarm within the housing is moved downward by a pull on a manually operated steel cable which is attached to a direction indicator. As the slotted arm moves downward, the antenna is rotated clockwise through 360 degrees. The design of the slotted



crossarm is such that the antenna locks positively in any position to which it is rotated.

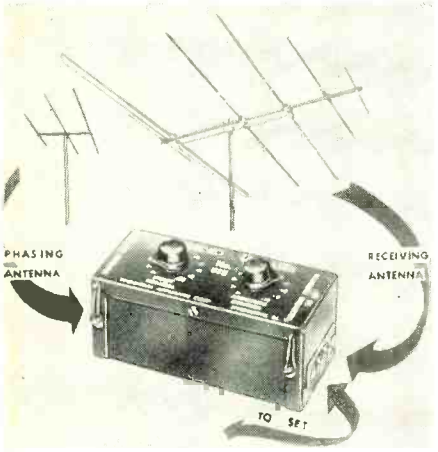
The rotator is shipped assembled, ready for installation, complete with cable, guides, rotating mast, etc.

INTERFERENCE ELIMINATOR

Technical Appliance Corp., Sherburne, N. Y., has developed a device for eliminating the "venetian blind" effect as well as other types of co-channel and/or adjacent channel inter-

ference. The device is the No. 815 "Co-Phaser." Employing a balanced time-delay circuit in conjunction with a level control, the "Co-Phaser" is adjusted by the set owner to meet local conditions. The calibrated controls of this unit permit accurate adjustment of both the amplitude and the phase shift.

The conventional receiving antenna which picks up the desired signal will frequently pick up an undesirable secondary frequency. This interfering signal may be reduced by means of an out-of-phase signal fed to the transmission line at the same time by a second antenna. The second signal should be of equal strength and 180° out-of-phase with the interference. The "Co-Phaser" does this in conjunction with a second antenna which is

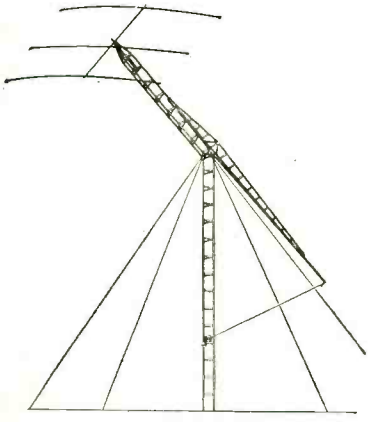


usually mounted on the same mast as the original one.

This unit does not require outside power and may be attached to the rear cover of the TV set.

FOLD-OVER TOWER

Rohn Manufacturing Company, 116 Limestone, Bellevue, Peoria, Ill., is now converting its No. 30 and No. 40 communication towers into fold-over types for use in amateur radio, experimental work, and antenna testing.



These towers are heavy-duty types and utilize standard sections with the addition of a special hinged section, boom and reel, and cable mechanism. Additional information and catalogue sheets are available from the company.

—30—

Selenium Rectifiers

(*Continued from page 71*)

An optional output-voltage indicating meter may be included in the completed unit, as shown dotted in Fig. 5. This must be a high-resistance d.c. voltmeter of at least 20,000 ohms-per-volt sensitivity.

Scope High-Voltage Supply

A selenium voltage multiplier circuit can simplify the high-voltage section of a 5- or 7-inch oscilloscope power supply. Fig. 6 shows a circuit of this type complete with focus and intensity controls.

A half-wave doubler is used so that a common ground may be employed throughout. A Type U50DP doubler type cartridge is used. The voltage multiplier capacitors are C_1 and C_2. Capacitor C_3 provides additional filtering action, operating in conjunction with the 2000 ohm filter resistor, since this circuit is not as easily filtered as the full-wave doublers described previously.

The transformer may be a special half-wave unit having a 1000 volt, low-current secondary. The entire secondary (both sides of center tap) of a

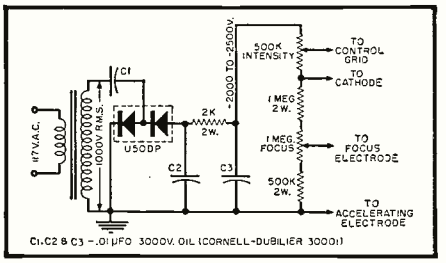


Fig. 6. High-voltage supply for a scope.

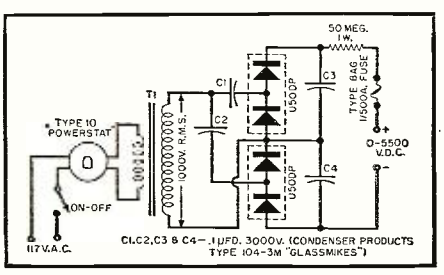
low-voltage transformer supplying the amplifier and sweep tubes in the oscilloscope may be employed under some circumstances.

Insulation Tester

Another type of continuously variable, high-voltage d.c. supply is shown in Fig. 7. This setup has been designed primarily for insulation testing and other dielectric breakdown measurements but may be used in any other application requiring an adjustable low-current output up to 5500 volts d.c.

Smooth variation of the output voltage is obtained by adjusting the input voltage to the transformer by means of a small (Type 10) *Superior Electric*

Fig. 7. Schematic of an insulation tester.



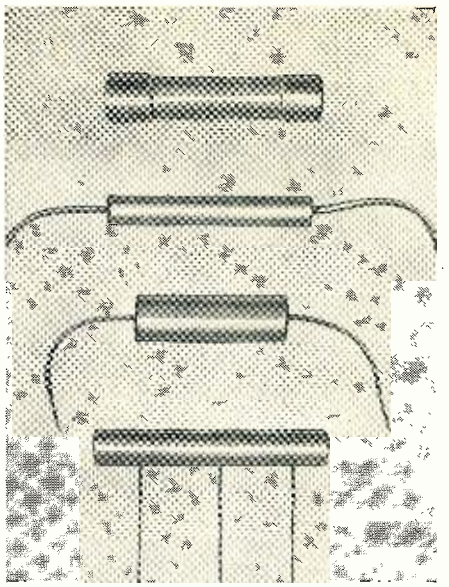


Fig. 8. High-voltage selenium cartridges.

"Powerstat." A *General Radio* 200B "Variac" may also be employed for this purpose.

The transformer has a 1000 volt secondary. Its output voltage is presented to a voltage quadrupler circuit composed of two U50DP doubler type selenium cartridges and capacitors C_1, C_2, C_3, and C_4. The d.c. output voltage is four times the peak value of the secondary r.m.s. voltage, minus the drop in the rectifiers.

The 50-megohm resistor in series with the positive output terminal limits the output current to 100 microamperes on external short circuit. The 8AG, 1/500 ampere fuse has a blow point of 3 ma. and protects the rectifiers in the event of a sustained external short circuit or overload.

A high-resistance d.c. voltmeter may be operated in parallel with the d.c. output terminals to monitor the output voltage. Where the use of such a meter is not feasible, however, the output voltage may be approximated from the measured value of a.c. voltage at the transformer primary. The following expression may be used: $E_{dc} = 5.65 E_i N$. Here, E_{dc} is the approximate output voltage, E_i is the r.m.s. primary voltage, and N is the turns-ratio of the transformer.

Conclusion

Possible uses of high-voltage selenium cartridges are multitudinous. Many other types and sizes are available, four additional ones are shown in Fig. 8. We have selected those applications about which information is constantly requested. These are small-sized devices in which the elimination of tubes contributes lighter weight, cooler operation, smaller size, simplicity of construction, and ease of servicing.

REFERENCE

1. Chambers, R. W. & Coleman, L. G.: "A High-Voltage Transistor Power Supply," RADIO & TELEVISION NEWS, *October 1955.*

—30—

Mac's Service Shop

(*Continued from page 76*)

I learned them in a hurry when I was putting together that scope kit that used two printed circuit boards. Too much heat there will cause the metallic conducting foil to separate from the board itself; so you have to be very careful not to use too much heat. What's more, in some places the conducting lines are quite close together, and an excess of solder means a short-circuit. The manufacturer suggests that you use one of the very small and light soldering irons of the solder-pencil variety on the circuit boards; so I tried this and found it worked reasonably well, but I also found you had to hold that light iron against some of the joints, especially the 'ground' ones that were surrounded by large areas of foil, for a long time to make a good joint. Finally I went back to my trusty old solder gun."

"How did you keep from overheating the printed circuit boards?"

"I held the solder gun against the wires protruding through the hole in the printed circuit board until they were hot. Then I dabbed the solder against these leads just opposite the solder gun tip. Almost instantly a little solder would melt and run down the short length of the wires to the foil, where it would instantly fuse to this foil that had been preheated through contact with the hot wires. This system was far faster for me than using the light iron; and anyway I just don't feel like I'm soldering unless I can hear the trigger of that gun click."

"Sounds all right to me," Mac commented; "and incidentally, it always worries me to see a fellow holding the tip of a solder gun against a joint while the tip heats, especially when that joint carries leads to units easily damaged by heat. The way to do it is to hold the tip off the joint for a second or so until it is hot and then dab it to the joint with the solder being applied almost simultaneously."

"Well," Barney said as he slipped off the bench and stretched luxuriously. "I guess we have reviewed the soldering situation pretty completely. As I get it, you are all in favor of making easy-to-remove joints in which the solder is depended upon to hold them solid, rather than making the joints mechanically solid."

"That's right. And don't forget to make neat-looking joints without too much solder. But don't go all out on this business of using a small amount of solder as one fellow did who brought a receiver he had put together for my inspection. He had barely tacked the connections together with a tiny speck of solder on each one, and you could break any of them loose with very little effort. The joint should be completely surrounded by a thin smooth layer of solder. It should be shiny and bright. If it looks dull and the solder

looks grainy, the joint is a poor one and must be done over. With a little practice you can *usually* tell a good joint from a bad one by just looking at it; but never forget that you can get a fooling. Now and then a rosin joint will look fine on the outside. The layer of insulating rosin is all on the inside where you cannot see it; so never hesitate to lay the iron to what seems to be a perfect joint when you are hunting trouble." —30—

POOR MAN'S PHONE PATCH

By STAFFORD E. DAVIS, W5HIM

MANY amateurs throughout the world are now making a definite contribution to military morale by handling third-party communications through their rigs. In many instances, the soldier's near relatives can speak with their GI through the medium of a phone patch. This is a means of connecting the amateur's radio equipment into the phone system so that the parties concerned can talk directly to each other without having a third party relay the conversation.

Unfortunately, the cost of such phone patches is beyond the means of many hams, including the author. A diligent search in the literature and intensive querying of the author's fellow hams produced the circuit shown in the diagram.

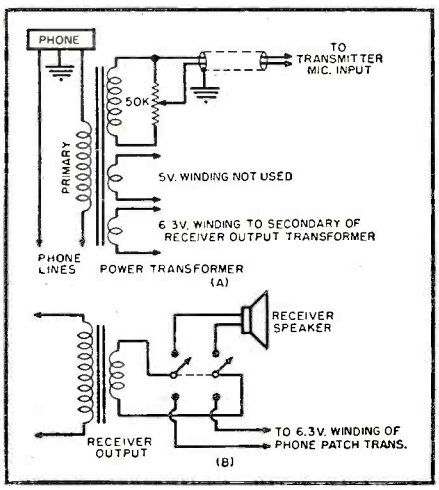
The unit can be constructed from junk box parts and, considering its simplicity and low cost, it works quite well. If all new parts have to be purchased, the phone patch can be built for five dollars or less and in about a half hour. Any replacement power transformer can be used in this application.

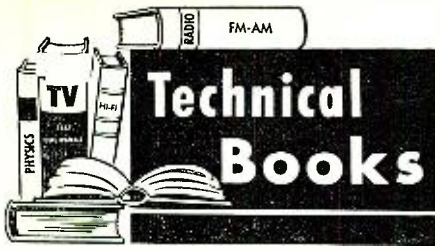
A word of caution is in order. Note that the primary of the transformer is connected in series with one side of the phone line and not across it. Next note that shielded lead must be used for the microphone input otherwise an extra loud hum will result.

When the phone patch is in use, the ham operator talks into the telephone instead of the microphone. Our thanks to W5KL, who has been using a similar phone patch since 1923, for the basic idea. This should convince even the most skeptical that the circuit has merit.

—30—

Complete schematic of the "junk box" phone patch (A) transmitter section and (B) receiver portion. The power transformer can be any of the available replacement types.





Technical Books

"TAPE RECORDERS AND TAPE RECORDING" by Harold D. Weiler. Published by *Radio Magazines, Inc.*, Mineola, N. Y. 186 pages. $2.95 (paper bound) and $3.95 (hard cover).

This compact volume is a "how-to-do-it" handbook for the home recordist. As the author points out there are some 1200 ways in which a tape recorder can be used, many of which have probably never occurred to the owner of the average tape recorder unit. Not only does he draw his readers' attention to some of the more unusual applications but explains the techniques involved in obtaining the best possible reproduction.

Turning out a good tape involves a combination of know-how, taste, and thorough knowledge of the recorder used. This book supplies the information needed to meet the first and last requirements. The thirteen chapters cover the theory of sound, sound and the human ear, microphones, room acoustics, recording with a mike, mike techniques, recording from records-radio-TV, tape recorders, sound effects, recording special sound effects, tape recorder maintenance, and how to add sound to slides and home movies.

The text material is illustrated by some 100 line drawings and photographs.

* * *

"SUPERHETERODYNE CONVERTERS AND I-F AMPLIFIERS" edited by Alexander Schure. Published by *John F. Rider Publisher, Inc.*, New York. 45 pages. Price $ .90. Paper bound.

This is the twelfth volume in the publisher's "Electronic Technology Series" and covers the theory underlying the operation of mixers and converters and the theory of the i.f. amplifier.

The text material is divided into five chapters covering the basic principles of superhet operation, early types of converters and mixers, modern converters and mixers, i.f. amplifiers, and the alignment of these sections.

The treatment is non-mathematical and the student studying on his own should have no difficulty in handling the material. Review questions are included at the end of each chapter.

* * *

"TRANSISTORS IN RADIO AND TELEVISION" by Milton S. Kiver. Published by *McGraw-Hill Book Company, Inc.*, New York. 320 pages. Price $6.50.

The readers of this magazine have long been familiar with Mr. Kiver's type of presentation and the facility with which he is able to make complex subjects crystal clear to the reader. His latest book is no exception.

Written for the radio and television service technician and those interested

in experimenting with transistor circuitry, the material is basic and, as such, could be used as a textbook for the tyro. The text is divided into ten chapters which cover modern electron theory, point-contact and junction transistors, a comparison of the two types of unit, transistor amplifiers, oscillators and radio receivers, the use of transistors in TV receivers, new transistor developments, the servicing of transistor circuits, and experiments involving transistors.

A series of transistor data tables and an extensive bibliography complete the text. Since the author uses a minimum of mathematics in his exposition, the student will find this volume helpful, as will those with wider electronic experience.

* * *

"COLOR TV TRAINING MANUAL" by C. P. Oliphant & Verne M. Ray. Published by *Howard W. Sams & Co., Inc.,* Indianapolis. 258 pages. Price $6.95. Paper bound.

This volume represents a basic color course for the practicing television technician. The text material is divided into three sections covering the principles of the color television system, color receiver circuitry, and the servicing of the color set. Those with training and experience in the servicing of black-and-white sets should have no difficulty in handling the material as presented since the book has been designed to be used for home-study as well as for the more formal training courses offered by schools.

There are about 500 illustrations in this manual, 126 of them in color. An appendix carries actual color picture tube displays, information on the use of several commercial color bar and white dot generators, and a glossary of color TV terminology. Test questions at the end of each chapter permit self-checking. The answers have been included to make the manual self-contained.

We believe that alert service technicians will find this a valuable springboard to the new business and increased profits which are to be made in color television work.

* * *

"AUDIO AMPLIFIERS AND ASSOCIATED EQUIPMENT" by Sams Staff. Published by *Howard W. Sams & Co., Inc.,* Indianapolis. 288 pages. Price $3.50. Paper bound, spiral binding. Vol. 7.

This volume provides complete servicing data on three preamplifiers, twenty-eight audio amplifiers, and sixteen custom AM-FM tuners that were released during the year 1955.

As is the case with this publisher's other "Photofact" publications, this handbook provides complete photo coverage, a comprehensive annotated schematic of the equipment, parts list, voltage and resistance measurements for servicing and troubleshooting, and step-by-step service procedures.

A cumulative index covering the previous volumes in this series is also included to facilitate spotting the required diagram.

The tremendous boom in hi-fi equipment sales makes this phase of servicing operations of dollar-interest to most technicians who are willing to specialize.

* * *

"GERMANIUM DIODES" by Dr. S. D. Boon. Published by *Philips' Technical Library,* Eindhoven, Holland. Available in the U. S. from *Elsevier Press, Inc.,* 2330 Holcombe Blvd., Houston 25, Texas. 85 pages. Price $1.95. Soft binding.

The increasing use of germanium diodes in electronic circuits makes it more important than ever that engineers and service technicians understand the nature and structure of these semiconductors. Those used to working with vacuum tube circuitry will find that this newer and smaller component requires an entirely different approach.

The text material has been presented factually and in the most practical manner possible. Theoretical discussion has been largely eliminated in favor of practical circuits which can be used as a guide to experimentation, etc. Twenty-seven circuits have been included in this handy and compact text.

* * *

"ELECTRONICS IN INDUSTRY" by George M. Chute. Published by *McGraw-Hill Book Company, Inc.,* New York. 422 pages. Price $7.50.

Since virtually every industry now comes within the sphere of influence exerted by electronics, it behooves not only service personnel but management to understand the role of such devices in speeding output and cutting production costs.

The text is written for the end user and those responsible for the maintenance of such equipment since it describes and analyzes commercially available items. Among the control devices discussed are simple welding controls, resistance-welding controls, light and heat relays, heating and light-dimming devices, simple speed and voltage regulators, electronic heaters, temperature recorders, light relays, register controls, servo-mechanisms, etc. A non-technical discussion of the tubes used in such devices is also included. Since this text is based on a study course in industrial electronics taught by the author, it is suitable for home study or formal academic programs. Problems are provided for review purposes at the end of each chapter. The correct answers are included.

* * *

"TIME-SAVING NETWORK CALCULATIONS" by Dr. Harry Stockman. Published by *SER Co.,* 543 Lexinton Street, Waltham, Mass. 120 pages. Price $1.75. Paper bound.

Engineers whose work involves network calculations of various types will find this compact manual a handy addition to their reference shelves. The book gives a set of general rules covering network calculations and describes the use of Thevenin's Theorem, the potentiometer method, and other

techniques for the transient and steady states.

One especially valuable contribution in this text is a comprehensive bibliography covering some 280 selected references to published material on the subject.

It goes without saying that a suitable mathematical background is prerequisite to an appreciation of this work and for obtaining maximum benefit from the outlined procedures.

* * *

"PRINCIPLES OF COLOR TELEVISION" by The Hazeltine Laboratories Staff. Published by *John Wiley & Sons, Inc.,* New York. 562 pages. Price $13.00.

This is an engineering text which covers the basic concepts of the production and transmission of the color signal. Based on the continuing series of technical reports that have emanated from the *Hazeltine Laboratories* over the past few years, this volume is a compilation and up-to-date picture of the entire subject.

The text material covers light and photometry, color perception, color space and color triangles, colorimetry, color in a TV system, required information content, characteristics of the eye, choice of color components and their interleaving in the composite signal, the production of the composite color signal, synchronization, nonlinear amplitude relations and gamma correction, FCC color standards, equipment for producing the transmitted signal, color receivers, decoders for three-gun displays, decoders for one-gun picture tubes, and test and measuring methods.

From the listing of contents, it is obvious that this book is directed toward a readership with advanced technical training. Practicing engineers, students in the graduate engineering faculties, and research engineers will derive the greatest benefit from this work. A fairly comprehensive mathematical background and a familiarity with engineering theory and the techniques of monochrome television are prerequisite and have been assumed by the authors.

* * *

"WIRELESS SERVICING MANUAL" by W. T. Cocking. Published by *Iliffe & Sons Ltd.,* London, England. 263 pages. Price $4.00. Available in U. S. from *The British Book Centre,* 122 E. 55th Street, New York 22, N. Y.

So popular is this work with radio service technicians that it has been necessary to issue a ninth edition of this volume. Ever since 1936 technicians have been consulting this work for practical suggestions on coping with day-to-day troubleshooting and servicing problems.

This newest edition has been revised and the circuitry and illustrative material brought up-to-date to reflect current developments. Among the new material included in this edition is data on a.f.c., push-pull amplifiers and negative feedback, the servicing of frequency-modulated v.h.f. receivers, antenna-ground systems, the use of CR test gear, and the handling of extension loudspeakers.

Those who have used this manual in the past will welcome this new edition with enthusiasm and those who are not yet acquainted with Mr. Cocking's straightforward presentation of his subject matter have an interesting experience ahead of them.

* * *

"BLOCKING OSCILLATORS" edited by Alexander Schure. Published by *John F. Rider Publisher, Inc.,* New York. 60 pages. Price $1.25. Paper bound.

This is a straightforward discussion of an often neglected and often misunderstood circuit, despite the fact that such circuitry is to be encountered in various types of electronic equipment.

The text material is divided into four chapters covering a description of the operating features of such circuitry, both popular and detailed descriptions of the operation, and applications for blocking oscillators. As a specialized work, students, technicians, and practicing engineers will find this book helpful. —30—

LOST—ONE TRAIN!

By CAPT. ROSS A. SHELDON, K4HKD

FROM hunting transmitters to hunting trains is quite a jump—but not for Alabama Emergency Net "P" which meets daily at 6 p.m. (CST) on 3955 kc.

When train Number 20 of the Southern Railway out of Mobile was overdue Sunday morning, July 8th, officials, knowing of flood conditions along the route, sent out a call for amateur radio operators to aid in finding it. K4CEM, a railroad employee, telephoned W4BFX from the depot at 0900 and W4BFX immediately went on the air alerting the members of the net. Net manager K4AOZ activated the net and took charge as net control station.

W4OBV-mobile was in Marion over the weekend and took the call, telephoning the Marion, Alabama police department which, in turn, relayed to the police in Jackson and alerted the highway patrol. It was established that Number 20 was missing somewhere between Jackson and the town of Suggsville. Meanwhile, W4GJW heard the alert on the Alabama Emergency Net frequency and switched over to 40 meters to catch a station he had been in contact with in Evergreen, W4FDZ. W4FDZ called the Evergreen police who also relayed the call into the Jackson police.

Forty-five minutes after the request was given to K4CEM, a Jackson police squad car found the stranded train trapped between two washouts and unable to move. The information was radioed back through police and amateur channels to Southern Railway officials.

The fine cooperation of hams and local police and railroad officials thus quickly allayed fears of the railroad and relatives of passengers as to the train's safety.

Bouquets to the Alabama Emergency Net and the quick thinking of its members. Stations participating in the operation were: K4AOZ, K4CEM, W4PXQ, W4HKK, W4GJW, W4BFX, W4OBV, W4FDZ, and W5ZLP. —30—

Tube Saver Triples Tube Life

EVERY time current is switched on in a radio, TV set, or other electronic equipment, destructive surge currents rush through tube heaters and cathodes. There is no question that these initial surge currents are destructive. In television servicing today it is estimated that a great majority of breakdowns are due to defective tubes. The same is true of other types of electronic apparatus both commercial and military. Laboratory tests have shown that initial surge currents in intermittently used vacuum tubes are to blame for 70% of normal tube deterioration and virtually all burnouts. To prevent such failures, or at least to delay them, a method is needed by which the in-rush current could be controlled, slowed, or delayed until heaters are warm enough to handle full current. By reducing the starting heater voltage to about 60% of normal for 10 seconds, tube life may be more than tripled.

A new commercially available device for doing this is the "Tube-Saver" made by the *Wuerth Tube-Saver Corp.* The circuit shown in Fig. 1 contains a resistor, a thermal relay, and an indicator bulb. The a.c. power plug of the TV set, radio, etc., is plugged into the socket provided. The line switch on the TV set or other equipment is still used but the instant the equipment is switched on, current enters the "Tube-Saver," passes through the bi-metal horseshoe *H*, and out through the surge limiting resistor, which has the time-delay indicator light in parallel. The voltage now received by the load is a fraction of normal and its tubes build up, their resistances safely.

In a sense then, the tube heaters are pre-warmed and readied for the full voltage. This type of treatment may not be as effective for series-heater circuits as it is for parallel circuits since in the former, the heaters may not obtain enough voltage in this period to warm up.

The current through the bi-metal horseshoe creates a small voltage drop and the heat generated deflects *H* so that it makes contact with the strip *S*. The instant this contact is made, the resistor and light are bypassed, placing full voltage on the apparatus. The deflection of *H* is not affected by the loss of heat in its right leg as the increased current in the left side is more than enough to overcome the drag of the unenergized right leg. An adjustment screw is used to position the contact opening for proper time delay.

Since the radio, TV set, etc., is turned off with its own switch, no current flows in the "Tube-Saver" when its contacts open. This insures long life for the contacts. —30—

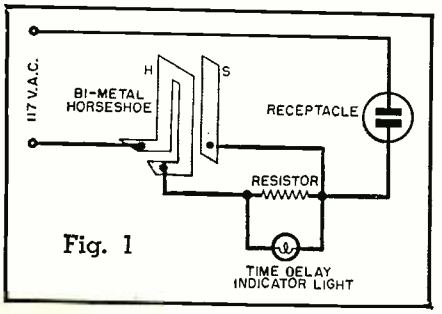
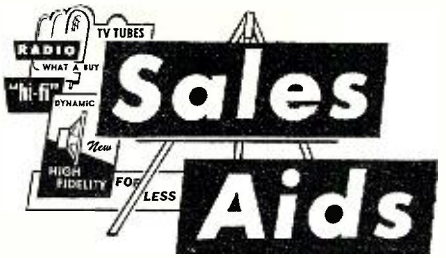


Fig. 1



REGENCY RADIO DISPLAY

The *Regency Division* of *I.D.E.A., Inc.*, 7900 Pendleton Pike, Indianapolis 26, Ind., is offering a new display mer-

chandiser, the "L-6," free with any order of three or more of the company's all-transistor miniature radios.

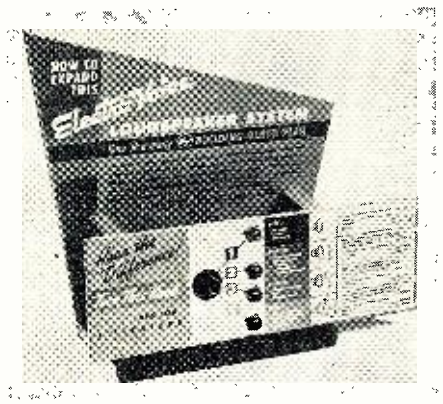
Modern in design, the display enables customers to hear and play the radios as well as see them. The sets can be picked up and handled but cannot be stolen, thanks to tiny, semi-concealed chains that attach to the back of each case. These chains are separate and need not be used if the merchandiser is employed for window display purposes.

Full details on this free merchandiser deal are available from the company's distributors or from the manufacturer direct.

* * *

E-V SYSTEMS SELECTOR

Electro-Voice, Inc. of Buchanan, Mich., has developed a unique sales tool which helps dealers demonstrate



the difference between single-speaker and multi-speaker high-fidelity reproducing systems.

Customers can make their own comparisons at the turn of a switch and dealers can demonstrate 36 different speaker systems using only five basic units. The new merchandising aid has been designated as the Model 522 Systems Selector. This easily installed unit measures 14½" x 13½" x 4½" and stands atop the company's speaker enclosures. By turning a single knob, the potential buyer can hear, for example, first a full-range coaxial speaker, next a coaxial unit plus a tweeter, then a system with a mid-range horn, and finally the complete multi-unit system.

Write the manufacturer direct for details on how this unit may be obtained.

* * *

ADMIRAL CAMPAIGN

Admiral Corporation of Chicago is backing up its dealer and distributor organization with an intensive national advertising campaign which will embrace all major media.

TV and radio, magazines, newspapers, and 24-sheet posters will be used in the firm's most comprehensive advertising campaign in recent years. The TV and radio expenditure alone will run approximately two-and-a-half million dollars.

* * *

"IRISH" TAPE DISPLAY

ORRadio Industries, Inc., of Opelika, Ala., is now supplying a two-color, self-selling display unit as standard packaging on its three most popular "Irish" brand tapes, the 7-2400 "Double-Play,"

the 600 and 600-AB "Long Play," and the 300 "Shamrock."

A copy panel on the back of the display box gives the counter salesman a quick descriptive summary on each of the six different tapes in the line.

* * *

TONE ARM BANNER

Gray Research & Development Co., Inc., of Manchester, Conn., has issued a colorful 16" x 20" wall and window banner to its dealers. This new sales aid points out the salient features of the firm's 108C viscous damped tone arm.

* * *

BIGGEST TUBE?

The Tube Department of *General Electric Company* is making sure that motorists on the Chicago-Florida Highway 231 are aware of the fact that Owensboro, Ky., is the home of one of its tube plants.

The company has had a 200,000 gallon water tower constructed in the shape of a 6BK7 miniature tube. Since the actual tube measures about two

inches, the tank is 84,000,000 times larger by volume.

The display will be floodlighted at night. The new tube factory, which is

under construction, is expected to be in operation some time next year.

* * *

HAND POWER TOOL DISPLAY

Wen Products, Inc., 5804 Northwest Highway, Chicago 31, Ill., is now offering an all-purpose, all-line display board which is designed to accommodate one each of the company's four most popular power tools.

The display mounts a "Quick-Hot" electronic soldering gun, an electric sander-polisher, an electric all-purpose saw, and the recently introduced, low-cost ⅜" power drill.

The board has tripod wooden legs for floor display, an easel for counter display, and can also be hung on the wall. Five colors are used on the display to assure customer eye appeal. A rack on the display accommodates 48 stuffers showing a complete description of each of the firm's consumer products.

For full details on how this display may be obtained without charge in connection with tool orders, write the manufacturer direct.

* * *

HOTPOINT TV AIDS

The television receiver department of *Hotpoint Co.*, 5600 W. Taylor Street, Chicago 44, Ill., has developed an extensive assortment of merchandising and sales promotional materials to in-

troduce the company's new line of portable, table, and console television receivers.

The new "Hi-Vi" merchandising dealer kit, containing the entire assortment, is available immediately. Write the company direct for details. —30—

Service Industry News

FORREST L. BAKER of San Antonio, Texas, president of the recently-formed American Electronic Council, in an address at the Electronics Fair held by the Texas Electronic Association, pointed out that the independent service industry is powerless to stem the tide of manufacturer centralized service in metropolitan areas without the cooperation of the dealers who sell the sets.

"Independent service," he said, "can meet the challenge of centralized service through the efforts of local associations cooperating with dealers and in strong state associations. The American Electronic Council will coordinate the activities of its member state associations and provide a national public relations program for the benefit of individual shops. Through the AEC the stronger state associations will help their sister associations improve their influence in their own states. The AEC will be able to win dealer cooperation through their liaison with dealer associations at the national level."

Baker, a very successful operator of an electronic service business, pointed out that service people must take a realistic view of the seriousness of the competitive situation that is rapidly developing. Recent announcements by prominent manufacturing executives have emphasized that only "six to eight" receiver manufacturers will be left in the field when the current readjustments are completed.

There has been a steady trend among set manufacturers to provide factory-controlled or factory-managed consumer service. When the entire consumer market for TV sets is divided up among a handful of manufacturers, it will be possible for all of them to get a high enough concentration of users of their brands in metropolitan areas to make centralized service profitable.

Baker also called attention to the most recent developments in the financing of the sales of color TV sets. Announcements by banks that the cost of the service contracts will be included in the 36-month financing they will provide for color TV, sets the stage for manufacturer domination of the consumer service market through centralized service depots.

The Television Service Association of Metropolitan Washington, D. C., is also seriously concerned with the inroads manufacturers' service depots are making on the business normally handled by independent service shops. Norman R. Selinger, chairman of the program committee, is contacting other associations on the eastern seaboard for information about the activi-

ties of set manufacturers in their areas in soliciting television service work.

On the other hand, some of the Pittsburgh, Pa., independent service operators feel that set owners who have had experience with manufacturers' depot servicing are now turning to independent shops for good, efficient service. Tom Scholler, writing in the RTSA "Video Scope" related:

"Real good news for local community service shops. The consumer is now looking for local reputable service shops. His reasons, according to an impartial survey, are definitely clear as crystal. They want a personal man whom they can ask a question and get a straight answer. They want his opinion on what they should purchase. They want more for their money than a tube replaced, a bill made out, and a fast-retreating technician.

"They want us to sit down and explain the why's and wherefore's of television in simple language. They do not wish to wait two or three days for a man to appear. They do not wish to wait longer than two or three days to get their sets back, unless it is due to a *bona fide,* honest reason. They prefer (whether we like it or not) to have a replacement set while theirs is tied up. They are willing to pay professional rates for a professional job.

"The fellow writing this article had occasion to make a call on a person possessing a paid-in-full factory service contract. I was not aware of the contract until after the repair, so I asked point blank why she called us. The customer replied that her neighbor had recommended us because we had made a fast, efficient repair of her set. She said we are a local outfit and seem to be interested in our work and in our customers. Since this incident we have practically monopolized a whole city block of service customers.

"Here is another observation that some readers may be interested in. We have heard quite a number of pet names that owners apply to their TV sets. A few are 'Hanging Gardens,' 'Bucket of Bolts,' 'Stripped-Down Charlie,' etc. None of them is intended to compliment the set or its manufacturer. Somehow or another, it might be that these names fit. If I were you men, I would give a customer a straight, honest answer when she inquires about buying one of these sets, and recommend a set that you know to be good. If you know a receiver is going to require more service than some other make, give her a straight answer. If she is interested in a set that has a pet name, change her mind. She deserves to know.

"One final note is this. We have a good crop of set discounters. The maker uses these characters to shove his junk on the market. One such discounter attempted to get us to use our time and talents to get one of his customers a new picture tube for one that was four months out of warranty. He supplied the customer with his letterhead and a fake sale date.

However, when the serial number was checked it made a fool and a liar out of the man. The customer paid for a new tube, the job, plus our wasted time. Her comment about the discounter is not printable.

"If you happen to be selling merchandise that is discounted I suggest that you do something about it. There are a couple of manufacturers who do not have a discount line and they make darned good sets. If you want to know who they are, just drop me a line."

Association News

Frank J. Moch has just resigned from the post of president of TESA-Chicagoland which he has held for the last eight years. The resignation came as a result of his recent serious illness which was occasioned by overwork. In resigning, Moch stated that the demands of the presidency of NATESA and TESA-Chicagoland have grown so vastly as to become full-time jobs. Mr. Joseph Blink, formerly first vice-president, will assume the duties of the presidency for the balance of the unexpired term. Mr. Moch will retain the post of chairman of the board.

The Associated Radio and Television Servicemen of New York (ARTSNY) announces establishment of a color TV clinic which will be held at *P & L TV*, 220 Knickerbocker Avenue, New York City. The clinic will be directed by Mr. Henry Levine and will be held on Wednesday evenings. The black-and-white television clinic will be transfered to *R.N. TV* at 663 Washington Avenue, Brooklyn, N. Y.

At a meeting in Greensboro, N. C., recently, the ground work was laid for an association of TV and radio service shops in the central part of the state. The meeting was called by the High Point Radio and TV Technicians Association and was attended by about thirty men from Greensboro, High Point, and Winston-Salem. For the time being, the group will be known as the Tri-City Technicians Association. Temporary officers elected to serve for three months are Jim Hornaday, president; Van Sickles, vice-president; Joe Woods, secretary; and C. B. Steele, treasurer.

All full-time service shops in the area are invited to join—membership is not limited to the three cities mentioned. It is hoped that in the future, this group may serve as a basis for a state-wide organization. Meetings will be held monthly and correspondence should be addressed to Joe Woods, 1708 Spring Garden Street, Greensboro, N. C.

A dynamic color demonstrator nicknamed the "Iron Monster," has just been presented to the Society of Radio and Television Technicians Inc., of Van Nuys, California, by its builder Irving Tjomsland of *Dean's Electronics* of Burbank. The demonstrator is actually an inside-out color set with all circuitry exposed to facilitate teaching the troubleshooting of such receivers. All circuits are unitized so

that various manufacturers' ideas and brand variations can be explored. The Society has announced a long-range teaching schedule using the demonstrator.

Recently, the University of Minnesota, through its Center for Continuation Study and the School of Business Administration, held a small business institute on the problems and needs of television service establishments. This three-day meeting was open to all and was strictly nontechnical for service engineers and service managers. It was presented through the cooperation of the Minnesota Television Service Engineers and the Small Business Administration of the United States Government. Some of the topics presented dealt with employer and employee relations, telephone techniques, legal problems, advertising, and public relations.

The Radio and Television Guild of Long Island has accelerated its promotion of the "Electronics Fair" to be held on December 6, 7, and 8 at the New York State University in Farmingdale, L. I. Exhibition space for interested manufacturers has been set up together with plans for color television promotion and lectures on many topics. According to the Guild, a preliminary poll of prospective exhibitors has been most gratifying. All booths are the same size but combinations are available. Address inquiries to Box 87, Bethpage, Long Island, New York. —30—

PHOTO CREDITS

Page	Credit
40, 41 (bottom)	Emerson Radio and Phonograph Corp.
41 (top), 173	Motorola Inc.
42	Admiral Corporation
43 (left)	British Industries Corp.
43 (center)	R. I. Mendels
43 (right)	Hartley Products Co.
49, 72, 73	Radio Corporation of America
50, 51	B & K Mfg. Co.
54	Futuramic Company
55	Simpson Electric Co.
57	Televex Co.
60, 61, 63, 65, 66, 140, 185	General Electric Company
68, 69	Zenith Radio Corporation
70, 190	International Rectifier Corporation
94, 95	Official U. S. Signal Corps Photo
100	American Bosch Arma Corp.
102	Bell Telephone Laboratories
154	Stromberg-Carlson
180	Signal Corps Engineering Laboratories

ERRATUM

In the article "A Portable Ultrasonic Protection System," which appeared on page 52 of our July, 1956 issue, it was indicated that the ultrasonic transducers and special transformers required for the system were available from Walter Kidde & Co., Inc. Although it was our understanding at the time the article was being prepared that such was the case, we have since been informed that they will not make these units available. We will endeavor to locate another source of supply for the transducers and transformers required, and, if we are successful, we will report the source at a later date. Meanwhile, if any of our readers know of such a source, we will be glad to pass this information on to others who have inquired.

INDEX OF Advertisers

OCTOBER 1958

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Classified

RATE: 50c per word. Minimum 10 words. December Issue closes October 10th, Send order and remittance to: RADIO & TELEVISION NEWS, 366 Madison Ave., N. Y. C. 17.

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 18 or 21 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

BUY Surplus transmitters, receivers, radar & electronic equipment. Direct from Government. List $1.00. Box 1842AW, Hartford 1, Connecticut.

MARINE Crystals by manufacturer since 1933. Quantity discounts. Airmail Service. C-W Crystals, Box 2065, El Monte, Calif.

HIGH Fidelity Equipment All Makes, Special Items. Barber & Howard, East Ave., Westerly, Rhode Island.

HAM Special! Johnson ¼ to ¼ flexible shaft coupling, bakelite insulated. 23/32 long, 13/16 square 3 for $1.00 ppd. Electronic Fasteners, 102 Warren St., N.Y.C.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

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.

DIAGRAMS—Radios, Amplifiers, Changers, $1.00 Each. Television Service Data $2.00. Unknown Models, Give Tube Layout And Part Numbers. Kramer's Radio Service, Dept. 656, 36 Columbus Ave., New York 23, N. Y.

COMPLETE Television Sets $11.95. Jones TV, 1115 Rambler, Pottstown, Pa.

FIRST 20 volumes Sam's Photofacts. Unused. $100 C.O.D. M. K. Meredith, Box 4023, Lubbock, Texas.

TRANSISTOR Kits. Free information. Transit Electronics, Box 15-N3, Alden Manor, Elmont, N.Y.

SERVICE time cut in half with Trouble Shooting Test Instrument made from old Television. $2.00. Sterling, 129 West Long Ave., New Castle, Pa.

WANTED

WANTED: ART-13 transmitters and parts—also ARC-1, ARC-3 and ARN-7. Have requirement for ARN-6 material, Iron Core Loops, need all types Collins and Bendix Aircraft Radio equipment. Florida Aircraft Radio & Marine, Inc. P. O. Box 205, International Airport Branch, Miami 48, Florida.

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. Box 50 % RADIO & TELEVISION NEWS.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. F. Gensler, W2LN1, 56 Crosby St., N. Y. 12N, N. Y.

AN/APR-4, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

WANTED: Receiver R5/ARN-7, MN-62A Transceivers, RT18/ARC-1, AN/ARC-3, BC-788C, I-152C, Collins, Bendix equipment, Test Sets, Dynamotors, Inverters. We pay highest prices. Advise quantity, condition, price first letter. Aircraft Radio Industries, Inc., 15 East 40th St., New York City, telephone LExington 2-6254.

CONCERTONE 1501 D (Direct-Drive) Tape-Recorder: W/C. Will Buy Best Offer. B. K. Balch, 611 Livingston Rd., Linden, N. J.

BC221's WANTED—Highest cash price for BC-221's paid even more if the unit has modulation and hasn't been tampered with. Original Book needed. Write giving Model No. to Bolton Laboratories, Inc., Bolton, Mass.

ANY Gear To Sell? Rex Pays Like—! Wanted—Surplus Military And Commercial Aircraft Electronics: BC-788, I-152, ARN-7, ARC-1, ARC-3, transmitters, receivers, test equipment, etc.! Wanted—Electronic Tubes: Broadcast, transmitting, receiving, Magnetrons, Klystrons, miniature, sub-miniature, ruggedized, etc! Top Prices Paid! For Fattest Checks—Sell to Rex! Write or phone description for immediate action. Bob Sanett, W6REX, 1524 S. Edris Drive, Los Angeles 35, Calif. Phones: REpublic 5-0215, CRestview 1-3856.

REPAIRS AND SERVICING

HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vesey St., N. Y. 7, N. Y. Ba. 7-2580.

TAPE RECORDERS

WHOLESALE! Recorders. Tapes. Phonographs. Radios. Catalogue 10¢. Towers-155, Philadelphia 5.

TAPE Recorders, Tape. Unusual Values. Free catalog. Dressner 69-02 R, 174 St., Flushing 65, N. Y.

CANADIANS! Let us quote on your tape recorder needs. Soundscription Service, 5239 Park Ave., Montreal, Que.

RECORDERS, Tape, Hi-Fi. Wholesale Prices. Catalogue. Klarston, 215 E. 88th St., N. Y. C. 28.

RECORDS

PHONOGRAPH Records Cheap. Catalogue. Paramount, ND-313 East Market, Wilkes-Barre, Penna.

BUSINESS OPPORTUNITIES

INDUSTRIAL Building For Sale. 150,000 sq. ft. Located in Greensboro, No. Car. Completely sprinklered and two high pressure boilers. Contact Robins and Weill, Inc., Southeastern Building, Greensboro, N. C.

CORRESPONDENCE COURSES

USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

USED Correspondence Courses and educational books bought, sold, rented. Free catalog. Educational Exchange, Menlo, Georgia.

USED Correspondence Courses, Educational Books Bought, Sold, Rented, Catalog Free. Vernon, 624 Mohawk, Rossville, Ga.

INSTRUCTION

STUDY at home for Commercial Radio Licenses. Free Sample lesson, very reasonable fee. Write Radio License Aids, 275 Dayless, Ft. Worth, Texas.

MISCELLANEOUS

LETTERHEADS, Repair Orders, Tags printed. Samples, prices free. Howprint, 723-K Eunice, Webster Groves, Missouri.

KITS assembled and wired. M. Vincek, 117 Center St., Clifton, N. J.

When you order by mail . . .
please print your name and address clearly, be specific in your order, enclose proper amount, allow ample time for delivery.

TUBE
SPECIALISTS to the WORLD

SELECT THE TUBES YOU NEED FROM ONE OF THE MOST COMPLETE TUBE INVENTORIES IN THE WORLD

RECEIVING TUBES

0A2	.69	6AD7G	1.50	6L6G	.98
0A4G	.95	6AF4	1.23	6L7	.95
0B2	.65	6AF6G	.85	6N7	.89
0Z4	.49	6AG5	.72	6Q7	.85
1A3	.68	6AG7	.98	6Q7GT	.79
1A7	.52	6AH4	.85	6R7	.85
1AD4	1.20	6AH6	.85	6R7GT	.68
1AE4	.92	6AJ5	1.49	654	.57
1AX2	.95	6AK5	.69	658GT	1.05
1B3GT	.79	6AK6	.75	65A7	.79
1C5GT	.52	6AL5	.58	65A7GT	.79
1G4	.65	6AL7	.95	65B7Y	.87
1G6GT	.49	6AM4	1.50	65C7	.72
1H5GT	.58	6AM8	1.10	65F5	.72
1J6GT	.69	6AN4	1.50	65F5GT	.69
1L4	.74	6AN5	2.75	65F7	.92
1L6	.79	6AN8	1.15	65G7	.65
1LA4	.79	6AQ5	.57	65H7	.74
1LA6	.85	6AQ6	.57	65H7GT	.59
1LB4	.85	6AQ7	1.15	65J7	.69
1LC5	.79	6AR5	.70	65J7GT	.59
1LC6	.79	6AR6	2.15	65K7	.64
1LD5	.85	6AS5	.70	65K7GT	.59
1LE3	.79	6AS6	1.95	65L7GT	.75
1LG5	.85	6AS7G	2.35	65N7GT	.75
1LH4	.85	6A58	1.15	65Q7	.59
1LN5	.79	6AT6	.52	65Q7GT	.59
1N5GT	.59	6AT8	1.05	65R7	.55
1Q5GT	.95	6AU4	1.05	6557	.75
1R4	.65	6AU5	1.10	65T7	.95
1R5	.65	6AU6	.65	6T8	.95
154	.65	6AU7	.85	6U5	.85
155	.65	6AV5	1.20	6U8	.95
1T4	.65	6AV6	.53	6V3	1.25
1T5	.69	6AX4	.79	6V6	1.10
1U4	.67	6AX5	.69	6V6GT	.59
1U5	.59	6B4G	.95	6W4GT	.65
1V	.65	6B8	.67	6W6GT	.79
1V2	.59	6BA6	.63	6X4	.48
1V6	1.49	6BA7	.85	6X5GT	.49
1X2A	.85	6BC4	1.50	6X8	.95
2A3	.95	6BC5	.68	6Y6G	.89
2A6	.59	6BC7	1.20	7A4	.79
2X2	.49	6BD5	1.35	7A5	.69
2X2A	1.35	6BD6	.73	7A6	.78
3A3	1.05	6BE6	.65	7A7	.75
3A4	.50	6BF5	.82	7A8	.75
3A5	.64	6BF6	.68	7AD7	1.65
3AL5	.65	6BG6G	1.75	7AF7	.89
3AU6	.70	6BH6	.79	7AG7	.95
3AV6	.60	6BJ6	.69	7AH7	.95
3B4	2.95	6BK5	.95	7B4	.75
3B7	.39	6BK7	1.05	7B5	.65
3BC5	.80	6BL7	1.05	7B6	.75
3BN6	1.05	6BN6	1.10	7B7	.75
3BY6	.75	6BQ6GT	1.15	7B8	.85
3CB6	.80	6BQ7A	1.15	7C5	.75
3CF6	.85	6BX7	1.20	7C6	.75
3D6	.39	6BY5G	1.25	7C7	.79
3LF4	.85	6BZ7	1.20	7E7	1.15
3Q4	.65	6C4	.38	7F7	.85
3Q5	.75	6C5	.48	7F8	1.10
354	.65	6C5GT	.46	7G7	1.10
3V4	.69	6C6	.49	7H7	.79
4BQ7A	1.30	6C8G	.85	7J7	1.25
4BZ7	1.35	6CB5	4.40	7K7	1.15
5AM8	1.05	6CB6	.68	7L7	1.10
5AN8	1.10	6CD6G	1.75	7N7	.85
5AQ5	.75	6CF6	.90	7Q7	.95
5AS8	1.10	6CG7	.85	7R7	.95
5AT8	1.10	6CL6	1.10	7V7	.95
5AV8	1.15	6CM6	.85	7W7	.95
5AW4	1.10	6C56	.75	7X7	.90
5AZ4	.60	6CU6	1.30	7Y4	.65
5J6	.90	6D6	.59	7Z4	.65
5R4GY	1.45	6DC6	.95	12A4	.85
5T4	.90	6E5	.75	12A6	.57
5U4G	.58	6F5	.59	12A8GT	.79
5U8	1.10	6F6	.85	12AH7GT	1.05
5V4G	.88	6F6GT	.69	12AL5	.65
5V6GT	.70	6F7	.85	12AQ5	.70
5W4GT	.65	6F8G	.72	12AT6	.48
5X4G	.75	6G6G	.72	12AT7	.92
5X8	1.05	6H6	.59	12AU6	.62
5Y3GT	.49	6H6G7	.49	12AU7	.75
5Y4G	.65	6J4	2.55	12AV6	.52
5Z3	.69	6J5	.48	12AV7	.95
5Z4	.89	6J5GT	.47	12AW6	.95
6A3	.95	6J6	.68	12AX4	.85
6A6	.82	6J7	.82	12AX7	.78
6A7	.89	6J7GT	.65	12AY7	1.15
6A8	1.05	6K6GT	.65	12AZ7	.85
6A8GT	.95	6K7	.74	12B4	.85
6AB4	.59	6K7GT	.59	12BA6	.60
6AB7	.95	6K8	1.10	12BA7	.89
6AC5	1.05	6K8GT	.95	12BD6	.70
6AC7	.85	6L6	1.69	12BE6	.65
12BF6	.60	14B6	.69	35W4	.44
12BH7	.89	14C7	.95	35Y4	.65
12BK5	.95	14E6	1.05	35Z3	.65
12BQ6GT	1.35	14E7	1.15	35Z5	.44
12BY7	.90	14F7	.85	41	.75
12BZ7	.95	14F8	1.10	42	.69
12C8	.69	14H7	.85	43	.79
12CU6	1.35	14N7	.85	50A5	.68
12H6	.59	14Q7	.85	50B5	.68
12J5GT	.65	14R7	1.20	50C5	.68
12K7GT	.85	14S7	1.10	50L6	.62
12K8	.69	14W7	1.25	50X6	.85
12Q7GT	.75	19BG6G	1.89	50Y6	.78
125A7	.69	19T8	.95	50Y7	.78
125A7GT	.69	25AV5	1.25	53	.92
125C7	.75	25AX4	1.05	70L7	1.15
125G7	.79	25BK5	.95	75	.65
125H7	.65	25BQ6GT	1.25	77	.47
125J7	.65	25CD6G	1.75	78	.57
125K7	.69	25CU6	1.30	80	.59
125L7	.85	25L6GT	.65	81	1.85
125N7	.75	25W4GT	.72	83	.95
125Q7	.59	25Z5	.25	83V	.95
125R7	.59	25Z6	.62	84/6Z4	.49
12V6GT	.73	30	.65	117L/M7	1.95
12W6GT	.87	32L7	.85	117N/P7	1.85
14A4	.95	35A5	.68	117Z3	.68
14A5	1.30	35B5	.68	117ZY4	1.05
14A7	.75	35C5	.68	117Z6	.95
14AF7	.95	35L6	.65		

CASH for YOU!

We urgently need for government contracts military electronic equipment, such as: BC312, BC342, BC348, ART13, APR4, ARC1, ARC3, ARN6, ARN7, BC221, BC788, BC610, and many others. State conditions, type and best price.

TRANSMITTING TUBES

0A3/VR75	.86	2D21W	1.95	4X150A	22.45
0B3/VR90	.73	2E22	3.15	4X150G	31.95
0C3/VR105	.68	2E24	2.40	5BP1	2.35
0D3/VR150	.68	2E26	3.25	5BP4	1.95
1B22	1.25	2E30	1.55	5C22	27.50
1B23	2.68	2G21	2.45	5CP1	1.95
1B24	4.85	2J31	14.00	5CP1A	8.45
1B27	12.95	2J32	12.50	5CP7	7.95
1B35	3.45	2J33	14.00	5D21	7.45
1B38	33.50	2J34	14.00	5FP7	1.20
1B40	3.45	2J36	14.95	5J29	29.50
1B41	3.75	2J51	97.50	5J30	17.25
1C21	1.89	2J55	39.50	5J33	6.95
1N21	.39	2J61	12.95	5JP1	12.45
1N21B	1.45	2J62	12.95	5JP2	6.35
1N23	.68	2K23	15.25	5JP5	9.95
1N23B	1.40	2K25	11.95	5LP1	7.40
1N34	.42	2K28	27.50	5NP1	4.95
1N34A	.48	2K33A	56.90	6AC7W	1.45
1P21	29.50	3AP1	2.90	6AK5W	1.45
1P22	13.25	3B24	.95	6AL5W	.95
1P23	1.85	3B24W	4.95	6AQ5W	1.70
1P24	1.45	3B25	4.95	6AS6W	2.69
1P25	64.50	3B26	7.45	6BF7W	3.45
1P28	8.95	3B27	3.45	6C4W	6.75
1P30	1.95	3B29	5.95	6C21	14.95
1P32	.95	3BP1	2.45	6F4	2.65
1P39	1.45	3C22	59.50	6J4WA	4.45
1P40	1.25	3C23	3.45	6J5WGT	3.90
1P41	2.45	3C24	1.26	6J6W	2.20
1P42	2.35	3C45	5.95	6J6WA	3.90
2AP1	4.95	3D21A	2.95	6K4	2.20
2B22	1.95	3DP1	3.25	6SN7WGT	1.85
2C21	.39	3E29	9.00	6X4W	1.20
2C34	.25	4-65A	13.25	6X5W	1.35
2C36	21.50	4-125A	18.95	7BP7	4.45
2C39A	10.95	4-250A	29.50	12DP7	14.95
2C40	9.45	4C27	3.25	15E	1.45
2C43	10.25	4C28	17.45	15R	.49
2C52	2.95	4C35	13.45	28D7	.95
2C53	10.75	4E27	7.95	100TH	6.25
2D21	.65				

100TL	8.25	885	.95	5829	1.35
211	.45	902	2.45	5840	4.40
249B	2.95	918	1.65	5841	7.40
249C	1.95	923	1.25	5844	.95
250TH	18.95	925	1.50	5851	3.45
250TL	14.75	927	.95	5876	12.50
262B	4.95	930	1.19	5879	1.25
274A	3.45	931A	2.95	5881	2.95
274B	.85	954	.25	5886	3.25
304TH	7.95	955	.35	5894	15.95
304TL	9.95	956	.35	5896	4.45
307A	1.10	957	.35	5899	3.95
350A	2.65	958A	.35	5902	5.95
350B	2.35	959	1.32	5905	8.75
371B	.85	991	.29	5906	14.95
393A	4.50	1603	2.95	5908	7.85
WL417A	2.95	1616	.50	5932	3.95
417A/5842	12.45	1619	.30	5933	2.25
434A	2.95	1622	1.45	5963	5.45
450TH	47.50	1624	.95	6021	4.45
450TL	35.00	1625	.29	6080WA	7.95
575A	9.95	1626	.19	6096	1.45
705A	.68	1633	.85	6097	1.45
707A	4.95	1635	1.48	6098	1.85
707B	3.95	1641	1.35	6099	1.35
715B	2.95	1654	1.75	6101	1.45
715C	10.95	2050	1.25	6113	1.25
717A	.35	2051	.65	6146	4.75
721A	.65	5516	6.45	6161	69.50
723A/B	8.45	5517	1.65	6187	3.95
725A	2.95	5634	6.95	6189	2.25
726A	4.95	5636	2.90	6263	11.45
726B	32.50	5637	4.95	6264	11.45
726C	32.50	5638	7.45	6539	2.95
750TL	65.00	5639	8.95	8005	4.75
801A	.38	5641	5.95	8008	3.95
802	2.45	5642	.95	8012	.98
803	1.40	5643	5.95	8013	2.65
804	8.85	5647	3.95	8013A	3.75
805	3.95	5651	1.35	8014	67.50
806	4.85	5654	1.25	8020	1.25
807	1.18	5656	7.90	8025	1.45
808	1.25	5670	1.10	9001	.82
809	2.20	5675	10.95	9002	.60
810	10.50	5676	1.25	9003	1.20
811	2.75	5678	.89	9004	.35
811A	3.25	5686	1.95	9005	1.39
812	2.75	5687	2.65	9006	.25
812A	3.25	5692	5.10	C1JA	10.95
813	10.50	5693	4.65	C6J	7.95
814	1.95	5696	.90	CK1005	.32
815	1.95	5702	1.95	CK1006	3.45
816	1.15	5703	.95	CK1007	.65
826	.65	5704	1.85	CK1038	4.70
828	7.42	5718	2.75	CK1039	4.70
829B	7.95	5718A	4.75	F123A	2.75
830B	.65	5719	2.15	F127A	22.50
832	5.75	5725	1.45	F128A	14.95
832A	7.95	5726	.60	FG17	3.50
833A	42.50	5727	1.25	FG27A	10.90
836	1.45	5732	2.95	FG32	3.95
837	1.25	5744	1.75	FG95	17.50
838	.69	5751	1.45	FG105	12.95
845	4.85	5762	99.50	FG172	17.95
851	8.95	5763	1.25	HF100	6.95
860	2.75	5783	4.45	HF200	9.95
861	12.95	5787CK	4.95	HF300	17.50
866A	1.15	5794	5.95	WL616	47.50
872A	1.25	5812	2.70	RK65	7.50
876	.72	5814	.95	RK72	.50
878	.48	5819	32.50	RX21	5.50
884	.95	5820	495.00	TZ40	3.50
		5823	1.35		

2" SIZE METER SPECIALS

0— 10 D.C. VOLTS	2.95
0— 40 D.C. VOLTS	2.95
0—100 D.C. VOLTS	2.95
0—150 D.C. VOLTS	2.95
0—300 D.C. VOLTS	2.95
0—500 D.C. VOLTS	2.95
0— 25 D.C. MILLIAMMETER	2.95
0— 50 D.C. MILLIAMMETER	2.95
0—100 with 300 mill SCALE	2.95
0—500	2.95

TERMS: cash with order or 25% deposit—balance C.O.D. 10 days net to rated accts. All prices F.O.B. our warehouse.

Special Quantity Discounts.

All Inquiries Answered Promptly

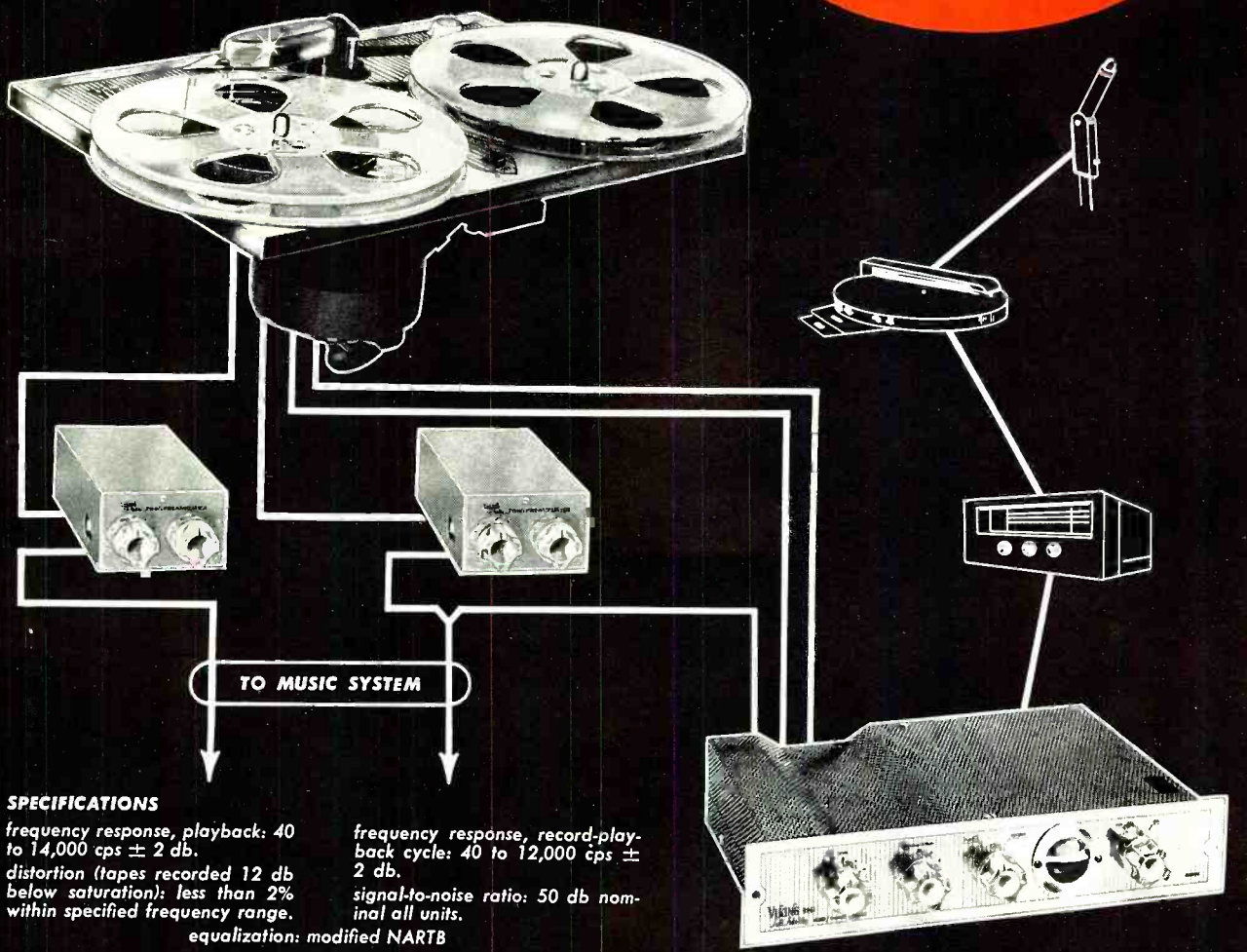
WE SHIP TO ALL THE WORLD. CORRESPONDENCE IN ALL LANGUAGES. CABLE ADDRESS: HAMSHACK NEW YORK

RADIO HAM SHACK, Inc.

370 Greenwich Street, New York 13, N. Y. Telephone CAnal 6-8446

PRINTED IN U.S.A.

STEREOPHONIC? ✓
MONAURAL ERASE RECORD? ✓
EXTENDED RANGE? ✓



SPECIFICATIONS

frequency response, playback: 40 to 14,000 cps ± 2 db.

distortion (tapes recorded 12 db below saturation): less than 2% within specified frequency range.

frequency response, record-playback cycle: 40 to 12,000 cps ± 2 db.

signal-to-noise ratio: 50 db nominal all units.

equalization: modified NARTB

The Viking FF75SR deck provides in-line heads for playback of stereophonic tapes. It provides half track erase and record/playback heads for extended range monaural recording and playback.

Use the FF75SR with a single RP61 Record/Playback Preamplifier and two PB60 Playback Preamplifiers as shown. This combination provides for professional quality recording from microphone, phono and radio sources, plus extended range reproduction of stereophonic tapes.

This same deck may be used with a pair of matched stereophonic record/playback preamplifiers (RP61 and slave amplifier, RP61-S) to provide monaural erase-record operation, **stereophonic recording of bulk erased tapes** and playback of stereo tapes.

Viking OF MINNEAPOLIS

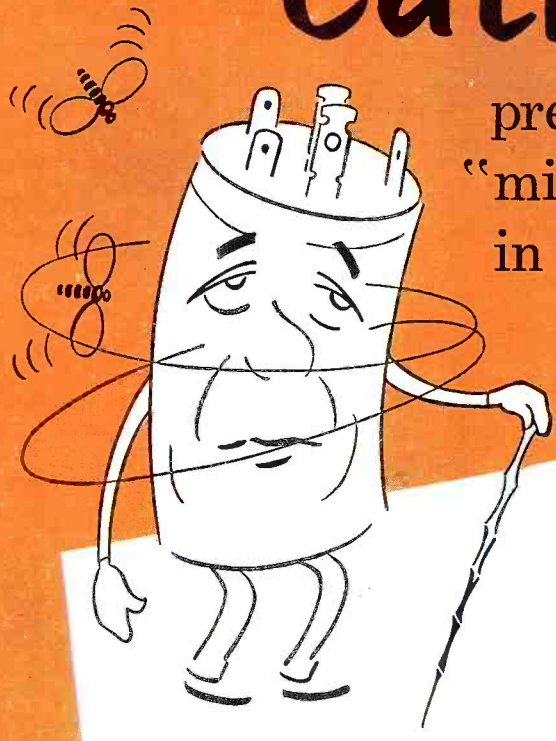
9600 Aldrich Avenue South, Minneapolis 20, Minnesota

EXPORT DIVISION: 23 Warren Street, New York City 7, New York
Cable: SIMONTRICE, NEW YORK (All Codes)

. . . another
MALLORY
service-engineered
product

Etched Cathode

prevents "middle age hum" in capacitors



Do your capacitors have etched cathodes? If not, chances are they are developing "middle age hum"—may cost you some dissatisfied customers.

All Mallory FP's, and all popular Mallory metal and cardboard tubular electrolytics, have etched cathodes—at no extra cost to you. Ask your Mallory distributor why this is important . . . or write directly to us.

P.R. MALLORY & CO. Inc.
MALLORY

P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

• Capacitors • Vibrators • Resistors • Controls • Switches
• Rectifiers • Power Supplies • Filters • Mercury Batteries