ELECTRONICS WORLD

Formerly RADIO & TV NEWS

JULY, 1959
50 CENTS

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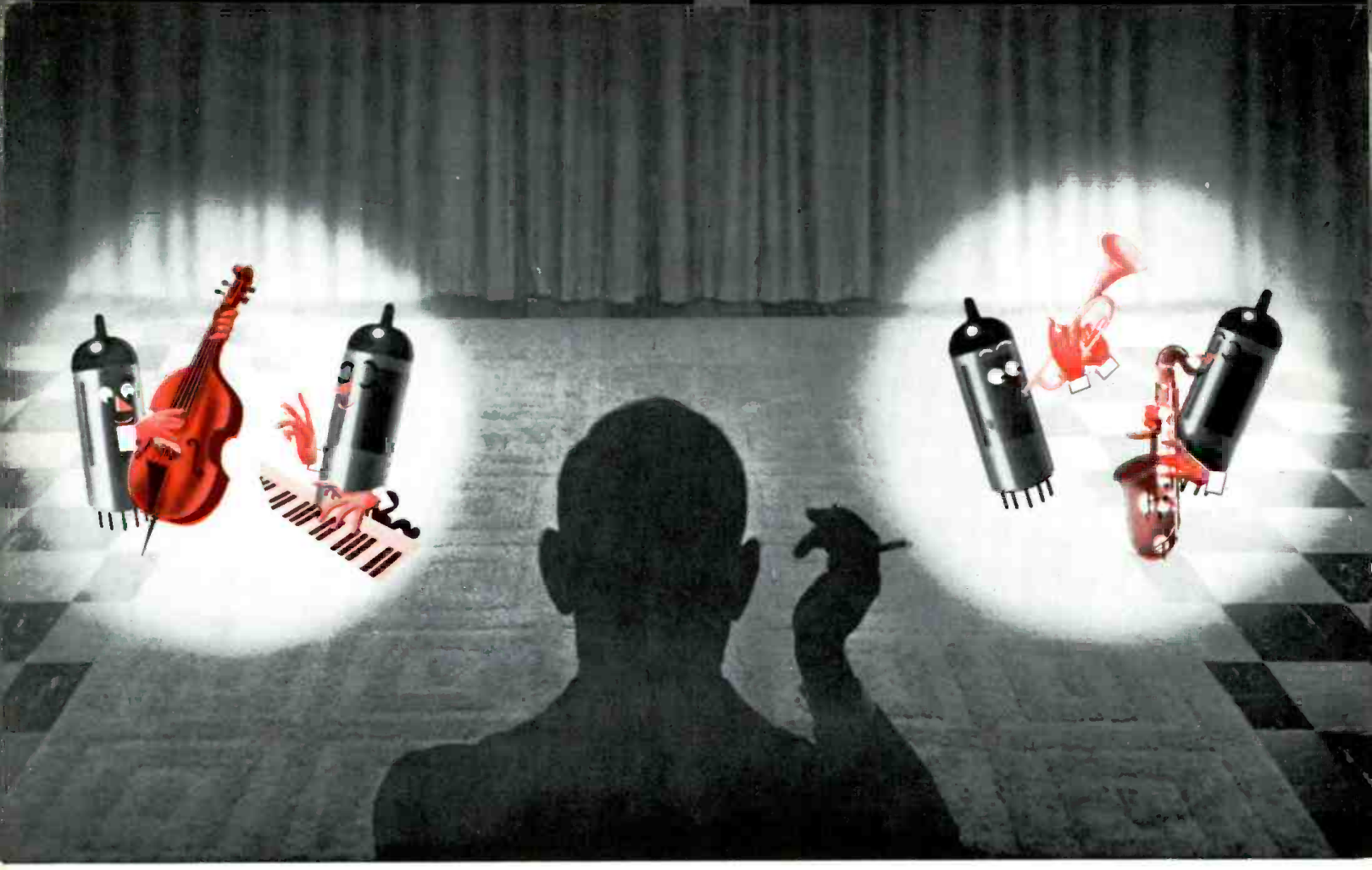

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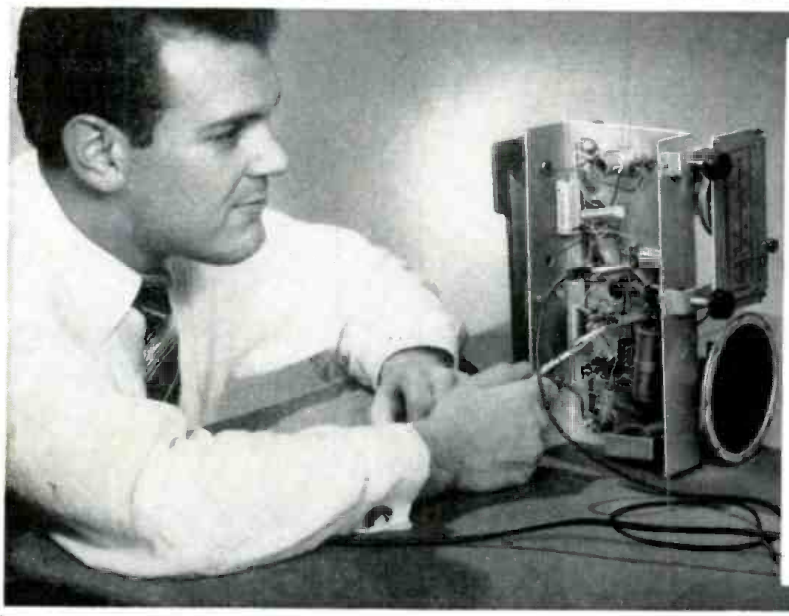

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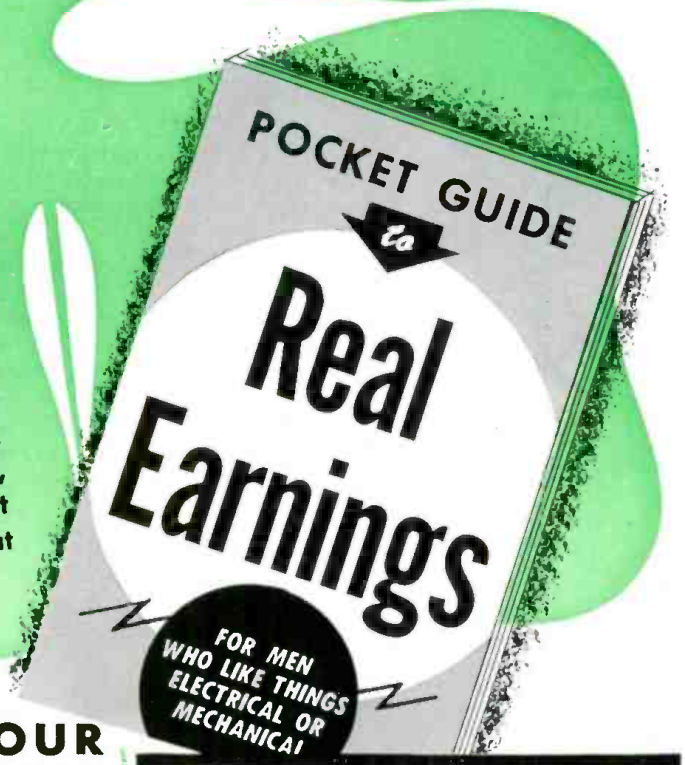

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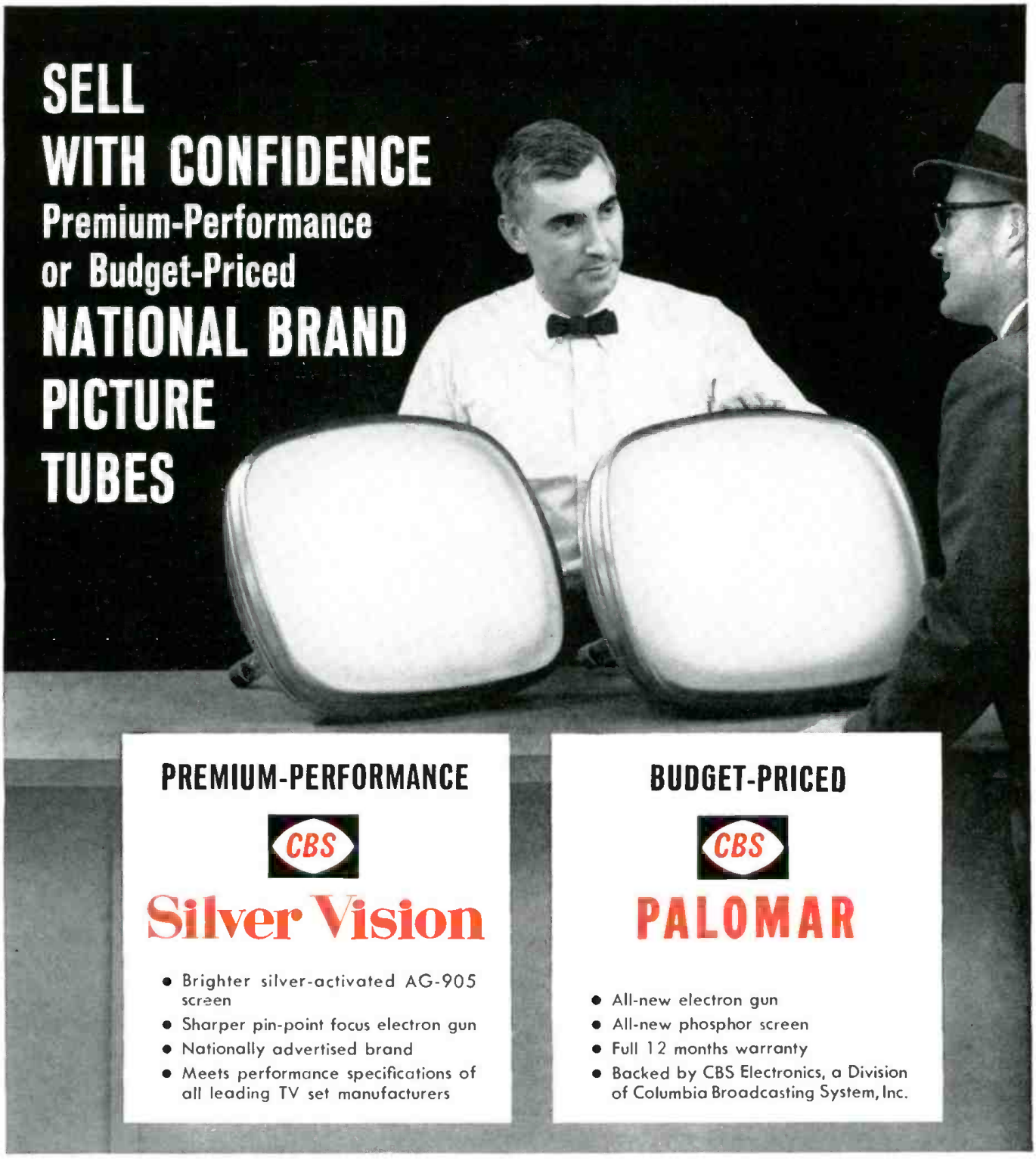

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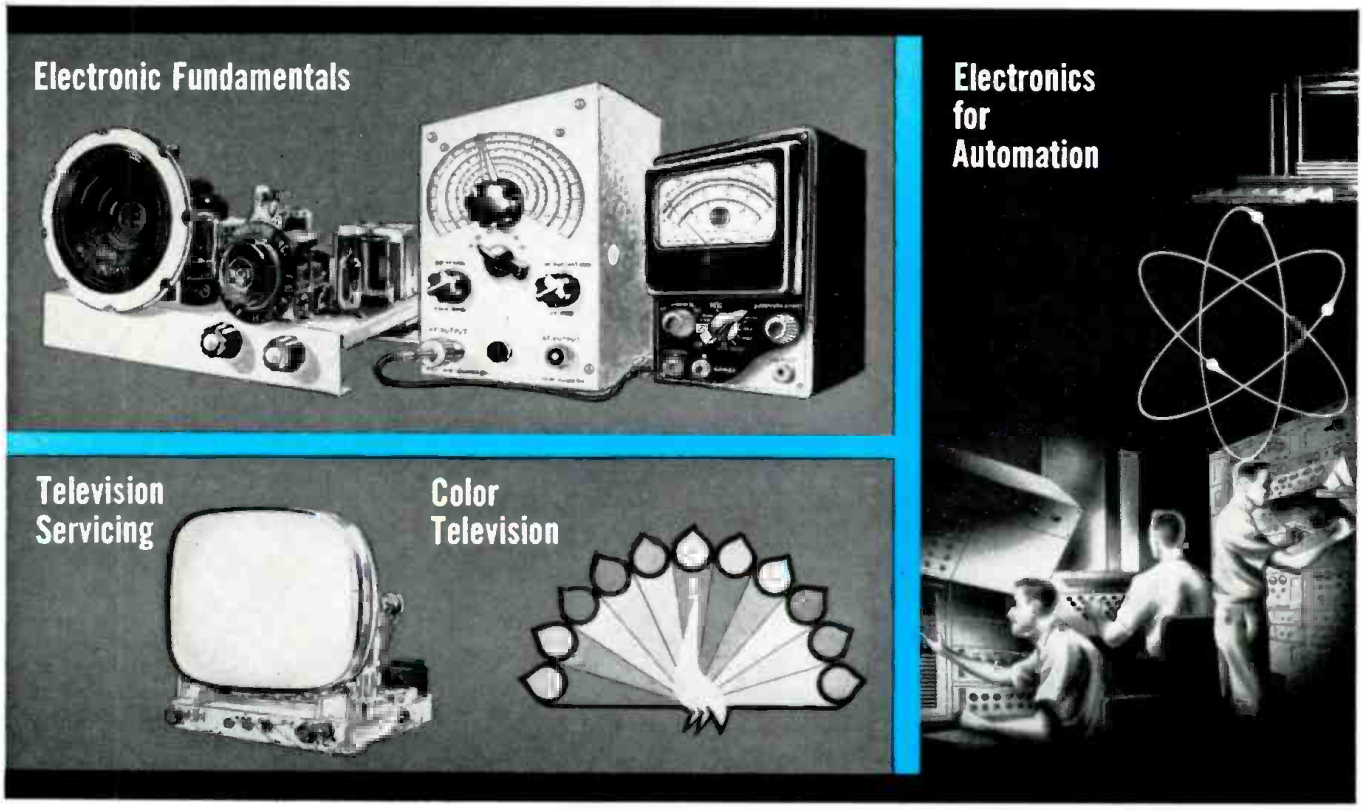

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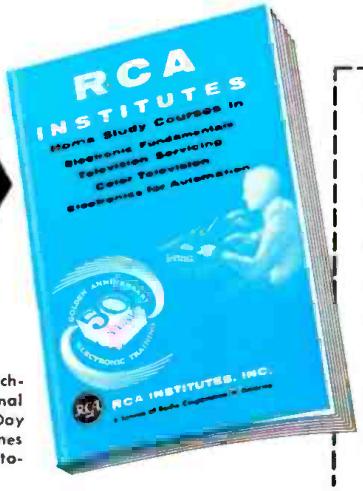

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...for the Record

By **W. A. STOCKLIN**
Editor

FORTY YEARS YOUNG

THIS month marks our fortieth year of service to the electronics industry and to the professionals who have helped to make it one of this country's economic giants, ranking fifth among manufacturing enterprises in the U. S. In a mere twenty years our industry has grown from a modest $340-million dollar enterprise to an impressive $7.9-billion dollar field. No growth of this magnitude could have been achieved without the intelligent interest and wholehearted support of electronics professionals.

When this magazine made its debut in 1919, electronics was in its infancy although Lee de Forest's "audion" was 13 years old at the time. Even at this early date a small and dedicated group of technicians and "wireless" men was moving into the field to form the nucleus of the profession as we know it today. From these modest beginnings emerged the techniques and "know-how" that have given the United States its commanding lead in electronics—and its enviable reputation throughout the world.

By present-day standards, the professional technician of 1919 probably seemed very much of the "pioneer" with his makeshift test equipment and home-built replacement parts, but the Yankee ingenuity behind the miracles he was able to perform with the radio equipment of the day is an awesome thing to contemplate in this area of well-stocked distributor shelves and exact replacements. Even at that early date RADIO NEWS was providing a solid core of technical material to help the man in the field do his job faster and better. This same attention to the needs of the individual in electronics has carried over to the present day although the magazine itself, like the industry it serves, has moved through a series of metamorphoses which has involved three changes in our title, several complete revisions of format, and alterations in our editorial emphasis to reflect the important advances of the industry it covers.

Today's electronics professional is a far cry from his earlier counterpart. Most of the men in service work today have had formal technical training and work with test equipment which formerly wouldn't have existed or would have been reserved only for the most advanced laboratories. This impressive line-up of "know-how" and equipment is involved in the task of installing, maintaining, and repairing a staggering amount of electronic gear whose very existence couldn't have been anticipated even ten years ago!

The exciting developments we have witnessed during the years we have been serving as your reporter of and guide to things electronic add up to a meaningful segment of history itself. From the early days of crystal sets and spark-gap transmitters to the 21-inch cyclops in every living room and world-wide instantaneous communications networks is an evolution within the memories of many of us in the industry although a very-much-taken-for-granted development in the eyes of the younger generation. If you don't believe that this is truly the "electronics age," watch the casual way that mere infants tune in their favorite TV programs or play their phonograph records on Daddy's elaborate hi-fi set-up. The presence of a wide variety of electronic gadgets in the American home is an accepted fact to most modern youngsters—electronics has been a part of their lives as long as they can remember and, as the new and more exciting products make their appearance, these will be assimilated in the same off-hand manner.

In a like vein, the electronic wonders of the "space age" will come to be looked upon as natural and logical progressions inherent in the era in which we live.

Although electronics has been our business for forty fruitful years, we have managed to retain our respect and appreciation for the impressive work that has been done in this field —and we hope that we are still able to convey this spirit of discovery and appreciation to our readers—"insiders" and professionals though they may be. We are dedicated to the task of keeping you abreast of every facet of our field and to that end will continue to provide the information you need to do the job for which the electronics industry is so eminently qualified.

So, again, in this our fortieth anniversary year, we re-pledge our efforts to your service and to the industry with which we are proud to be associated.

—30—

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The new Phoenix-Flagstaff link illustrates again how Bell System engineers work together to improve telephone service. Back of their efforts is the constant development of new communications systems at Bell Telephone Laboratories.

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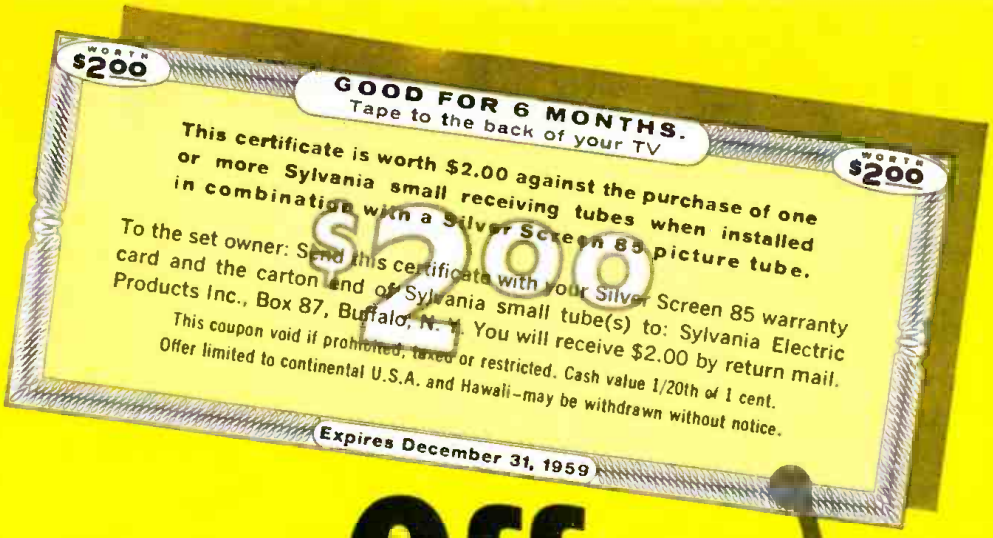

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TV INTERFERENCE CHART

To the Editors:

In the March, 1959 issue, your gatefold entitled "TV Spectrum and Interference Chart" was one of the most informative pieces of material I have ever come across in any of the varied radio and electronics magazines.

Since I am a ham, and am operating on six meters, I was very glad to see this particular gatefold. The article was worth twice the price of the magazine to me.

ROBERT ISAACS, Instructor
U. S. A. Signal School
Fort Monmouth, New Jersey

Thanks to Reader Isaacs and to our many other readers who have written in to compliment us on the gatefolds that have been appearing in recent issues. We are planning more for the future.—Editors.

* * *

MONO VS STEREO

To the Editors:

After reading Leonard Feldman's feature on "The Case for A Third Channel" (March issue), I sincerely wonder exactly where this stereo age will end. Could it be that in future years the home owner will invite his visitor *inside* his infinite baffle to hear speakers mounted on five walls of this "listening room," and each speaker connected to a different channel?

Stereo listening can be better than monophonic listening only in certain instances. Small bands, etc., are all right for stereo recording; slight improvement can even be noticed in large orchestras when one hears the violins on his left and the lower instruments on his right. When one records a singer, however, and claims that a sense of direction is attained, it is just too much. Direction should not be a factor when all the sound originates from one point in the first place.

DOUG QUAYLE
Ridgewood, New Jersey

To the Editors:

I must take issue with some of the sweeping statements and predictions of things to come in the world of stereo made by various authors of articles in the otherwise enjoyable February issue. For example, the following statement appears. "By 1962 the changeover to stereo should be virtually complete, with monophonic records going the way of 78's today."

I agree that in some respects stereo is superior to mono sound, but cannot agree that mono records are on the way out. I believe that co-existence is possible and probable.

Surely there are other music lovers who believe as I do that there will always be mono records available for people who wish to listen to the musical qualities of a composition and disregard the "special effects." If there are, I certainly would enjoy hearing from them.

WILLIAM E. ELLIOTT
P. O. Box 294
El Cajon, California

It is hard to believe that the record industry can successfully market both mono and stereo records economically. There certainly is the possibility of the industry going completely over to stereo. On the other hand, there are some who definitely go along with Reader Elliott's point of view. To know for sure, we will just have to wait and see.—Editors.

* * *

COLOR ORGANS

To the Editors:

Your February issue carried a reader's letter referring to the Photorhythmicon which was described in your magazine of last August. The letter told of a similar apparatus made in Brazil, which the inventor termed a color organ.

The designation "color organ" is often used loosely and incorrectly to describe anything that throws colored lights on and off, even to blink them as the Photorhythmicon does. Because there is wide interest in the use of color illumination for esthetic purposes, I believe that some attempt should be made at correct semantics—that the term "color organ" should be properly defined.

An "art of light" has long been dreamed about. This art would give enjoyment to the eye as music does to the ear. It would be based on color, form, and motion, and the effects would usually be seen on some type of screen surface. Neon light patterns used in advertising signs as well as blinking lights of any kind that are in general use are interesting and intriguing, but fall far short of exemplifying an art. A "color organ" should be an apparatus that houses a source or sources of light, color filters, controls, etc. to produce visual effects that meet artistic standards. Under these conditions, this term may be used until a better one is found.

There is much to be done to make this art available and generally understood. The many interested experimenters should know just what they are aiming at. Efforts in the right direction will get results, and everyone who finds a new way to blink a colored

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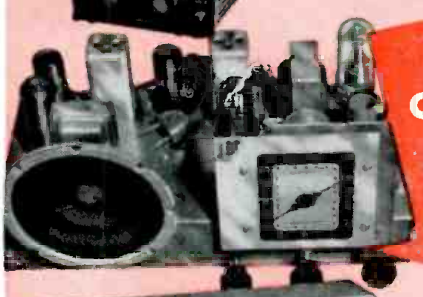
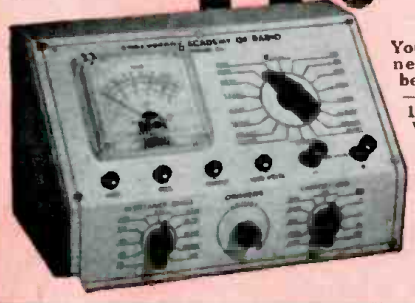
- Now offered . . . this fine modern oscilloscope.
- You build this powerful two-band superheterodyne radio receiver.



Big New CATALOG AND Sample Lesson FREE!



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

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

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

Complete Facts Free—Act Now; Offer Limited

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

HOME STUDY TRAINING IN SPARE TIME

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

LET US PROVE HOW EASILY YOU CAN LEARN!

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

SPRAYBERRY Academy of Radio-Television

1512 Jarvis Avenue, Dept. 25-X, Chicago 26, Illinois

Mail This Coupon Now—No Salesman Will Call

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

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

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

ADDRESS.....

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

light will not think he has built a "color organ."

CHARLES E. SINGLETARY
Luminola Laboratories
Chicago 14, Illinois

* * *

WHEN YOUR SET NEEDS SERVICE

To the Editors:

Your editorial "When Your Set Needs Service" (April, 1959 issue) is very good, but you didn't mention at least two other important facts.

You work up the idea that the set owner is suspicious of the technician, but you don't confront your reader with the fact that the technician may also be suspicious. He knows that a certain percentage of set owners is dishonest. He has a "deadbeat" list to prove it. You also wisely suggest that the customer ask for an itemized bill. but you neglect to advise him to be prepared to pay the amount due when it is presented or make a satisfactory credit arrangement beforehand.

I'm sure that you will agree that it could easily be established that honest service technicians have been cheated out of many, many more dollars by dishonest set owners than set owners have been by dishonest technicians. I'll be the first to agree that a very high percentage of set owners is appreciative and 100 per-cent honest—but the same is also true of service technicians.

GLENN W. GODSHALK
Three Rivers, Michigan

We have, of course, been aware of this other side of the picture, as a great deal of material we have run in recent years will substantiate. These points were not mentioned in the editorial simply because, for a change, that particular effort was directed to set owners rather than technicians.

The only sensible conclusion we can draw is this: the trouble with both set owners and set repairers is that a few bad actors in each group give an unjustified poor reputation to that group. —Editors.

* * *

CITIZENS BAND TRANSCEIVER

To the Editors:

I've had it. The Citizens Band transceiver on page 49 of the March issue did it. The transmitter section works fine, but the receiver section is for the birds. I've tried everything. My wife is ready to divorce me. Please help me!

H. I. SCHUMAKER
Los Angeles, California

For those of our readers who are having some difficulty with the receiver portion of the Citizens Band transceiver, we would suggest the following modifications.

Increase the number of turns on RFC_1 from 50 to 75 or simply shunt the original 50-turn coil with 25-30 μμf. capacitor. Add a 330-μμf. capacitor between pin 2 of V_{1B}, the first audio stage, to ground, if audio oscillation is the problem.

Note also the heater connections for V_2 are pins 3 and 4, and not 4 and 5, as shown.—Editors. —30—

Opportunities in Electronics

Do you know how you can convert your present electronics knowledge into a profitable and interesting career in any of the fields listed here?

Thousands of interesting well paid jobs in electronics must be filled. To fill such jobs, you need sound technical training. An FCC license is convincing proof of technical skill. Send for the three Cleveland Institute booklets offered here. They explain how you can prepare for an interesting and profitable career in electronics. Mail the coupon today—no obligation.

Find out how modern technical training and a Government License (FCC) can lead to profitable employment in any branch of electronics.

good training doesn't cost—it pays!

- **Radar**
- **Guided Missiles**
- **Broadcasting**
- **Aeronautical Electronics**
- **Computers**
- **Automation**
- **Industrial Electronics**
- **Home Electronics**

Send for these 3 FREE Booklets

Accredited by the National Home Study Council

Cleveland Institute of Radio Electronics

Desk RN-31 — 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 .....

RN-31

Top Performers in Satellites
. . . and in Transistor Radios

Mallory Mercury Batteries

In U.S. satellites and space probes, Mallory Mercury Batteries have been selected to power the radio transmitters that send vital data from outer space. The same reasons they were chosen for this exacting duty make Mallory Mercury Batteries your best choice for replacement in transistor radios.

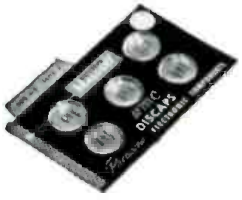
Long life . . . in Explorer I, they lasted twice as long as anticipated. In transistor radios, they outlive ordinary batteries by as much as five times!

Steady power . . . unlike ordinary batteries which gradually "fade", Mallory Mercury Batteries stay at full strength for their entire long life.

Miniature size . . . this unique battery packs tremendous energy in a tiny, compact package.

Mallory also manufactures a complete line of Zinc-Carbon batteries with the same quality and dependability of Mallory Mercury Batteries. Your distributor has a stock of sizes of both Mercury and Zinc-Carbon batteries to fit all popular radios. See him today.

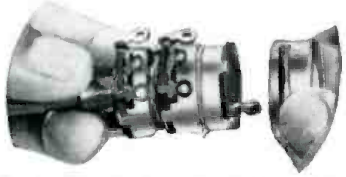
Mallory GEMS—five tubular capacitors in easy-to-use dispenser; best bet for outstanding service in buffer, by-pass or coupling applications.



RMC Discaps®—another veteran of outer space, and long the original equipment standard, Discaps are now available for replacement in handy "file card" five pack.

®*Registered Trademark of Radio Materials Company, a P. R. Mallory & Co. Inc. Subsidiary.*

Gold Label* Vibrators—for longer, more trouble-free radio servicing, especially on critical jobs. Feature exclusive buttonless contact design for longer, quieter service.



Sta-Loc* Controls—new design enables your distributor to custom-build the exact replacement in just 30 seconds, eliminates waiting for out-of-stock controls.

**Trademark*

P.R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Learn Electronics

PREPARE FOR YOUR F. C. C. LICENSE—YOUR TICKET TO A BETTER JOB AND HIGHER PAY!

F.C.C. LICENSE—THE KEY TO BETTER JOBS

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

WHICH LICENSE FOR WHICH JOB?

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

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

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

GRANTHAM TRAINING PREPARES YOU

The Grantham Communications Electronics Course prepares you for a *FIRST CLASS* F.C.C. license, and it does this by TEACHING you electronics. Each point is covered simply and in detail, with emphasis on making the subject easy to understand. The organization of the subject matter is such that you progress, step-by-step, to your specific objective—a first class F.C.C. license.

CORRESPONDENCE OR RESIDENCE CLASSES

Grantham training is available by correspondence or in resident classes. Either way (residence or correspondence), we train you quickly and well—no previous training required. Even a beginner may qualify for his first class license in a relatively short time.

FOUR COMPLETE SCHOOLS: *To better serve our many students throughout the entire country, Grantham School of Electronics maintains four complete Divisions—located in Hollywood, Calif., Seattle, Wash., Kansas City, Mo., and Washington, D.C. All Divisions of Grantham School of Electronics offer the same rapid courses in F.C.C. license preparation, either by home study or in resident classes.*

This booklet **FREE!**

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

Upgrade Your Income with a First Class

F. C. C. LICENSE

HERE'S PROOF...

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

	License	Weeks
Donald E. Mason, 2659 Centinella, Santa Monica, Calif.	1st	12
Everett T. Bozard, 411 N. Wash. St., Alexandria, Va.	1st	12
Henry M. Best, 1003 Vermont St., Fremont, N. C.	1st	11
Harold V. Jones, P.O. Box 705, Alamogordo, N. M.	1st	13
Michael F. Aperio, 916 Townsend St., Chester, Pa.	1st	12
Earl A. Stewart, 3918 Modesto Dr., San Bernardino, Calif.	1st	14
Donald L. Leeburg, Box 1075, Anchorage, Alaska	1st	12
J. Milton Condit, 1312 N. 78th Street, Seattle, Wash.	1st	8
John R. Bahrs, 72 Hazelton St., Ridgefield Park, N. J.	1st	12
Richard Baden, 4226 - 37th St., N.W., Washington, D.C.	1st	12
James F. Stewart, 2618½ Prospect Ave., La Crescenta, Calif.	1st	12
Norman R. Cook, 130 Olive Street, Neodeska, Kans.	1st	12

GRANTHAM SCHOOL OF ELECTRONICS

HOLLYWOOD CALIF.	1505 N. Western Ave. Hollywood, Calif. (HO 7-7727)
SEATTLE WASH.	408 Marion Street Seattle, Wash. (MA 2-7227)
KANSAS CITY MO.	3123 Gillham Road Kansas City, Mo. (JE 1-6320)
WASHINGTON D. C.	821 - 19th Street, N. W. Washington, D. C. (ST 3-3614)

MAIL COUPON TO SCHOOL NEAREST YOU

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS

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

Gentlemen:

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

Name _____ Age _____

Address _____

City _____ State _____

I am interested in: ☐ Home Study, ☐ Resident Classes 96-K

Within the Industry

DAVID B. TOLINS has been appointed to the newly created position of advertising and sales promotion manager of the semiconductor division of *Sylvania Electric Products Inc.*

Mr. Tolins has been advertising supervisor for *Sylvania Electronic Tubes*, a division of the company, since 1956. Prior to joining the organization he was associated with *Cowan and Dengler Advertising Agency* and was publicity director for *JFD Electronics Corp.*

Mr. Tolins attended City College of New York where he received a bachelor of science degree in social science.

* * *

ASSOCIATION OF ELECTRONIC PARTS AND EQUIPMENT MANUFACTURERS, INC. has announced the appointment of 17 committees to conduct the program of the 137-company trade group for the coming year. Committee heads are:

Helen S. Quam, *Quam-Nichols Co.*, Industry Coordinating and Advisory; Norman Ackerman, *Perma-Power*, Industry Relations; Mike Remund, *Jensen Industries*, Program and Attendance; Roy Vetzner, *Vaco*, Membership; Jay Greengard, *Waldom*, Orientation; Joe Morin, *Howard W. Sams & Co.*, Educational; Ray Mattson, *Belden*, Credit; Dave Rice, *Electronic Publishing*, Conference Coordinating; Mel Krumrey, *Quam-Nichols*, Social; Dan O'Connel, *Radion*, Survey; and W. L. Larson, *Switchcraft*, Publicity.

Also, Bruce Vinkemulder, *Centralab*, Industrial Distribution; Howard Harwood, *Shure Brothers*, Advertising; Ralph Hill, *Grayhill*, Catalogue; Ken Hathaway, *Ward Leonard*, Finance; and Helen S. Quam, *Quam-Nichols*, Nominating.

* * *

RICHARD J. MAHLER has been named general merchandising manager of *Sonotone Corporation's* electronic applications division.

Mr. Mahler is a veteran of over thirty years in manufacturing, engineering, and merchandising in the electronics and audio fields. Prior to joining the company, he was vice-president of *Ronette Acoustical Corporation* in charge of sales, engineering, and production for three years. Prior to this, he served as vice-president of *Symphonic Radio and Electronic Corp.*, manager of the production department of *CBS Laboratories*, head of the electronics section of *Sears-Roebuck's* merchandise development laboratory, and then as senior buyer of that firm's radio merchandising department.

He is a member of the Institute of Radio Engineers, the Audio Engineering Society, and SMPTE.

* * *

HENRY I. METZ has been appointed vice-president in charge of engineering for *Capitol Radio Engineering Institute* . . . **HAROLD S. RENNE** is now information manager at *Bell Telephone Laboratories* . . . *CBS Electronics* has announced the following new appointments: **JOE C. HARMONY**, director of general engineering, receiving tubes; **HERBERT G. RYAN**, assistant director of general engineering, receiving tubes; **L. H. NIEMANN**, sales manager, semiconductors; and **JOHN A. MAYBERRY**, merchandising manager for dealer products . . . The promotion of **RICHARD L. JACOBSON** to the newly created position of dealer sales administrator has been announced by the *Heath Company* . . . **JOSEPH A. FRABUTT** has been named general manager of *Gonset Division* of *Young Spring and Wire Corp.*

* * *

DANIEL P. KNOWLAND, JR. has been named vice-president of *Heath Company*, a subsidiary of *Daystrom Incorporated.*

Mr. Knowland has been associated with the parent company since 1954. He joined the firm as tax accountant and assistant to the controller. In 1955 he was transferred to the *Heath Company* in Benton Harbor, Michigan as controller.

In 1956 Mr. Knowland was promoted to assistant general manager of the Michigan concern. Under his guidance the company's dealer sales program was put into effect.

Mr. Knowland is a graduate of Lehigh University and is a member of the Comptrollers Institute of America, the American Management Association, and the American Institute of Management.

* * *

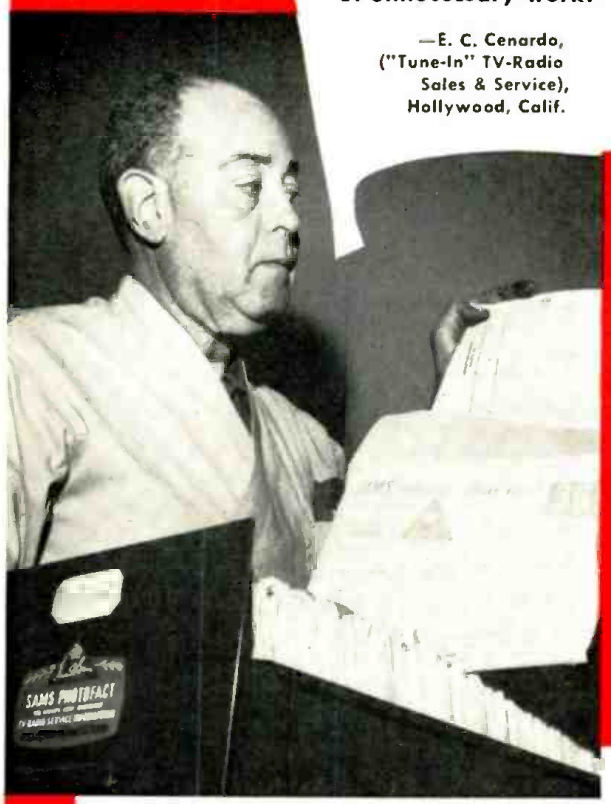
CBS-HYTRON is changing its name to **CBS ELECTRONICS**, effective July 1. The firm is a subsidiary of the *Columbia Broadcasting System, Inc.* . . . **SYLVANIA HOME ELECTRONICS CORPORATION** has been established by **SYLVANIA HOME ELECTRONICS**, a division of *Sylvania Products Inc.* This wholly owned

ownership of a PHOTOFACT SERVICE DATA LIBRARY SPELLS SUCCESS FOR SERVICE TECHNICIANS

here's actual proof from the men who know

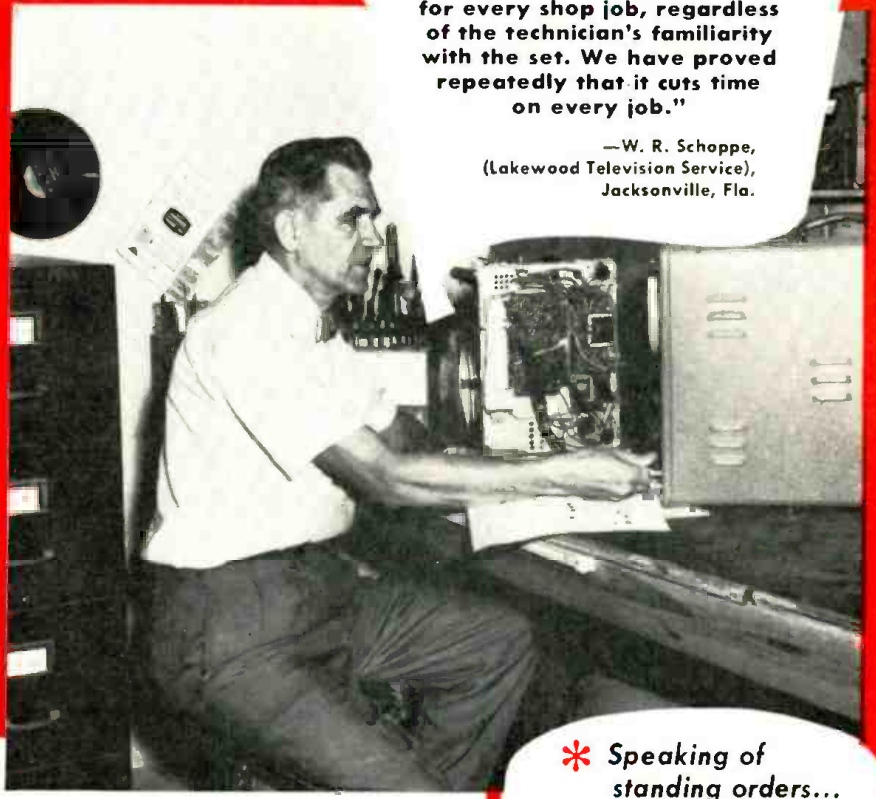
"PHOTOFACTS are a tremendous aid to a service technician in that they save hours of unnecessary work."

—E. C. Cenardo, ("Tune-In" TV-Radio Sales & Service), Hollywood, Calif.



"It is impossible to do business without PHOTOFACT. It is a standing order* in our shop to pull PHOTOFACT from the file for every shop job, regardless of the technician's familiarity with the set. We have proved repeatedly that it cuts time on every job."

—W. R. Schoppe, (Lakewood Television Service), Jacksonville, Fla.



HERE'S MORE PROOF...FROM COAST-TO-COAST

"PHOTOFACTS mean so much to my business that I would not think of operating for any length of time without them."
—James G. Haynes
Leitchfield, Ky.

"The PHOTOFACTS that I have purchased on the Easy-Buy plan have been paying for themselves each month."
—Donald Johnson
Hector, Minn.

"PHOTOFACT means faster service to my customers, and more sets through my shop, which means more profit to me."
—Frank J. Schumacher
Hillsboro, Ore.

"I would be lost without SAMS PHOTOFACT. PHOTOFACT has become a part of servicing."
—Joseph S. Musil
Stamford, Texas

"PHOTOFACT means quicker and more efficient service to the customer."
—Wesley F. Scott
Logansport, Ind.

"Would not be without my PHOTOFACTS. Their return in time saved on servicing, pays for their cost many times over."
—E. R. Hayes
Clemson, S. Car.

(These are just a few of the hundreds of "Success with PHOTOFACT" letters in our files)

* *Speaking of standing orders...*

you'll find the truly successful Service Technicians are those who stay ahead because they're on a Standing Order Subscription with their Distributors to receive all new PHOTOFACTS as released monthly . . .

For Standing Order Subscription and Easy-Buy Plan details, see your Sams Distributor today or write to Howard W. Sams . . .

NEW EASY-BUY PLAN!

It's the money-saving way to build your complete profit-making PHOTOFACT Library!

NO INTEREST—NO CARRYING CHARGE—AS LITTLE AS $10 DOWN

FREE! Valuable steel file cabinets given to PHOTOFACT monthly subscribers and Library purchasers.

Valuable booklet shows you how PHOTOFACT boosts your profit-capacity **FREE**

Send for it!

HOWARD W. SAMS & CO., INC.
2203 E. 46th St., Indianapolis 6, Ind.

☐ Send me Free booklet "Your Guide To Maximum Profits"
☐ I'm a Service Technician: ☐ full-time; ☐ part-time

My Distributor is: _____

Shop Name _____

Attn. _____

Address _____

City _____ Zone ____ State _____

marketing subsidiary will be responsible for the styling, merchandising, and distribution of the firm's television sets, radios, and phonographs . . . **THE VOKAR COMPANY** has incorporated as **VOKAR PRODUCTS, INC.** . . . Stockholders of **SCOTT RADIO LABORATORIES, INC.** have approved a change in the corporate name to **ELECTROVISION CORPORATION** . . . **PACKARD-BELL ELECTRONICS CORP.** has acquired majority interest in **TECHNICAL INDUSTRIES CORP.** . . . **TECHNICAL OPERATIONS, INCORPORATED,** has acquired substantially all of **MICROWAVE ACCOCIATE's** interest in *Power Sources, Inc.*, in exchange for stock of *Technical Operations* . . . A new firm, **CROSBY-TELETRONICS CORP.**, has acquired all outstanding stock of **CROSBY-LABORATORIES, INC.** and **TELETRONICS LABORATORY, INC.** . . . **RICHARD ELECTROCRAFT, INC.** has changed its corporate name to **ELECTROCRAFT, INC.** . . . **WILTEC ELECTRONICS, INC.** is now actively engaged in operations of all phases of special-purpose electron tube research, development, and production. The firm is located in South Norwalk, Connecticut . . . **APPLIED ELECTRONICS COMPANY** (APELCO), a wholly owned subsidiary of *Raytheon Manufacturing Company*, has purchased the assets of **WEBSTER MANUFACTURING COMPANY.** No change is contemplated in plant location or personnel.

* * *

E. K. WIMPY has been appointed manager of marketing research for *CBS Electronics*. Mr. Wimpy was formerly director of general engineering for receiving tube operations.

He began his career in the electronics industry in 1941 as an engineer with *Westinghouse Electric Company* and in 1946 was made a supervisor of quality control for that firm. Mr. Wimpy joined the *Columbia Broadcasting System* subsidiary in 1946 as chief engineer of the lamp department and in 1949 was made director of quality control. He was elevated to director in 1954.

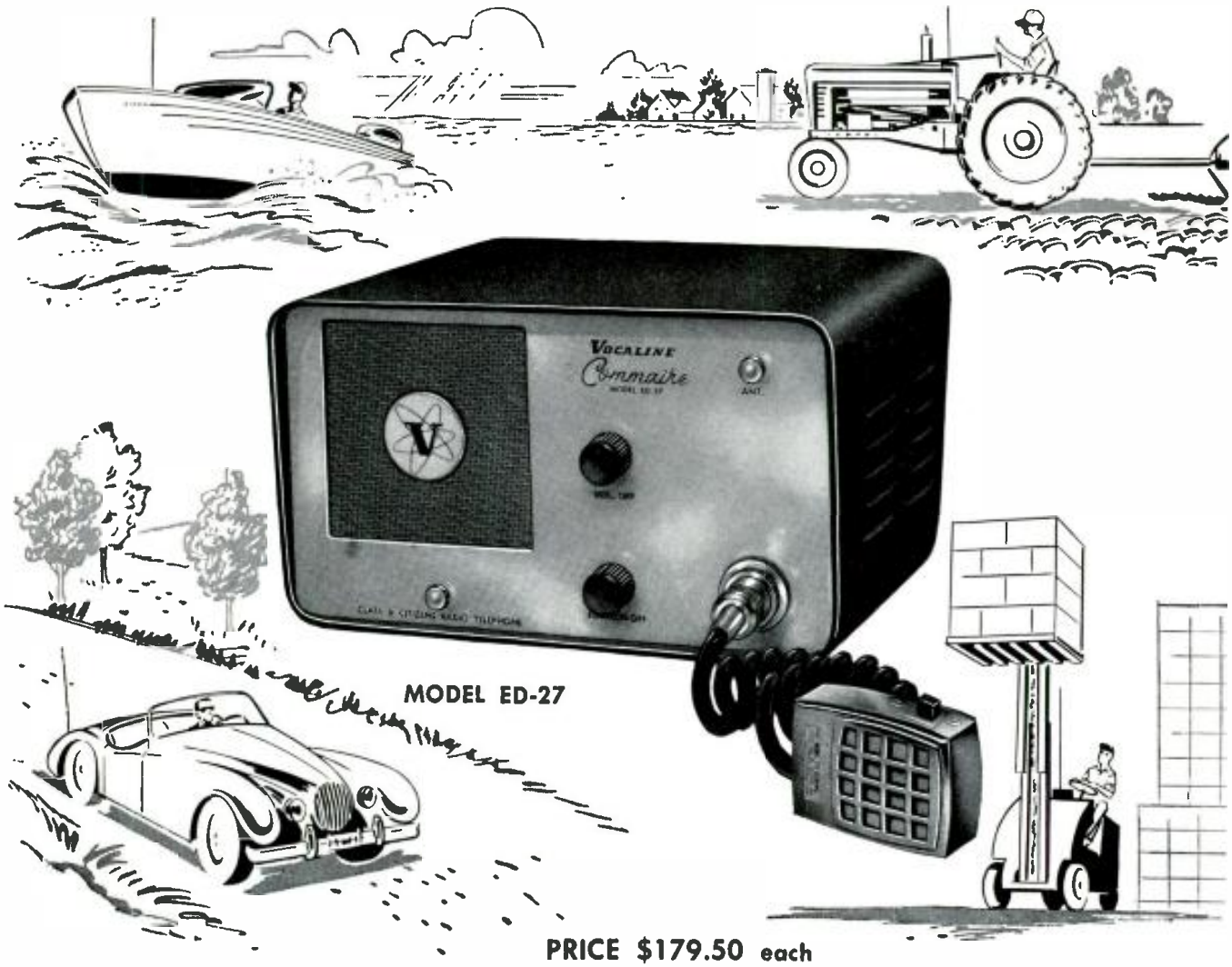
* * *

JOSEPH B. ELLIOTT, president of *Tele-Dynamics, Inc.*, has been named chairman of the Electronic Industries Association's newly established Small Business Committee.

The Committee is a vehicle for small EIA electronic manufacturers to review and act upon "small business" problems. In addition to Mr. Elliott, the following members were appointed:

Ben Adler, *Adler Electronics, Inc.*; Roland M. Bixler, *J-B-T- Instruments, Inc.*; A. N. Haas, *Bud Radio Inc.*; Harry W. Houck, *Measurements Division*; K. F. Julin, *Leach Corp.*; Jos. J. Kurland, *Illinois Condenser Co.*; Wilfred L. Larson, *Switchcraft, Inc.*; L. M. Sandwick, *Pilot Radio Corp.*; Edward C. Tudor, *Industrial Development Engineering Associates, Inc.*; and Ray Zender, *Lenz Electric Mfg. Co.* —30—

NOW! VOCALINE LEADS AGAIN with...



PRICE $179.50 each

The NEW *Commaire* ED-27

CLASS "D" CITIZENS BAND TWO-WAY RADIO

The Finest Available Every Detail Perfected

From the new transistorized power supply to the modern, compact design, the "COMMAIRE" ED-27 is new and advanced in every respect. Nothing has been overlooked to bring you the ultimate in Class "D" Citizens Band performance.

Check these amazing features!

HIGHLY SELECTIVE RECEIVER – Virtually removes all normal interference

EXTREMELY CLEAR TRANSMISSION—Made better through recent advances in design

AMAZING NEW SENSITIVITY – (1/10 of a microvolt!) Makes possible clear reception of even the weakest signals

PATENTED, EXCLUSIVE "Silent-Aire" SQUELCH—Varies and controls the sensitivity in order to keep out noise and unwanted signals on the same frequency

VOCALINE COMPANY OF AMERICA, INC.
OLD SAYBROOK, CONN.

Better than ever-- GENERAL
Bigger than ever-- TOTAL

Ready to do a better job in more sockets—G-E Service-Designed Tubes for TV!

1B3-GT	3CB6	6AF4	6BQ7-A	6CY5	6U8-A
1H2	3DT6	6AF4-A	6BU8	6DN7	6V6-GT
1J3	5AQ5	6AL5	6BZ6	6DQ6-A	6X8
1K3	5BK7-A	6AQ5-A	6BZ7	6DT6	12AT7
1X2-B	5CG8	6AU4-GTA	6CB6-A	6EA8	12AU7-A
2AF4-B	5EU8	6AU6-A	6CD6-GA	6EU8	12AX4-GTB
3BN6	5U4-GB	6AX4-GTA	6CG7	6J6	12BY7-A
3BU6	5U8	6BK7-B	6CG8-A	6SN7-GTB	12DQ6-A
3BZ6	5V3/5AU4	6BN6	6CL8-A	6S4-A	19AU4-GTA
	5Y3-GT	6BQ6-GA	6CX8	6T8-A	

ELECTRIC SERVICE-DESIGNED TUBES! OF 70 LOW-CALLBACK TYPES!

Check the improvements in three popular Service-Designed Tubes at left! These typify quality features that mark the entire line. Over 1,000 advancements give General Electric Service-Designed Tubes top performance, extra reliability!

Install them to *save!* Callbacks are less; your time is kept free for new service work. Install them to *profit!* Service-Designed Tubes cost you no more—customers prefer them—the satisfaction they give builds repeat business for you.

General Electric is broadening constantly the value of these tubes to technicians, by developing additional types to meet growing replacement needs. Now 12 high-quality tubes for hi-fi and radio supplement the extensive Service-Designed TV line.

Here is full coverage of your servicing requirements! Every job you undertake, now can have the benefit of finer, more dependable tube performance. Insist on Service-Designed Tubes! See your G-E tube distributor! *Distributor Sales, Electronic Components Division, General Electric Co., Owensboro, Ky.*

TELL YOUR STORY OF QUALITY SERVICE with this colorful leaflet! Slip it in with invoices, mail it with letters, leave it on calls! Available in quantities from your General Electric tube distributor.

Now...for finer performance...G-E Service-Designed Tubes for Hi-Fi and Radio!

6AV6	6BE6	12AU6	12AX7/7025	12BE6	35W4
6BA6	6L6-GC	12AV6	12BA6	35C5	50C5

In addition, several General Electric Service-Designed Tubes for TV are equally fine performers in hi-fi or radio equipment: namely, Types 5Y3-GT, 6AL5, 6AQ5-A, 6AU6-A, 6T8-A, 6V6-GT, and 12AT7.

Progress Is Our Most Important Product

GENERAL ELECTRIC

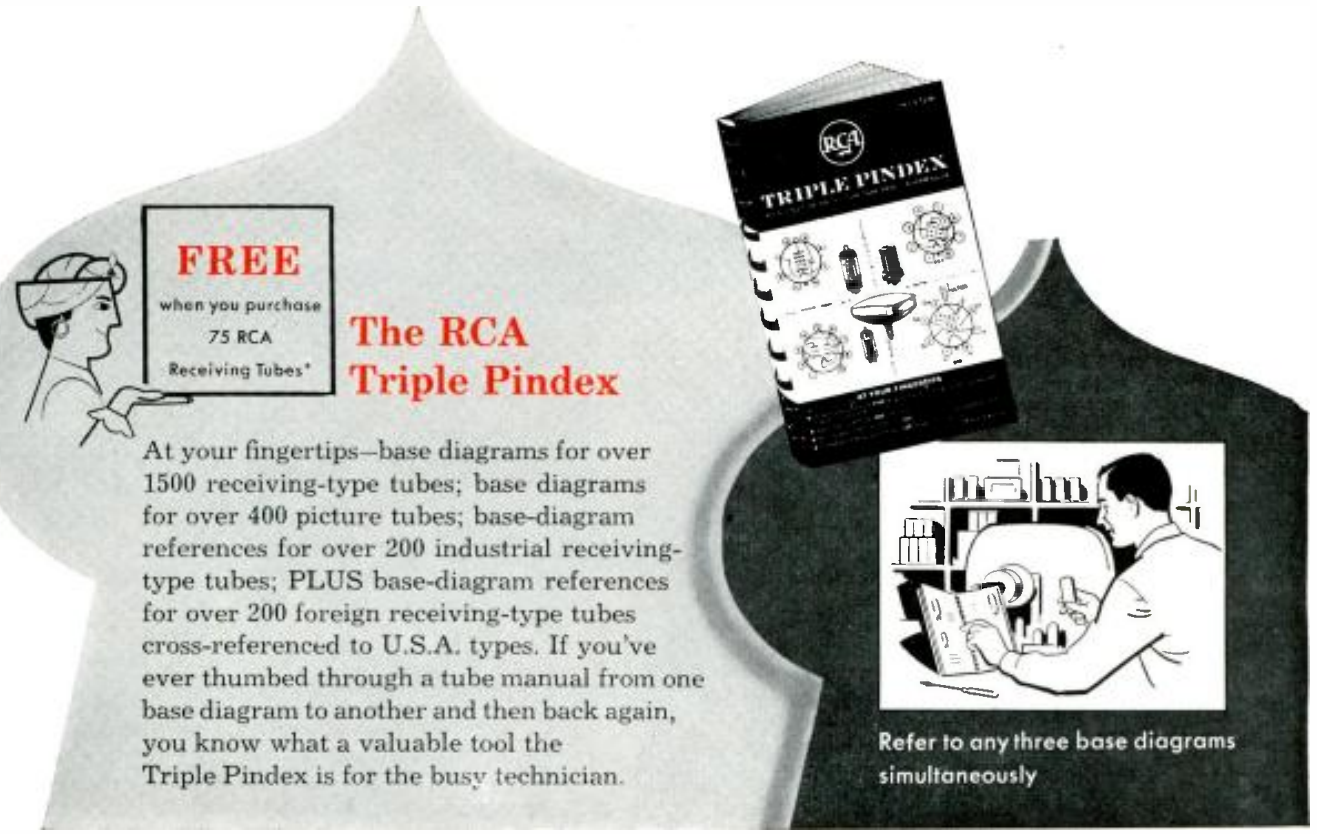
2-111-221

These valuable service aids can be yours

FREE

when you purchase RCA Receiving Tubes

In old Baghdad "genies" made life easier and more convenient. And that's exactly what RCA's new Service Aids Campaign will do for you. These service aids will make your job a little easier and a lot more profitable. They're available from authorized RCA Tube Distributors participating in this program.



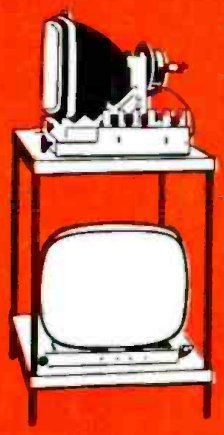
Offer for limited time only...Contact your

FREE
when you purchase
425 RCA
Receiving Tubes*

The RCA TV-Toter Table

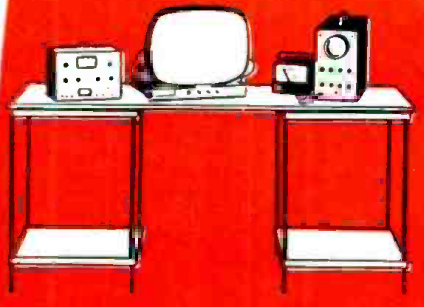
SAVE LABOR! SAVE TIME! One of the most useful tools you've ever had in your shop, the RCA TV-Toter Table is constructed of 20 gauge reinforced steel with chrome-plated hardened-steel tubular legs, has a durable office grey hammer tone finish. Each table comes complete with four leg extensions and four casters to permit easy change-over from no-tilt table to handy roll-about unit. Measuring 24" x 24" x 33½" high, the RCA TV-Toter Table supports a TV chassis at convenient bench height.

The handy, convenient TV-Toter Table



Increase your storage facilities

Increase your service facilities

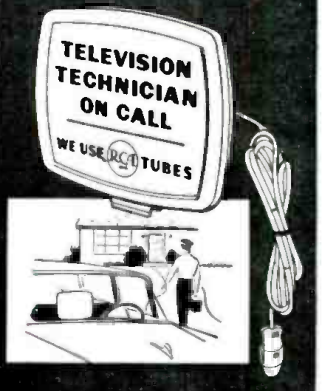


Use two TV-Toters as a fixed bench

Use three TV-Toters as a rest bench with roll-out center section

Also available to build business

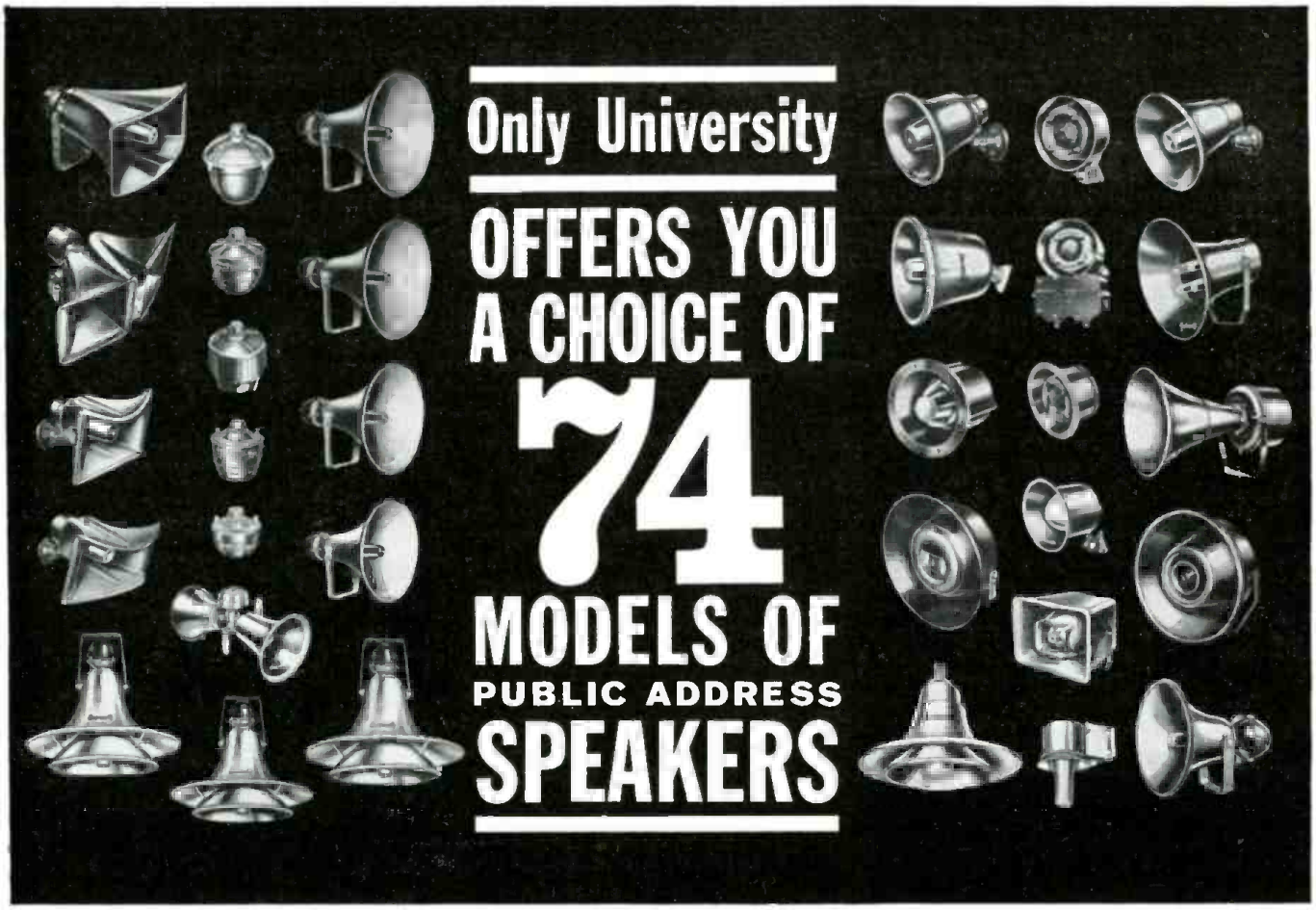
is the new RCA TV Service Auto Light. A rugged plastic display with built-in light and magnetic base, the TV Service Auto Light is a practical and convenient way to advertise your services and products to everyone who sees your parked car or truck. Also ask your RCA Tube Salesman about the many other RCA sales and servicing aids available to you all year 'round.



RCA **RADIO CORPORATION OF AMERICA**
Electron Tube Division Harrison, N. J.

*Suggested Value

Authorized RCA Tube Distributor for details today!!



ONLY WITH University® CAN YOU GET...

45 different trumpet / driver combinations, 8 paging talk-back, 5 submergence-proof, 2 explosion-proof, 3 high fidelity weatherproof, 7 super-power and 4 Powerpages.

More than 74, in fact, because many of these units come in three versions — 4, 8 and 45 ohms. In addition, we make a large number of special speakers for special applications, as well as a complete line of accessories.

THE SPECIFIC SPEAKER YOU NEED—no "all-purpose" compromises, but the right speaker for the right job—paging, explosion-proof, super-power, etc.—with several models in each class.

THE RIGHT POWER YOU NEED—from 5 watts to 600 watts. *Not* more than you need, *not* less than you need.

THE SOUND DISPERSION YOU NEED—deep or shallow penetration, narrow or wide, 360° horizontal.

THE FREQUENCY RESPONSE YOU NEED—your choice of high and low cut-offs as required—whether to cut through extreme noise levels, or for true high fidelity music reproduction.

THE ECONOMY YOU NEED—lowest initial costs for planning and installation, lowest running costs, lowest repair and service costs.

. . . and only with University can you get the quality you need — exclusive design features, the finest materials, exacting construction standards and performance tests. All these are your assurance that University will do the job better, longer, and at lowest possible cost.

. . . THAT'S WHY UNIVERSITY IS THE UNIVERSALLY ACCEPTED NAME IN THE ENTIRE FIELD OF SOUNDCASTING

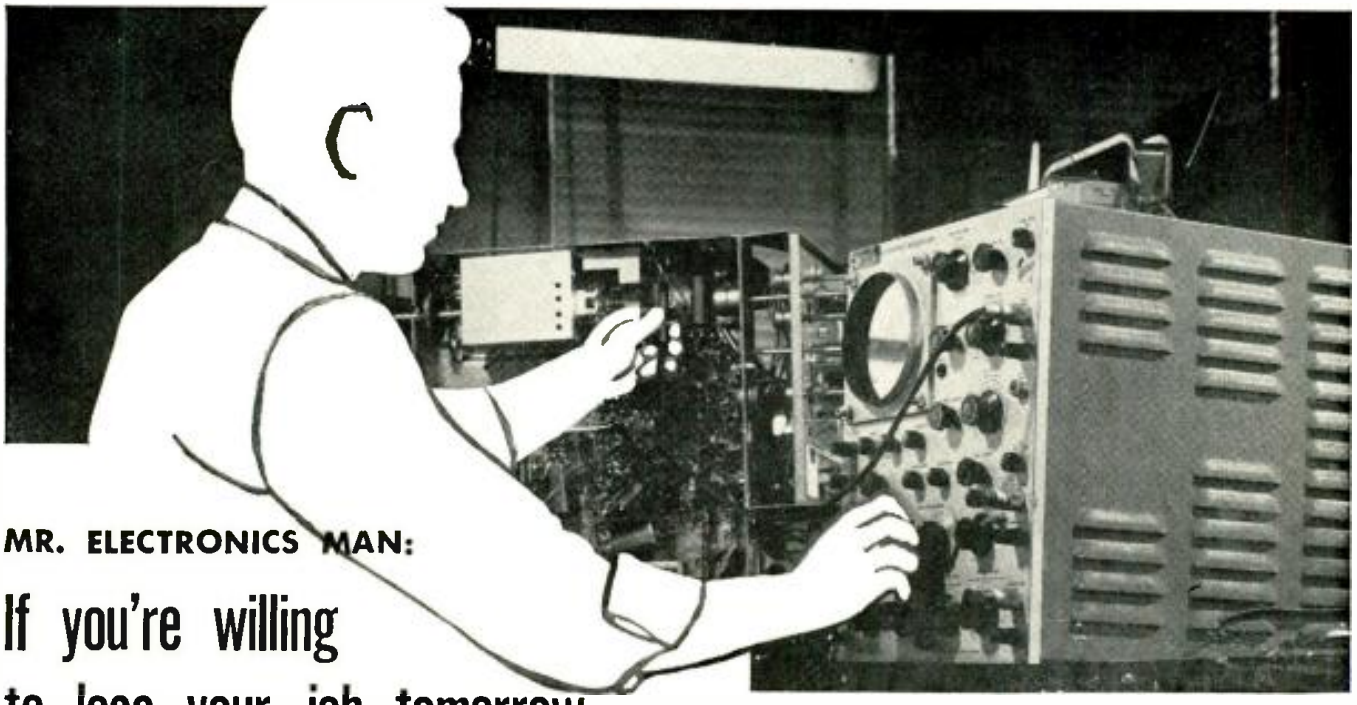
How you can choose the right speaker for the specific application . . .

Invest $1 for the invaluable 64-page UNIVERSITY TECHNILOG, the authoritative reference book for planning P.A. speaker systems

Only book of its kind . . . packed with the solid factual data you need to save time and money. Covers in detail: how to select the proper driver for the specific job, directional vs. wide-angle horns, best use of radial trumpets, high fidelity in P.A., coping with reverberation, methods of overload protection, etc. Includes specs, charts, diagrams, and the *exclusive* SOUND SYSTEM DESIGN CHART—effective guide for planning typical installations. Send $1.00 to Desk e-3. University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, New York.

Send for FREE copy of Product Catalog

Contains information and specifications on all University public address speakers . . . directional, radial, wide-angle, paging and talk-back, submergence-proof, high fidelity weatherproof, super-power, explosion-proof, portable soundcasting, etc. Also, high fidelity cone speakers, enclosures and speaker systems suited for commercial installations.



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If you're willing to lose your job tomorrow to a technically-trained man, *turn the page, mister*

Many of the men currently on the street are there for a reason. "As many as 8 out of 10 are deadwood," estimates the chief engineer of a medium-sized Philadelphia firm; the problem is to find the live ones. —*from ELECTRONICS MAGAZINE*

If you're interested in an honest-to-goodness career in the vigorous young electronics industry, here's how you can step ahead of job-competition, move up to a better job, earn more money, AND BE SURE OF HOLDING YOUR TECHNICAL JOB, EVEN WHEN THE "DEADWOOD" IS BEING CLEANED OUT.

The "how" is advanced, professional home study education in Electronic Engineering Technology including AUTOMATION, INSTRUMENTATION, INDUSTRIAL ELECTRONICS, AERONAUTICAL ELECTRONICS, GUIDED MISSILES, SERVOMECHANISMS, COMPUTERS, ASTRONAUTICS, TELEMETERING, COMMUNICATIONS, MANUFACTURING, TELEVISION. You don't have to be a college graduate. You *do* have to be willing to study—at home. You can do it while holding down a full-time job. Thousands have. Since 1927 CREI has provided alert young men with the technical knowledge that leads to more responsibility, more job security, more money. And CREI has constantly kept pace with the rapid expansion and progress in electronic achievement.

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Spot News

Latest Information on the Electronic Industry

By ELECTRONICS WORLD'S WASHINGTON EDITOR

50-TV-CHANNEL ALLOCATION PLAN PROJECTED—A compromise 50-channel very-high, ultra-high proposal, suggested by some members of the Commission and others in industry, which would enlarge TV service by expanding the present v.h.f band to 474 mc., is now under official consideration as the only practical way to achieve nationwide television coverage. Such a program would require surrender—and exchange—of a block of government channels (216-300 mc.); a decision experts believe will be made early this summer. The frequency shift will depend upon, according to FCC Commissioner F. W. Ford, whether international defense conditions will permit the use of other channels. Economics might also stand in the way. Commenting on this problem, commissioner J. S. Cross said: "Swapping some existing u.h.f. and v.h.f. space with the military . . . involves replacing hundreds of millions of dollars worth of current military (and allied) electronic equipment . . . and, in addition, has receiver incompatibility disadvantages".

$166,000 RADIO TELESCOPE UNDER CONSTRUCTION BY UNIVERSITY STUDENTS—A team of ten students directed by Dr. John D. Krause of Ohio State University is now constructing a unique radio telescope—which will map the radio sky—under a National Science Foundation grant of $166,000. The design calls for a pair of 360-foot-long antennas; a fixed parabolic type, 360-feet long by 70-feet high, and a flat tiltable reflector 360-feet long by 100-feet high. Radiation from the area of the sky under observation will be received on the tiltable antenna, reflected to the fixed antenna, and thence to the receiver where it will be recorded. The collecting area of the tiltable antenna will be approximately equivalent to that of a 170-foot diameter steerable dish antenna at as little as 10 per-cent of the cost.

RADIO NETWORK OF SATELLITE-TRACKING STATIONS IN OPERATION—A detection line capable of tracking all earth satellite vehicles and high-flying objects which pass over this country now spans the southern part of the nation. One of the major purposes of this program is to insure a constant check on all passive or silent satellites, that is, those without internal telemetering radio emitter or one whose radio is inactive—so that they will not be able to orbit unnoticed. The network will also be capable of obtaining certain types of scientific data from such silent satellites as may be in orbit. The transmitters used emit a continuous thin fan-shaped spray of radio-frequency energy into the sky along the line of tracking stations. These emissions overlap to provide a detection "fence" across the continent. A satellite passing through the "fence" would be detected by the energy reflected from the body of the satellite and picked up by sensitive receiving antennas.

BILL INTRODUCED FOR FCC CONTROL OVER WIRED PAY-TV—Congressman Oren Harris, chairman of the House Commerce Committee, has introduced a measure asking for regulation of wired-subscription television. Reviewing the reasons for introduction of the bill, Representative Harris said: "Instead of contemplating pay-television by radio or by wire on a permanent or extended basis, my new bill is intended to prevent runaway tests of pay-TV by wire which might result in the virtual establishment of a new service without the Congress having had an opportunity to consider whether the establishment of such a service on a permanent basis is in the public interest".

ELECTRONIC THINKING MACHINES MAKE DEBUT IN WASHINGTON EXHIBIT—An electronic "thinking" machine that pits its skill against human opposition in a game called "21", and another that takes on challengers—who can tie but cannot win—in a version of "tic-tac-toe", was unveiled recently in a communications-industry exhibit in the lobby of the Commerce Department building. The machines were set up to demonstrate the important qualities of electronic automatic apparatus that has such diverse usage as the routing of complex long-distance calls and the functioning of automatic message-accounting systems employed for billing communications users. Another unusual feature of the displays was to illustrate its effectiveness in continental defense. The two games use push-button techniques. In each, the human player presses a button to make his move and the electronic brain then counters. The designs employed in these brains will be, it was said, employed in miniaturized all-electronic communication switching offices of the future.

—30—

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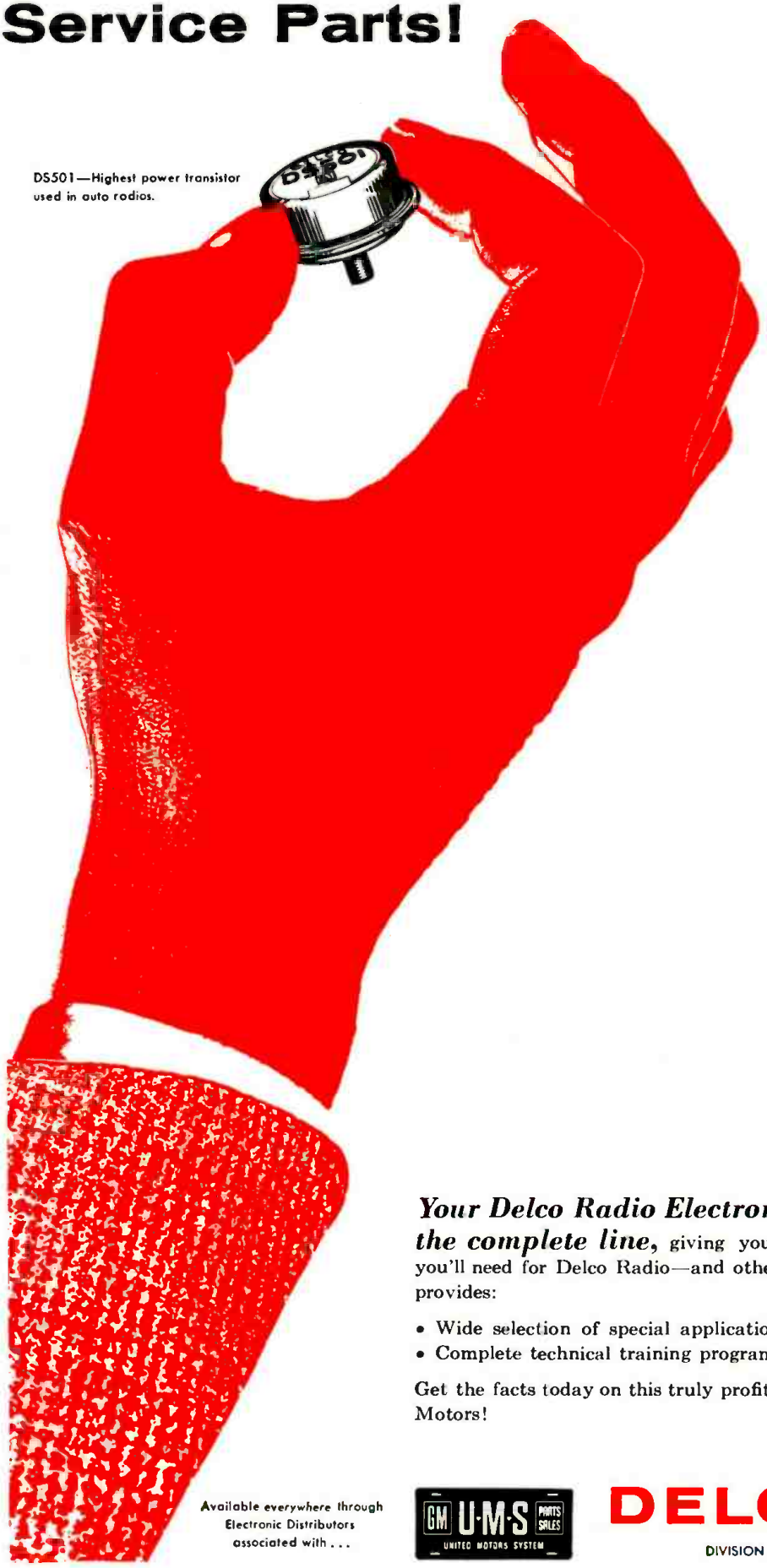

DS501—Highest power transistor used in auto radios.

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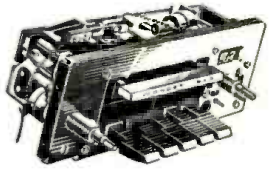

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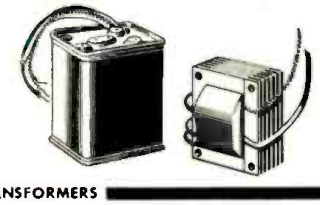

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Over 1 MILLION EICO instruments in use throughout the world.

NEW STEREOPHONIC EQUIPMENT

HF85: Stereo Dual Preamplifier is a complete stereo control system in "low silhouette" design adaptable to any type of installation. Selects, preamplifies, controls any stereo source—tape, discs, broadcasts. Superb variable crossover, feedback tone controls driven by feedback amplifier pairs in each channel. Distortion borders on unmeasurable even at high output levels. Separate lo-level input in each channel for mag. phono, tape head, mike. Separate hi-level inputs for AM & FM tuners & FM Multiplex. One each auxiliary A & B input in each channel. Independent level, bass & treble controls in each channel may be operated together with built-in clutch. Switched-in loudness compensator. Function Selector permits hearing each stereo channel individually, and reversing them; also use of unit for stereo or monophonic play. Full-wave rectifier tube power supply. 5-12AX7/ECC83, 1-6X4. Works with any high-quality stereo power amplifier such as EICO HF86, or any 2 high-quality mono power amplifiers such as EICO HF14, HF22, HF30, HF35, HF50, HF60. **"Extreme flexibility . . . a bargain"** — HI-FI REVIEW. Kit **$39.95.** Wired **$64.95.** Includes cover.

HF86: Stereo Dual Power Amplifier for use with HF85 above or any good self-powered stereo preamp. Identical Williamson-type push-pull EL84 power amplifiers, conservatively rated at 14W, may be operated in parallel to deliver 28W for non-stereo use. Either input can be made common for both amplifiers by Service Selector switch. Voltage amplifier & split-load phase inverter circuitry feature EICO-developed 12DW7 audio tube for significantly better performance. Kit **$43.95.** Wired **$74.95.**

HF81: Stereo Dual Amplifier-Preamplifier selects, amplifies & controls any stereo source — tape, discs, broadcasts—& feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Monophonically: 28 watts for your speakers; complete stereo preamp. Ganged level controls, separate focus (balance) control, independent full-range bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers, excellent output transformers. "Service Selector" switch permits one preamp-control section to drive the internal power amplifiers while other preamp-control section is left free to drive your existing external amplifier. **"Excellent"** — SATURDAY REVIEW; HI-FI MUSIC AT HOME. **"Outstanding quality . . . extremely versatile"** — RADIO & TV NEWS LAB-TESTED. Kit **$69.95.** Wired **$109.95.** Includes cover.

MONO PREAMPLIFIERS (stack 2 for Stereo) HF-65: superb new design. Inputs for tape head, microphone, mag-phono cartridge & hi-level sources. IM distortion 0.04% @ 2V out. Attractive "low silhouette" design. **HF65A** Kit **$29.95.** Wired **$44.95.** **HF65** (with power supply) Kit **$33.95.** Wired **$49.95.**

MONO POWER AMPLIFIERS (use 2 for STEREO)

HF60 (60W), HF50 (50W), HF35 (35W), HF30 (30W), HF22 (22W), HF14 (14W): from Kit **$23.50.** Wired **$41.50.**

MONO INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF52 (50W), HF32 (30W), HF20 (20W), HF12 (12W): from Kit **$34.95.** Wired **$57.95.**

SPEAKER SYSTEMS (use 2 for STEREO)

HFS2: Natural bass 30-200 cps via slot-loaded 12-ft. split conical bass horn. Middles & lower highs: front radiation from 8½" edge-damped cone. Distortionless spike-shaped super-tweeter radiates omni-directionally. Flat 45-20,000 cps, useful 30-40,000 cps. 16 ohms. HWD 36", 15¼", 11½". **"Eminently musical"**—Holt, HIGH FIDELITY. **"Fine for stereo"**—MODERN HI-FI. Completely factory-built: Mahogany or Walnut, **$139.95;** Blonde, **$144.95.**

HFS1: Bookshelf Speaker System, complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. Capacity 25 w. 8 ohms. HWD: 11" x 23" x 9". Wiring time 15 min. Price **$39.95.**

FM TUNER HFT90: For the first time, makes practical even for the novice the building of an FM tuner kit equal to really good factory-wired units. No instruments needed. Pre-wired, pre-aligned temperature-compensated "front end" is **drift free**—eliminates need for AFC. Precision "eye-tronic" DM-70 traveling tuning indicator, supplied pre-wired, contracts at exact center of each FM channel. Pre-aligned IF coils. Sensitivity 6X that of other kit tuners: 1.5 uv for 20 db quieting, 2.5 uv for 30 db quieting, full limiting from 25 uv. IF bandwidth 260 kc at 6 db points. Frequency response uniform 20-20,000 cps ±1 db. Has 2 output jacks: cathode follower output to amplifier, plus Multiplex output for FM Multiplex Stereo adapter; thus prevents obsolescence. Flywheel tuning, AGC, stabilized low limiting threshold for excellent performance from weaker signals, broadband ratio detector for improved capture ratio & easier tuning, full-wave rectifier & heavy filtering, very low distortion. **"One of the best buys you can get in high fidelity kits"** — AUDIOCRAFT. Kit **$39.95*.** Wired **$65.95*.** Cover **$3.95.** *Less Cover, F.E.T. incl.

NEW AM TUNER HFT94: Matches HFT90. Selects "hi-fi" wide (20c — 9kc @ —3 db) or weak-station narrow (20c — 5kc @ —3 db) bandpass. Tuned RF stage for high selectivity & sensitivity; precision "eye-tronic" tuning. Built-in ferrite loop, prealigned RF & IF coils. Sensitivity 3 uv @ 30% mod. for 1.0 V out. 20 db S/N. Very low noise & distortion. High-Q 10 kc whistle filter. Kit **$39.95.** Wired **$69.95,** incl. Cover & F.E.T.

BEFORE YOU BUY, COMPARE:

You may examine the complete EICO line at any of 1900 neighborhood EICO distributors coast to coast. Compare critically with equipment several times the EICO cost—then you judge. You'll see why the experts recommend EICO, kit or wired, as your best buy.

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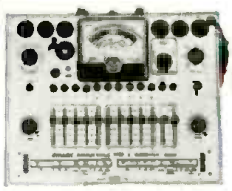
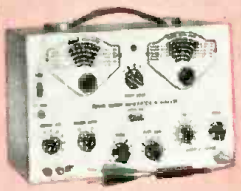


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. Tests all receiving tubes (and picture tubes with adapter). Composite indication of Gm, Gp & peak emission. Simultaneous sel of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). New series-string voltages: for 600, 450, 300 ma types. Sensitive 200 ua meter. 5 ranges meter sensitivity (1% shunts & 5% pot). 10 SIX-position lever switches: freepoint connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. Direct-reading of inter-element leakage in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors: separate meter readings of collector leakage current & Beta using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. CRA Adapter $4.50



NEW! TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

Entirely electronic sweep circuit (no mechanical devices) with accurately-biased inproductor for excellent linearity. Extremely flat RF output: new AGC circuit automatically adjusts osc. for max. output on each band with min. ampl. variations. Exceptional tuning accuracy: edge-lit hairlines eliminate parallax. Swept Osc. Range 3-216 mc in 5 fund. bands. Variable Marker Range 2-75 mc in 3 fund. bands; 60-225 mc on harmonic band. 4.5 mc Xtal Marker Osc., xtal supplied. Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: output, 'scope horiz., 'scope vertical. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95 WIRED $129.50

• Features DC Amplifiers!

Flat from DC-4.5 mc, usable to 10 mc. VERT. AMPL.: sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull thruout; K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. SWEEP: perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); preset TV V & H positions; auto. sync. ampl. & lim. PLUS: direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

5" PUSH-PULL Oscilloscope #425: Kit $44.95, Wired $79.95.
7" PUSH-PULL Oscilloscope #470: Kit $79.95, Wired $129.50.

NEW! RF SIGNAL GENERATOR #324

KIT $26.95 WIRED $39.95

150 kc to 435 mc with ONE generator! Better value than 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. amplifier: only 3.0 v 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 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

NEW! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

KIT $29.95 WIRED $49.95

Half-turn of probe tip selects DC or AC-Ohms.

Uni-Probe – exclusive with EICO – only 1 probe performs all functions!

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. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet.

NEW 6-TRANSISTOR PORTABLE RADIO RA-6
KIT $29.95
Wired $49.95
Includes leatherette case, F.E.T.; less 9V battery
All U.S.-made. Highly sensitive, selective. Prealigned RF, IF xfmrs; push-pull audio; 6" oval PM speaker

NEW Power & Bias Supply for Transistorized Eqpt, #1020
Kit $19.95 Wired $27.95

NEW TUBE & CRT FIL. Tester #612
Kit $3.95 Wired $5.95
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Transistor-Tube "Walkie-Talkie"

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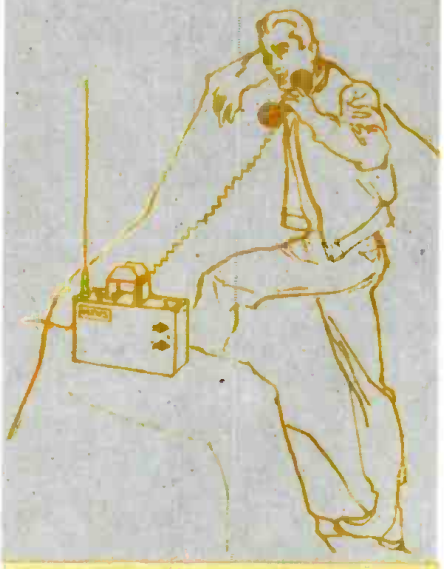


By **DON STONER**
W6TNS

THE design of portable transmitting and receiving equipment has progressed considerably since the days of the *Abbott* TR-4 and other two-tube transceivers. The unit to be described incorporates the latest advances in "the state of the art." This particular unit was developed as an amateur radio club project and has been duplicated by several of the members. It should be emphasized that amateur licenses (at least Technician or General class tickets) are required to operate this transmitter.

The receiver and transmitter sections are compatible, that is, the receiver can "hear" anything that the transmitter can work. The range, using the self-contained loaded whip, is approximately five miles. Contacts up to 60 miles have been made using a three-element beam. Transistors are used in the receiver section for maximum battery economy. The four flashlight cells will run the receiver continuously for 2000 hours! A simple, but effective two-tube circuit is used in the transmitter section.

Either of two power/control systems can be used with the "walkie-talkie" package. The first system, which is referred to as the "deluxe" version, uses a transistorized power converter to supply "B+" for the transmitter. Although this system is much more expensive initially, it uses only four flashlight cells which cost 14 cents each. Dry batteries are used in the "standard" system for filament and "B+" power. A set of batteries will cost slightly over three dollars. If the transceiver is used constantly, the "deluxe" power supply will pay for itself in no time. In addition, the deluxe system features push-to-talk operation. The function of the unit is controlled by a button on the telephone-type handset.

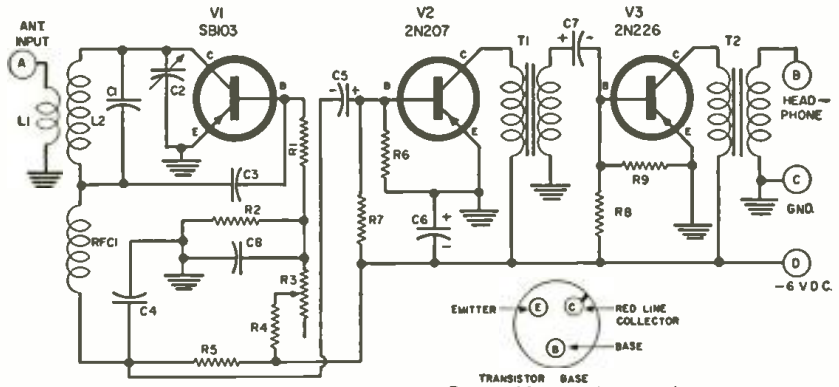
Over-all view of "walkie-talkie" showing power transistors on outside of case.

The "standard" power/control circuit (shown in Fig. 4) uses a 90-volt "B" battery with four flashlight cells making up the 6-volt "A" battery. A double-pole, double-throw toggle switch is used to change over the antenna and power circuits, rather than a relay. Microphone and earphone jacks are provided instead of the more exotic handset. An additional toggle switch (d.p.s.t.) is used to turn the batteries off and on.

You will note from the receiver and transmitter schematics (Figs. 1 and 2 respectively) that connections are made to a series of lettered points. The corresponding terminals will be found on the two control schematics, Figs. 3 and 4. These are simply *connecting points* and *do not* represent pins on a connecting plug. The diagrams were drawn in this somewhat unusual manner so that the constructor would have the option of using either the deluxe or standard control circuit.

Receiver Circuitry

Some readers may be apprehensive at the thought of working with these miniature metallic monsters, the transistors, and wonder why the author used such fiendish devices. Let me assure you that there is a good reason and it is not just the glamour. The three transistors used in the receiver (Fig. 1) consume 10 ma. from the 6-volt battery, or 0.06 watt! An equivalent vacuum-tube receiver using a 1U4,



R_1, R_3, R_9—22,000 ohm, ½ w. res.
R_2—1 megohm linear taper pot
R_4—100,000 ohm. ½ w. res.
R_5—3300 ohm, ½ w. res.
R_6—1000 ohm, ½ w. res.
R_7—68,000 ohm, ½ w. res.
R_8—82,000 ohm, ½ w. res.
C_1—4.7 μμfd. disc ceramic capacitor
C_2—1-10 μμfd. variable capacitor (1 stator, 2 rotor plates)
C_3—56 μμfd. disc ceramic capacitor
C_4, C_8—.005 μfd. disc ceramic capacitor
C_5—8 μfd., 6 v. elec. capacitor
C_6—50 μfd., 6 v. elec. capacitor
C_7—2 μfd., 6 v. elec. capacitor
RFC_1—20 μhy. r.f. choke
L_1—1 t. #22 plastic covered hook-up wire, wound over cold end of L_2
L_2—8 t. #28 tinned wire, ½" dia., spaced dia. of wire (Air Dux #432)
T_1—Interstage trans. 10,000 ohms to 2000 ohms (Argonne AR-109, Stancor TA-35, or Triad TY-56X)
T_2—For 2000 ohm headphones, same as T_1. For telephone handset, Argonne AR-153, Stancor TA-34, or Triad TY-54X
V_1—SB-103 (2N346) or T1324 (see text) transistor (Philco)
V_2—2N207 or T0037 transistor (Philco)
V_3—2N226 transistor (Philco)

Fig. 1. Transistor receiver circuit. A superregen detector drives a two-stage transistor amplifier which provides more than adequate volume for the headphone.

a 1S5, and a 3Q4, would consume 0.3 watt of filament power alone! Another 0.9 watt would be snapped up in the "B" supply. Thus, it amounts to approximately 2000 hours of battery life against about 100 hours. The cost of the tubes would run around $3.69 while the transistors used in the receiver will cost only slightly more.

A transistorized version of the ultra-audion circuit, using a *Philco* SB-103/2N346 functions as the detector. A feedback path exists between the collector and base and the stage oscillates at a frequency determined by C_1, C_2, and L_2. The current is controlled by the base bias circuit composed of R_1, R_2, R_3, and R_4. Superregeneration occurs with approximately 0.2 ma. of collector current in the SB-103. Audio is developed across the collector load resistor (R_5, 3300 ohms) and is coupled to the base of the first audio amplifier, a type 2N207. The amplified signal is coupled to the output transistor, a 2N226. All three of these transistors are manufactured by *Philco*.

Although surplus transformers were used in the receiver's audio section, standard items have been specified in the parts list. These transformers have been tried in the circuit and the performance is at least equal to the original. The interstage transformer, T_1, can be any unit that will provide an impedance match for 10,000 ohms to 2000 ohms. The output transformer, T_2, will be determined by the type of earphone used. For the telephone handset, a transformer matching 10,000 ohms to roughly 200 ohms should be used. If high-impedance headphones are used (2000 ohms) a transformer identical to T_1 of the parts list will be satisfactory.

There are several precautions that should be observed when working with the transistors specified—particularly the surface-barrier SB-103. Always grip the leads with needle-nose pliers, between the iron and the transistor case, to conduct heat from the transistor junction. Never connect the transistor into the circuit with the power applied for a surge of current can cause damage. When soldering the SB-103 into the circuit, use a soldering gun rather than a soldering iron. The power-line leakage sometimes found in irons may blow the surface-barrier transistor.

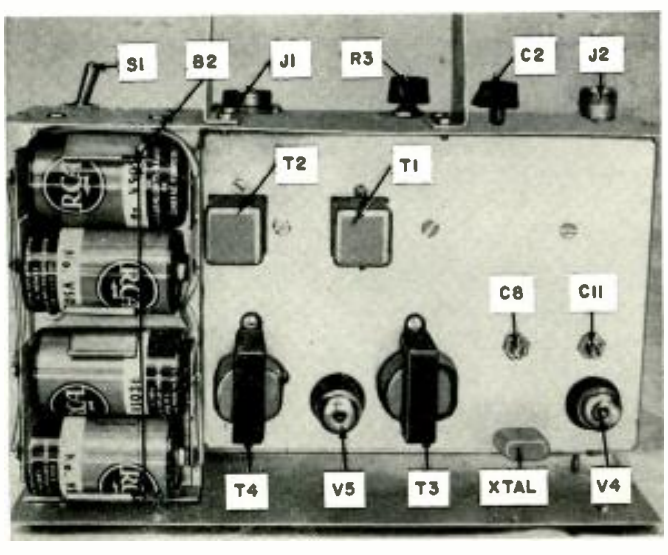
Although 6-volt electrolytic capacitors are specified in the parts list accompanying Fig. 1 any type with a high-voltage rating will be satisfactory. Coupling capacitor C_5 should be a good quality unit or the first audio stage will draw excessive current because of leakage in the capacitor.

The receiver circuit has been constructed in several layout configurations and the performance of the original has been duplicated each time, which seems to indicate that the layout is not too critical. The receiver has ears like a Sioux scouting party and a 3 μv. signal will produce "Q5" headphone copy. Re-radiation from the receiver is noticeable for several hundred feet. However, due to the low power level at which the detector operates (1.2 milliwatts), the unit will seldom cause interference to other 6-meter stations.

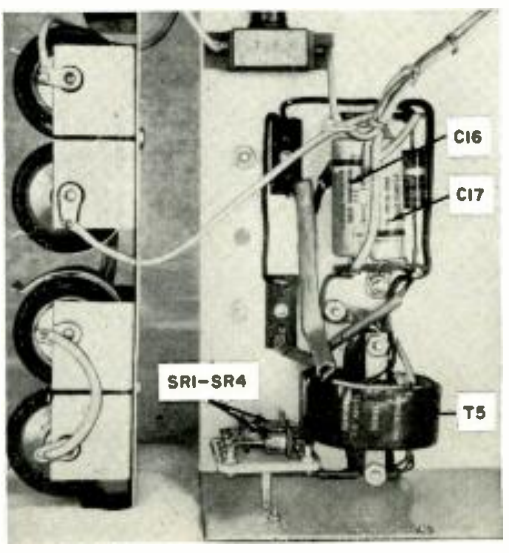
Transmitter Circuit

A type 3A5 tube is used as a 25 mc. oscillator, which in turn drives the second section as a doubler to 50 mc. Many purists may turn up their noses at such a system, but in terms of miles *versus* milliamperes, this system is in a class by itself. An *International Crystal* 25-mc. third overtone crystal (Type FA-9) determines the carrier frequency. Tank coil L_3 is tuned to the high-frequency side of 25 mc. and the stage oscillates due to the feedback capacity inside the tube. Output from this stage is coupled to the doubler through a 56-μμfd. capacitor, C_9. The 50-mc. plate tank is connected in a push-

Top-chassis view. Receiver is at top, transmitter at bottom.



Lifting out batteries reveals the transistor power supply section. Transistors are mounted on outside of case. This circuit steps up 6 volts from battery to 125 volts for the transmitter. Operation is similar to vibrator power supply, except that transistors switch electronically. The efficiency is 70%.



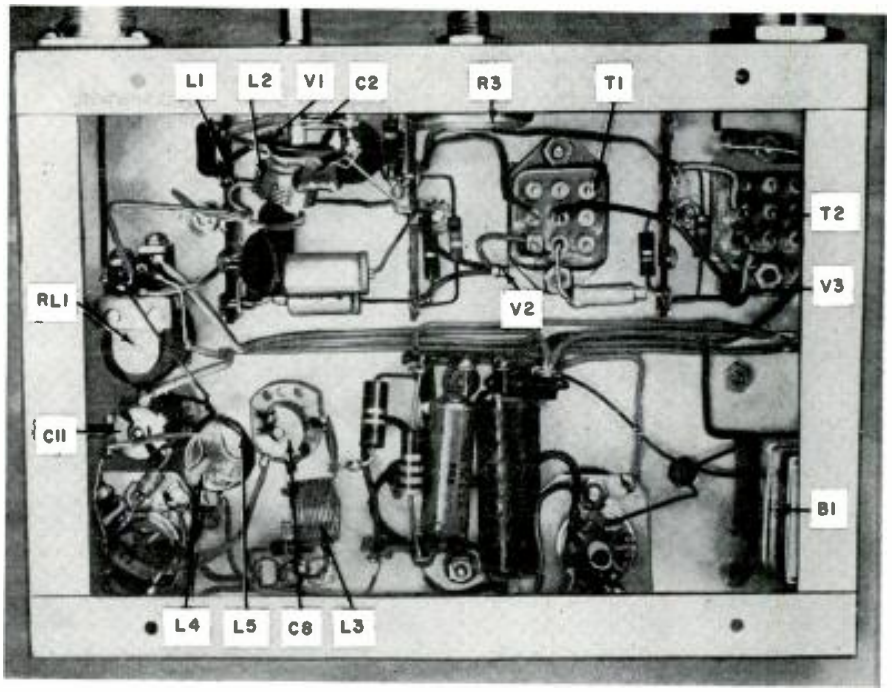
pull configuration so that in-phase energy can be applied to the grid of the tube. This introduces a small amount of regeneration into the circuit which increases the output noticeably. The r.f. energy is coupled to the antenna through a two-turn link coil. The filaments of both tubes are series-connected in order to utilize the 6-volt "A" battery at maximum efficiency.

A type 3A4 tube is used as the modulator. Although the circuitry is straightforward, this stage delivers more audio than is necessary. When the batteries start to get weak or when signal strengths are low, this extra modulation comes in very handy. A slight tendency to "downward modulate" may be noted but this is a characteristic of modulated doublers. In any event, stations communicating with the portable units always give glowing audio quality reports so it apparently does not cause any trouble.

Microphone current is obtained from the 6-volt "A" battery through a decoupling *RC* network. The modulator is biased with a 8.4-volt mercury cell. The use of a mercury cell appears to be unnecessary since the modulator grid does not draw any current. Six 1.5-volt penlite cells connected in series will work just as well and cost slightly less. Note that the positive end of the battery is returned to pin 7 of the 3A4 modulator and not to ground. This connection, as well as the other filament connection, should be observed carefully. Transposing filament pins might, in some cases, cause improper bias on the 3A4 tube.

The modulation transformer is connected to match 5000 to 10,000 and one-half of the primary is used. A high step-up ratio microphone transformer is used to provide adequate drive for the modulator. Since the modulator has more than adequate audio, reasonable substitutions can be made in this circuit.

The antenna is a base-loaded vertical with 36 inches of radiating surface. Stiff piano wire, available at most model airplane shops, makes an excellent low-cost whip. When coupled to the loading coil, a *Millen* grid-dip meter will read almost to half-scale when the transmitter is properly tuned up.



Photograph above shows under-chassis view of the 6-meter transmitter-receiver unit. All receiver components are along the top and the transmitter is along the bottom.

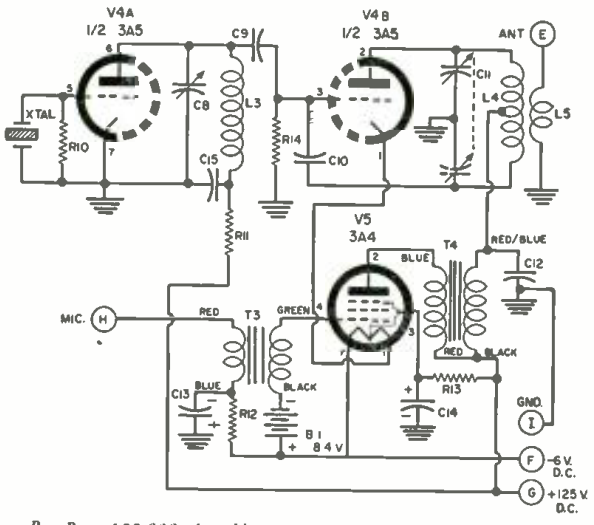


Fig. 2. Complete schematic diagram and parts listing for the two-tube transmitter is shown here. Note that 25-mc. energy from a third overtone crystal drives the final power amplifier, which doubles to 50 mc. A carbon microphone, coupled through transformer T_3, is connected to V_5, the modulator tube. The output of this tube is applied through the modulation transformer to plate of the final.

R_{10}, R_{14}—100,000 ohm, ½ w. res.
R_{11}—10,000 ohm, 1 w. res.
R_{12}—100 ohm, ½ w. res.
R_{13}—33,000 ohm, 1 w. res.
C_8—15 µµfd. var. capacitor (E. F. Johnson 15M11)
C_9—56 µµfd. disc ceramic capacitor
C_{10}—4.7 µµfd. disc ceramic capacitor
C_{11}—11 µµfd. butterfly var. capacitor (E. F. Johnson 11MB11)
C_{12}—.001 µfd. disc ceramic capacitor
C_{13}—100 µfd., 25 v. elec. capacitor
C_{14}—4 µfd., 150 v. elec. capacitor
C_{15}—.01 µfd. disc ceramic capacitor
L_3—12 t. #28 tinned wire, ½" dia., spaced dia. of wire (Air Dux #432)
L_4—14 t. # 28 wire, ½" dia., spaced dia. of wire, center-tapped (Air Dux #432)
L_5—2 t. #22 plastic covered wire, wound over center of L_4
T_3—Mike-to-grid trans. (Stancor A-4747 or Triad A-1X)
T_4—Mod. trans. 10,000 ohms c.t. to 5000/8000/10,000 ohms (Triad M-1X or equiv.)
Xtal.—25-27 mc. third-overtone crystal (International FA-9)
B_1—8.4-volt mercury battery (RCA VS312. See text on alternate)
V_4—3A5 tube
V_5—3A4 tube

"Deluxe" Power Supply

The only batteries used in the "deluxe" power supply and control circuit are four flashlight cells. Those supply the receiver directly or provide a source of energy for the transistorized power converter when transmitting. The supply consists of a *Triad* TY-68S transformer, two 2N255's for switching, and a set of silicon rectifiers connected in a bridge circuit. This transformer is designed to supply 250 volts with 12-volt input, at an efficiency of 75%. When used on 6 volts, the supply delivers 125 volts at 30 ma., with an efficiency of 70%. Base bias for the switching transistors is provided by R_{15} and R_{17}. Capacitor C_{16} filters the output and resistor R_{16} acts as a bleeder to drain the supply.

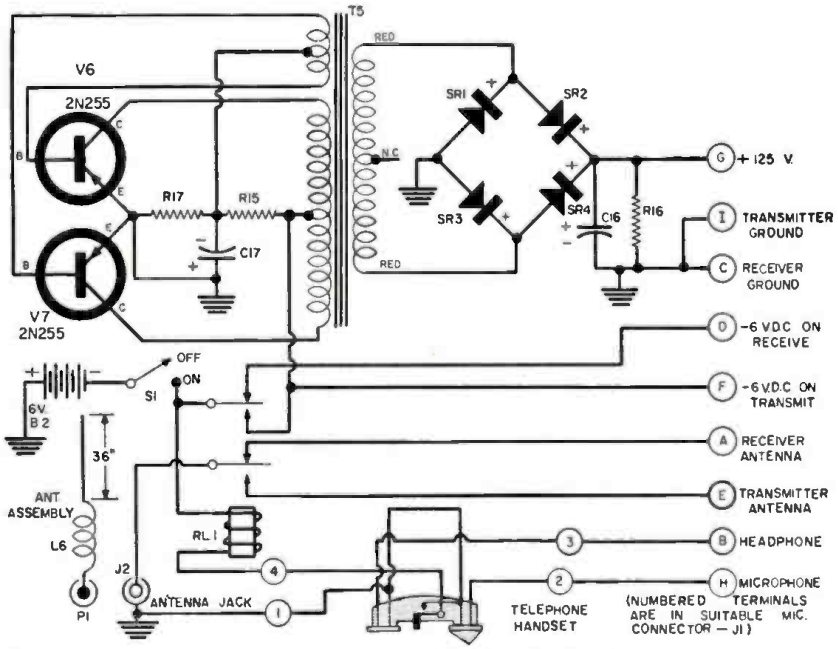
The 6-volt d.p.d.t. relay is used to control the various functions. The first section switches the −6-volt source from the transistor receiver to the power converter and transmitter tube filaments. The second section is used to switch the antenna from the receiver to the transmitter.

"Standard" Supply

Fig. 4 is the schematic of the "standard" control and power-supply circuit. In this circuit a d.p.d.t. toggle switch is used to change over power and antenna functions. Dry-cell batteries are used instead of the transistor power converter. With either power and control method, the performance of the "walkie-talkie" is the same. It should be pointed out that the constructor can use the push-to-talk scheme with the dry-cell circuit, but the battery life will be shortened considerably. There are several other combinations or variations that may occur to the reader.

Construction

The transmitter and receiver are



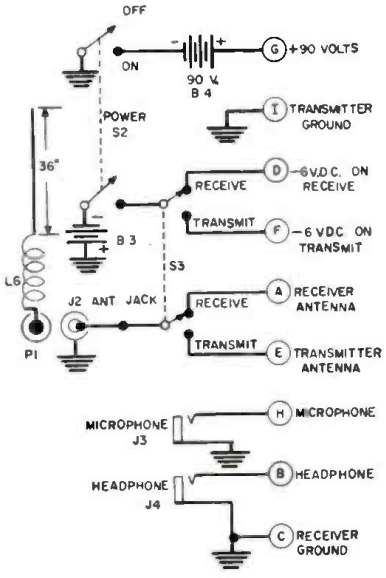
R_{15}—270 ohm, 1 w. res.
R_{16}—100,000 ohm, 1 w. res.
R_{17}—68 ohm, 1 w. res.
C_{16}—4 μfd., 150 v. elec. capacitor
C_{17}—25 μfd., 25 v. elec. capacitor
L_6—12 t. #24 en. closewound on ½" poly rod (see text)
RL_1—D.p.d.t. relay, 6 v. d.c. coil
S_1—S.p.s.t. toggle switch
T_5—Transistor power converter trans. 12 volts to 250 watts. (Triad TY-68S or equiv.)
SR_1, SR_2, SR_3, SR_4—1N538 silicon diode (G-E)
P_1—Male antenna coax connector, u.h.f. type
J_1—Four-pin microphone connector
J_2—Antenna coax connector, u.h.f. style
B_2—Four 1.5-volt flashlight cells
V_6, V_7—2N255 transistor (CBS-Hytron)
1—3½" x 6" x 10" aluminum case (L.M. Bender "Tite-Fit" chassis box #TF-784)
1—2" x 5" x 7" chassis (California Chassis Co. A-101)
1 pc.—36" length stiff piano wire
1 pc.—1¾" length of ½" dia. polystyrene rod
1—Telephone handset or carbon mike and separate headphone and switch
1—Plug to match J_1

Fig. 3. Deluxe control and power circuitry is shown here. Note the use of transistorized power supply as well as the push-to-talk circuitry employed.

wired inside a 2" x 5" x 7" chassis which is housed in a 3½" x 6" x 10" chassis box. In the forward part of the chassis will be found the receiver and audio circuitry. Mounted on the front apron of the chassis are the antenna jack, receiver tuning, regeneration control, and handset jack. The transmitter portion of the unit is located on the rear half of the chassis. There are no transmitter adjustments accessible outside the case since the circuits need no adjustment once the initial alignment is complete. A push-to-talk relay is located between the two sections, approximately on the center line. The cable from the power supply enters the chassis at the opposite end. Cheap Bakelite terminal strips are used in both the transmitter and receiver. They are visible in the underchassis view of the unit. The base circuit of the detector transistor is low impedance and can be tied to the "high loss" terminal strips without deleterious effect. Terminal strips between the modulator and final amplifier are used to mount the modulator components. A "space tie-point" is used at the cold end of L_3 to secure R_{11} and C_{15}. The components associated with the r.f. section of the transmitter are self-supporting.

The transistor power converter was mounted in the lower third of the case. An aluminum shelf directly above the power-supply components supports the four flashlight cells and the holders. Although the transistors were mounted on the outside of the aluminum case, the use of a heat sink was found to be unnecessary. These transistors run "lukewarm" and can be mounted inside the case, on porcelain stand-off insulators. The four rectifiers are mounted on a small terminal board which is secured to the bottom of the case. The filter and base bias components are mounted adjacent to the transistor terminals. There is no color coding on the power transformer wires, since they are enamel-covered wire, but the proper connections are clearly marked on the case.

Fig. 4. An inexpensive power and control system with batteries and manual switching.



J_3—Mike jack
J_4—Headphone jack
S_2—D.p.s.t. toggle switch
S_3—D.p.d.t. toggle switch
B_2—Four 1.5 volt flashlight cells
B_3—90-volt "B" battery (RCA VS090)

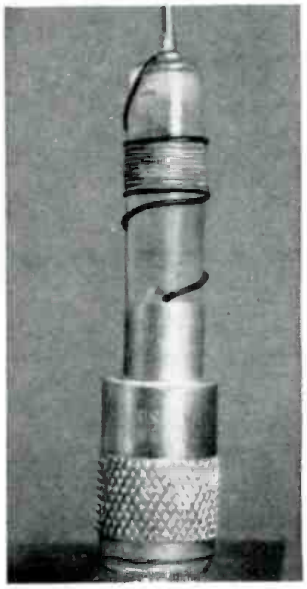
Antenna Construction

Drill out the inside of a standard coaxial connector with a 7/16" drill. Heat the connector with a heavy-duty soldering iron and force a 1¾" length of ½" polystyrene rod into the end. Drill a small hole, at an angle, through the poly rod. Pass the end of length of #24 enamel wire through the hole and connect it to the center pin of the coaxial connector. Loading coil L_6 consists of 12 turns of #24 enamel wire, closewound at the center of the poly rod. The coil should not be cemented in place until final alignment. The radiating element itself consists of a 36" length of piano wire, as previously mentioned, that has been tinned with solder about an inch from one end. The tinned end is heated and forced into the top end of the polystyrene rod.

Alignment

There is only one tuned circuit in the receiver section and its resonant frequency is adjustable from the front panel. Therefore, the receiver doesn't actually require alignment. However, the tuning range should be checked with a grid-dip meter or signal generator. Its tuning range will extend from about 49 mc. to something over 54 mc. Detector oscillation will occur with the regeneration control at approximately one-half rotation and with a collector current of .2-.4 ma. After the receiver

Close-up construction details of base loading coil. Whip consists of 3-foot length of piano wire. It is heated and forced into piece of polystyrene rod. Rod fits securely into a standard Amphenol PL-259 coaxial connector unit.



Cover Story

THIS month's cover shows our author Don Stoner trying out the 6-meter transistor-tube "walkie-talkie" he has just built and which he describes fully in the accompanying article. Don is making the contact with the self-contained loaded whip antenna. By picking a suitably high location on one of California's wooded slopes, a range of 5 miles is easily obtained. Contacts up to 60 miles have been made with a three-element beam.

Signals from the "walkie-talkie" are being received in the shack at the lower left on a Hallicrafters SX-101 (Mark IIIA). This receiver incorporates provision for reception on 6 and 2 meters with a converter. The SX-101 is a super-deluxe ham-band-only communications receiver which has just about all the features one would require for top-notch operation. Double conversion circuitry, crystal-controlled oscillators, "T"-notch filter, and built-in crystal calibrator are some of its features. Hallicrafters also has available for 6- and 2-meter use a complete transmitter-receiver unit, the SR-34, that might also have been used.

Alongside the receiver, is a Johnson Viking "6N2" transmitter and v.f.o. This is an efficient, compact rig with bandswitching to cover both 6 and 2 meters. Making use of the ham's existing modulator and power supply, input power is 100 watts on phone and 150 watts on c.w. The mike is an Astatic 10-C. —30—

(Cover photo by Ed Teal)

is working properly, the most sensitive spot for the regeneration control can be determined experimentally. This spot will usually be found beyond the point where the detector breaks into oscillation.

The crystal is an *International Crystal* third overtone type for 25 mc. The oscillator-tuned circuit should be resonant slightly higher than this frequency for proper operation. For the initial alignment, a *Millen* or similiar grid-dip meter will be quite handy for setting coils L_8 and L_4 to 27 mc. and 50 mc. respectively. If such an instrument is not available, set capacitors C_5 and C_{11} to minimum capacity and energize the transmitter. Connect a vacuum-tube voltmeter to the grid of the doubler (pin 3) and adjust C_5 for maximum negative grid voltage. You will notice that as the coil starts to resonate the circuit will cease oscillating abruptly. The proper setting for C_5 is just before this occurs. Turn the transmitter off and on several times to insure that the oscillator starts easily each time.

Next, connect a dummy load, consisting of a connector and #49 pink-bead pilot lamp, to the antenna connector. Adjust C_{11} for maximum brilliance of the bulb. To insure that the unit is stable, remove the crystal and note that the bulb goes out. Final alignment consists of "pruning" the loading coil for maximum radiated power. The turns should be spread or compressed until a grid-dip meter or receiver "S" meter reads maximum. Then C_{11} and C_5 should be rechecked to obtain the last milliwatt of radiated power. If a dipper is not available, the a.c. lead of a *Heath* V-7A vacuum-tube voltmeter (hanging near the antenna whip) will indicate when maximum output occurs. It is possible to read approximately 1.5 volts a.c. (actually r.f.) when the units are tuned up. If trouble-shooting should be necessary, a voltage chart for the transmitter and receiver is given in Table 1.

Cutting Corners

There are several spots in this "walkie-talkie" where a few dollars can be saved. For example, if an "L" shaped chassis were used it would effect a saving over the "chassis-within-a-chassis" arrangement used by the author.

Any transformer, surplus or not, that will match 10,000 ohms to 2000 ohms can be used for T_1 and T_2. A suitable multi-impedance transformer is available from several sources at a very inexpensive price tag.

A less expensive detector transistor is available as a substitute for the SB-103. This carries *Philco* part number T1324 and costs $1.65. The very tiny first audio transistor (2N207) can be replaced by a similar T0037 which nets for 75 cents.

It should be pointed out that these so-called "experimenter's transistors" are not rejects. As an example, the T1324 is simply a SB-103 that falls outside the parameter spread in one regard or another. Since they do not meet specifications, they are sold to experimenters at a much lower cost. In this particular application, they all seem to work about the same. Any of the transistors mentioned in connection with the receiver circuit can be obtained from any *Philco* distributor.

Conclusions

The "walkie-talkie" has proven itself quite capable over a five-mile obstacle path between Pomona and Ontario, California. Communication distance between units will vary widely, depending on the terrain and the altitude of the stations. Contacts up to 50 miles have been made with this unit although the device was never intended as a "DX machine." For CD work, the "walkie-talkies" have been "worth their weight in gold." Although no r.f. amplifier is incorporated in the receiver, little, if any, interference between units can be noted. The detector power level is so low that the units do not re-radiate more than 200 feet. Battery life, with either supply, is extremely good. An estimated battery life of 2000 hours on "receive" should be possible even with continuous operation. With a short "transmit-to-receive" duty cycle the batteries give many hours of service.

One peculiarity will be noted in the "walkie-talkie." Since the filaments are switched off when receiving, they take a second to come up to operating temperature when the push-to-talk button is pressed.

For the "transmitter hunters" in the crowd, this unit is very directional. By holding the unit near your knees, with the antenna about two feet from your body, a strong signal peak will occur when you face the hidden transmitter. For close-in work, turn the regeneration control off (full counterclockwise). The SB-103 then acts as a crystal detector and the receiver will have a range of approximately 1000 feet. The transistor detector can be damaged due to excessive r.f. pickup by the antenna. If you should operate the unit this close to a transmitter, grasp the loading coil. This will reduce the r.f. to a safe level. If you store your unit near your 6-meter station, remove the whip antenna. —30—

Table 1. Voltages and currents in receiver and transmitter sections of the unit.

RECEIVER SECTION

	V_1	V_2	V_3
Collector	—4.6 to —5.8*	—5.2	—4.9
Base	—0.1 to +0.2*	—0.08	—0.04
Current Drain	0.4 ma.	0.3 ma.	3.0 ma.

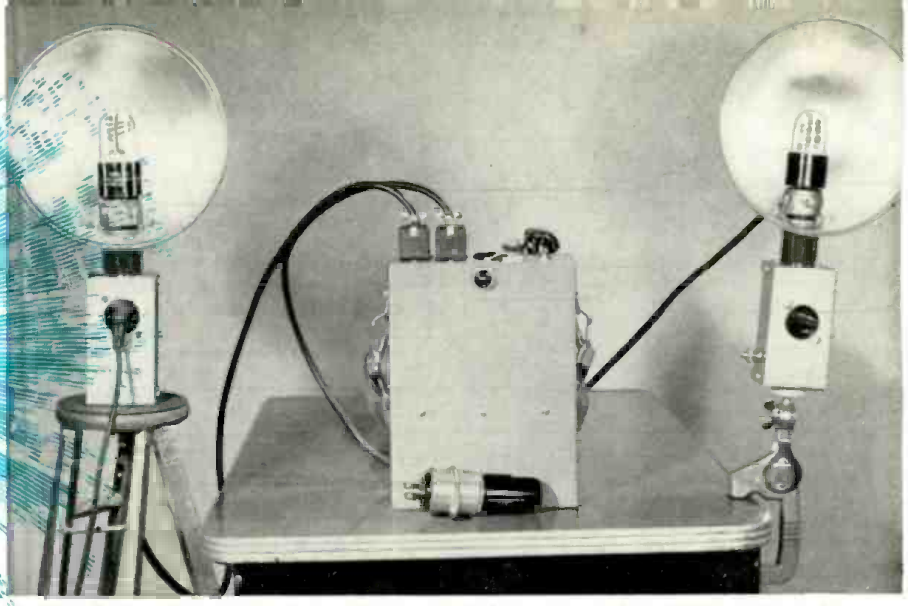
* Varies with setting of regeneration control.

TRANSMITTER SECTION

PIN NO.	V_4	V_5
1	—2.7	—2.7
2	125	125
3	—4	93
4	—1.35	—14.2
5	—9.0	—4.4
6	73	125
7	0	—6
Current Drain	Osc.—3.4 ma. Doubler—6.8 ma.	6 ma.

All readings taken with Heath V-7A vacuum-tube voltmeter.

Compact Electronic Photoflash



Photoflash unit is shown here with two flash tubes plugged in. Cable at the extreme left is for camera shutter connections. Photo slave adapter is in front of main unit.

◀ Cover has been removed to show placement of the battery used.

By **MARVIN CANTOR**

Construction of simple, lightweight unit resulting from careful planning and judicious choice of parts.

THIS author's particular complaint with "how-to-build" articles is that their authors usually boast of having built their brain children out of "junk box" parts. This display of ingenuity is commendable, but I find that attempting to duplicate their devices from *my* junk box usually gives them the appearance of their origin—junk, that is!

In building an electronic flash unit, such as the one described by Charles Hellman in the March 1953 issue of RADIO & TV NEWS, the author encountered problems of weight and bulk. Having had occasion to photograph everything from weddings to engineering symposia, necessitating long periods of carrying the unit, I have found that I had the choice of developing bursitis or strong shoulder muscles. All this forced me to build a flash unit which, as the result of careful planning and the judicious selection of parts, is extremely compact and will not cause the wearer to garner dirty looks when riding a crowded subway. Circuit theory of the speedlamp was adequately covered by Mr. Hellman and since it is not the author's purpose to duplicate his material, I would rather dwell on the construction refinements that have been incorporated in this unit.

The principal components of any speedlamp unit are the batteries and capacitors. A 100 watt-second portable unit usually contains two 525-μfd., 450-volt electrolytic capacitors with a dry battery supplying the required high voltage. The special high-capacitance, high-voltage electrolytics used by the author were *Sprague* FF-1 units, although equivalent capacitors are available from *Cornell-Dubilier, Mallory,* and *Illinois Condenser Co.*

This component, then, cannot be changed unless we decide to use one capacitor—giving a 50 watt-second unit but resulting in a 30 per-cent decrease in guide number.

Much research has been conducted by *National Carbon Company* with the result that they have on the market a 510-volt battery (*Eveready* #497) which measures 5⅝" x 1 19/32" x 3" and weighs 1 pound, 10 ounces. Compare this with the two batteries used in Mr. Hellman's unit measuring 4 29/32" x 2 29/32" x 3" and weighing 2 pounds, 8 ounces each!

Nothing comes free in this world, however, so it must be pointed out that with the same 100 watt-second load, the two 225-volt batteries will last twice as long as the single 510-volt battery. The conclusion is that we must sacrifice battery life to obtain a lighter unit. No financial sacrifice is involved, however, since one #492 sells for approximately the same price as a #497, resulting in the same cost-per-flash (about 1.6 cents).

Although the terminal voltage of the battery is 510 volts, due to the type of cell used the voltage will drop to 440 volts when applied to a 100 watt-second load.

The shelf life of the type of capacitor used in this unit is an important but often overlooked factor. Since the purchaser of these components has no way of knowing how long they have been lying on the dealer's shelf, there is some danger of overloading the battery when the unit is first turned on.

Tests have shown that capacitors which have had no voltage applied for about 20 months have an initial leakage current, in the first minute of charging, in excess of 20 ma. By contrast, capacitors which have had no voltage applied for one month have an initial leakage current of less than 3 ma. in the first minute of charge. This is, of course, due to the reforming of the electrolytic film. The speedlamp unit itself must, in fact, be turned on at least once a month in order to preserve this forming layer or damage to capacitors and battery will result. To avoid this, an auxiliary d.c. high-voltage input has been provided. It may also be used for operating the unit from a.c. lines with the external d.c. supply.

Using one flashlamp at the camera usually results in a "flat" picture with little modeling of facial features and insufficient separation of the subject from the background. For this reason, a second output socket has been added for a second flashlamp, both sockets merely being wired in parallel. Since the energy of the capacitors will discharge equally through both lamps, each lamp will then be a 50 watt-second unit, necessitating appropriate changes in the lens aperture.

The DX-type lamp (*Sprague* FA100) plugs into an Edison-base adapter (*Sprague* FA102) from which the cable leads to the power-supply plug. The adapter, in turn, screws into an Edison-to-wall outlet adapter which plugs into

a "Minibox". This method was used because of the quick connect-disconnect feature thus made possible. The "Minibox" holding the lamp has three polarized a.c. receptacles wired in parallel. The top receptacle is for the lamp itself and the front and back receptacles for connection to the camera synchronization cord or a photocell tripper for the flash unit. The photocell tripper is used in conjunction with another electronic flash unit thus making possible the use of four separate lamps or the remote operation of another unit. The base of the "Minibox" contains a ⅜-inch thick piece of brass, tapped for a ¼-20 screw so that the lamp may be mounted on a tripod or a *Kodak* "Flexiclamp".

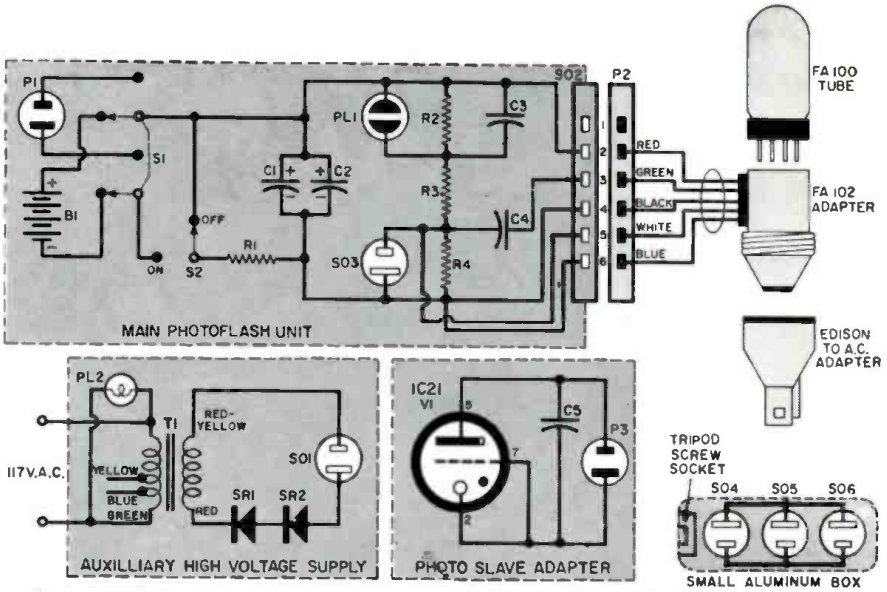
The case for the unit is an *Insuline* "Fleximount" chassis (#29444) cut down to size. The inner container and shield for the capacitors is bent out of a piece of light gauge aluminum. It is supported by three screws through the front panel and two angle brackets at the top.

As can be seen from the photograph, there is no waste space inside. All components are fitted rather snugly, making careful wiring and the liberal use of insulation a "must". Once put together, however, there is no chance of a shock when changing batteries.

It might be mentioned in passing that S_2 in the "off" position discharges the capacitors. This little safety feature is, surprisingly, rarely used in commercial units, thus leaving the capacitors always on charge. The resulting shock to the careless individual replacing batteries is guaranteed to change his facial expression a bit.

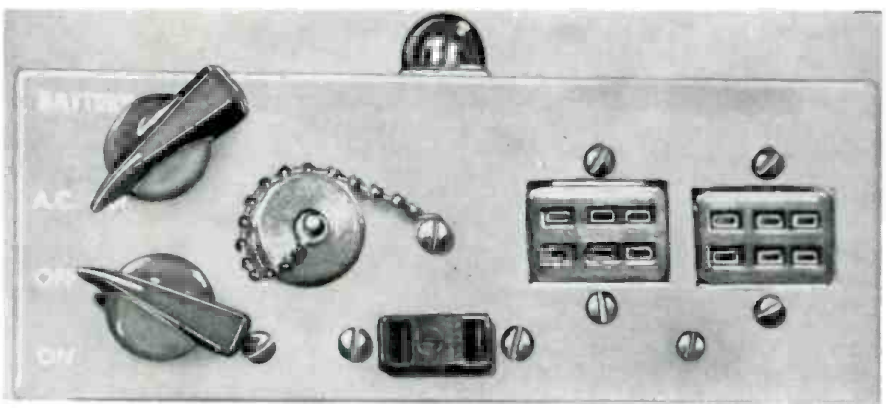
A word about guide numbers. Guide numbers are exactly that. They are meant to be used as guides and will vary according to the type of equipment you are using and how you like your negatives—thin or contrasty.

Care and forethought in building this unit will result in an electronic flash rivalling commercially made units in both appearance and compactness—to say nothing of performance. —30—

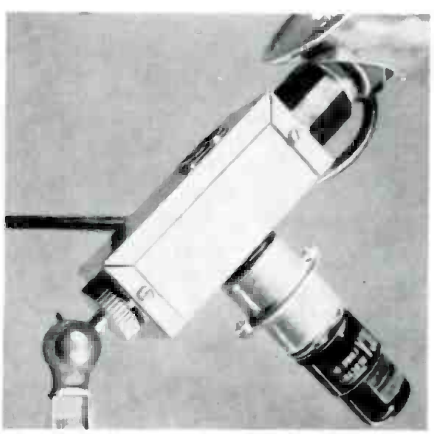


R_1—500 ohm, 5 w. res.
R_2—1.5 megohm, ½ w. res. ± 5%
R_3, R_4—3.3 megohm, ½ w. res. ± 5%
C_1, C_2—525 µfd., 450 v. elec. capacitor (Sprague FF-1 or equiv.)
C_3—.05 µfd., 200 v. capacitor
C_4—.25 µfd., 400 v. capacitor
C_5—.5 µfd., 200 v. metallized paper capacitor
SR_1, SR_2—25 ma., 260 v. selenium rectifier (Radio Receptor 16Y1)
T_1—Photoflash trans. 105/115/125 v. a.c. pri.; sec. charges up to 1050 µfd. to 450 v. d.c. (Stancor P-6425)
SO_1—Polarized receptacle (Amphenol 80PC2F)
SO_2—Output socket (Cinch-Jones S306AB)
SO_3—Receptacle (Cinch-Jones 2R2)
SO_4, SO_5, SO_6—Polarized receptacle (Amphenol 61F1)
P_1—Polarized plug (Amphenol 80PC2M)
P_2—Plug for lamp (Cinch-Jones P306CCT)
P_3—Polarized plug (Amphenol 61MP)
S_1—D.p.d.t. rotary switch (ICA 1289)
S_2—S.p.d.t. rotary switch (ICA 1287)
PL_1—NE-51 pilot light and holder (Dialco 95410)
PL_2—117-volt pilot light
B_1—510 volt (440 v. under load) battery (Eveready #497 or Burgess U320)
V_1—1C21 photo tube
2—Shells (Amphenol 61-61, see photo)
1—Case (Insuline "Fleximount" chassis 29444, cut to size)
1—100 watt/second, 450 volt flash tube (Sprague FA-100)
1—Tube base-to-Edison adapter (Sprague FA-102)
1—Edison-to-a.c. outlet adapter
1—Reflector (Sprague FA-101)

Schematic of photoflash. Note that SO_2, SO_4, and SO_5 are in parallel and may be used as either camera shutter connection or as receptacle for the photo slave adapter. Mark SO_5 with correct polarity. SO_6 is for the Edison-to-a.c. adapter.



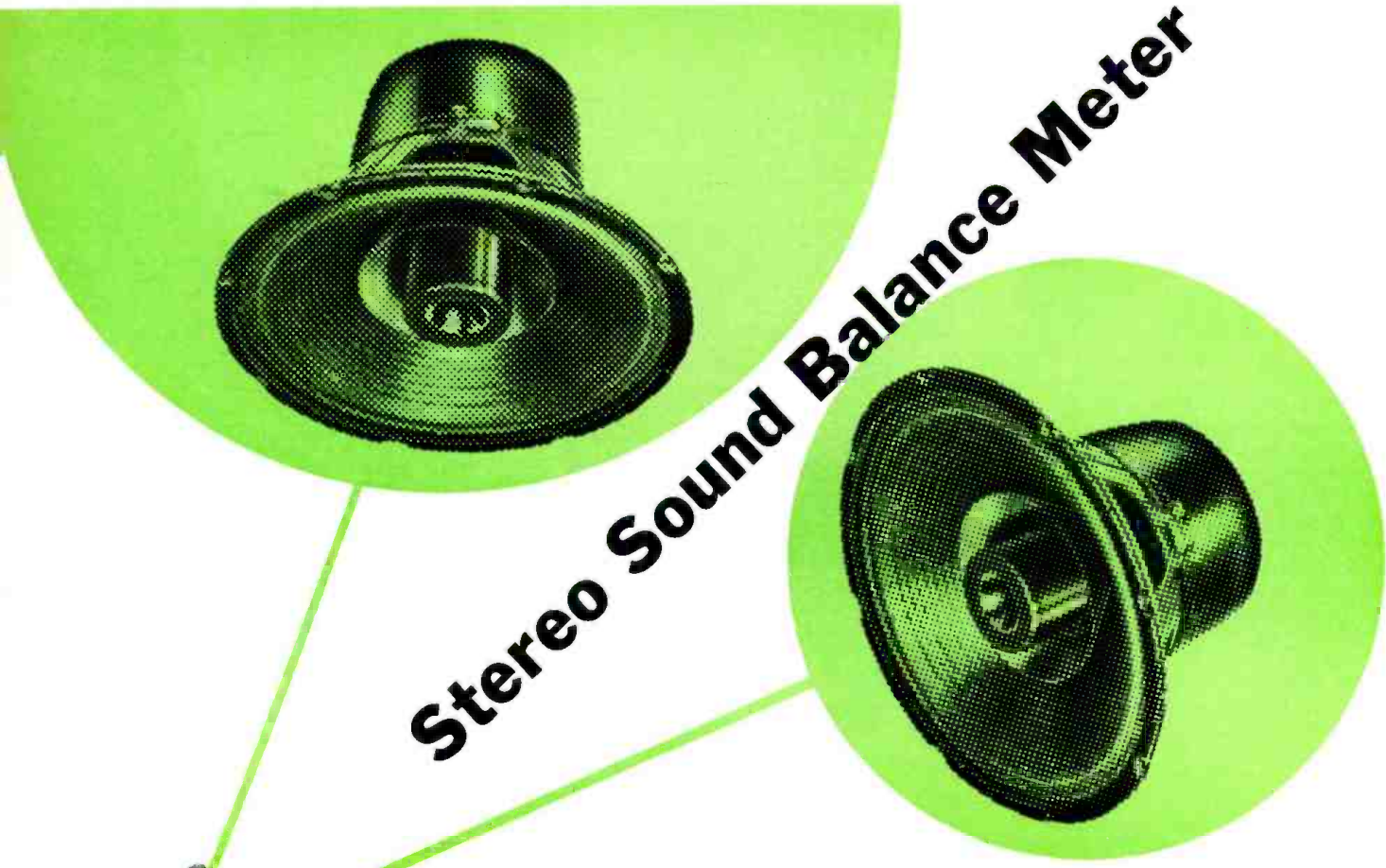
▲ Top view of main unit showing S_1 and S_2, with cap on P_1, which is used for connection to auxiliary high-voltage supply. Note that two 6-terminal output sockets, wired in parallel, are used. SO_3, also shown, is for shutter or slave adapter unit.



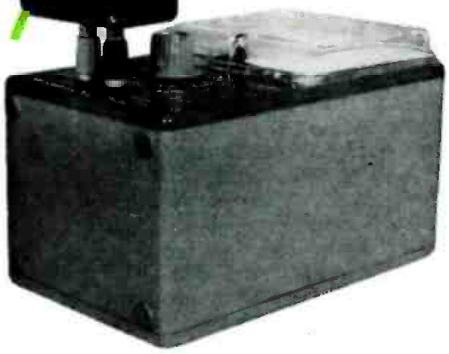
Lamp housing showing the photo slave adapter plugged into the back receptacle (SO_5), for use as a slave unit. Note how the 1C21 tube has been mounted atop a pair of back-to-back Amphenol socket shells. ▶

(Far right) Front view of the auxiliary high-voltage d.c. power supply is shown.

Stereo Sound Balance Meter



The sound level instrument is plugged directly into the input jacks of an audio v.t.v.m. With the meter in this horizontal position, the operator, when standing behind the instrument, can conveniently manipulate the controls on the meter and can see meter face clearly. Sound unit front faces sound source.



By **HAROLD REED**

Here is how to eliminate guesswork in balancing your stereo system with this simple sound level meter used with an audio v.t.v.m.

THE device to be described in this article is designed as an accessory to an audio vacuum-tube voltmeter or a.c.-d.c. voltohmmeter—the combination converting the voltmeter into a sound-level indicator which provides visual indication of the acoustic output level from any loudspeaker. It is a valuable addition to the test equipment line-up of both audiophiles and technicians engaged in setting up stereophonic systems. The device was designed with low cost, compactness, and ease of operation as basic criteria.

One of the most important considerations in a stereo setup is the balancing of the sound level from the two loudspeakers. The most favorable speaker locations in any particular room depend on the room acoustics and the sound level desired, as well as on the personal preferences of the listener. Trying to obtain the correct sound balance by ear does not always give the best results as one is never quite sure that proper balance has been obtained.

Circuit Description

The schematic diagram of this v.t.-v.m. accessory is given in Fig. 1. A small 2½" PM speaker is used as a microphone to pick up sound output from the stereo speakers. Its 3.2-ohm voice coil works into transformer T_1, a 3.2:1000-ohm unit. An impedance of 1000 ohms is about right for the input circuit of the first transistor stage, V_1. The audio signal is fed to the base of V_1 through capacitor C_1. Proper bias and stabilization of the first transistor stage is provided by resistors R_1 and R_2. Coupling to the base of the second stage, V_2, is through capacitor C_2 and volume control R_4. Bias and stability conditions are taken care of by the resistance of the volume control and R_5. Audio output for the indicating meter is obtained through capacitor C_3 which is connected to the output terminals.

Power for the circuit is supplied by a miniature 15-volt battery. The minute power output from the small speaker-microphone is, therefore, amplified to a suitable level to provide a satisfactory reading on an a.c. vacuum-tube voltmeter.

Construction

The little device is assembled in a miniature 3" x 2⅜" x 1⅜" plastic speaker baffle. This baffle was designed for use with the speaker selected for this application.

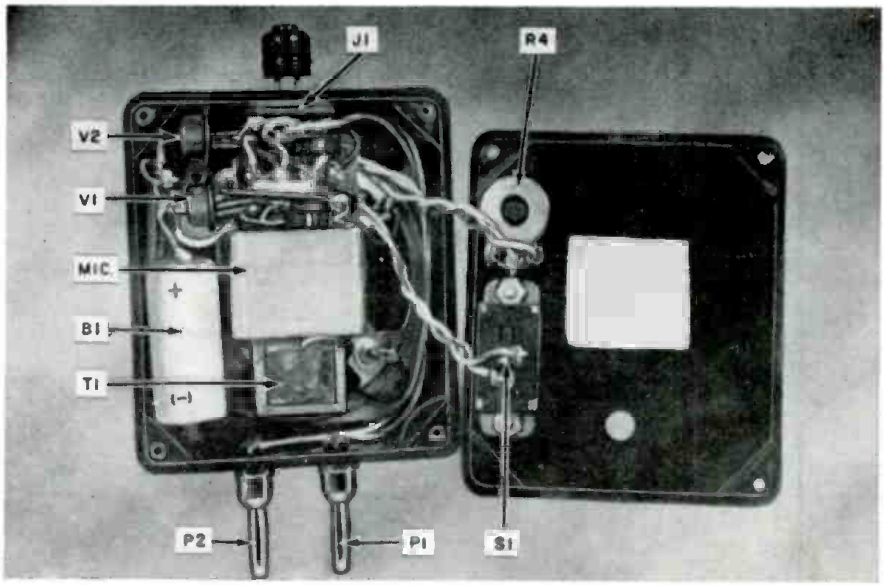
A small piece of perforated Bakelite board, equipped with solder terminals, is used as a tie point for the various components. This board may be made from the Bakelite strips and the flea

clips that are readily available. The terminal board was fitted with two small home-made metal brackets which were soldered to the speaker framework. The transistors, resistors, and capacitors were soldered directly to the terminals as shown in one of the photographs. The battery is connected to these same terminals with #16 insulated leads. The back of the speaker case fits snugly against the battery and this, together with the heavy wire leads, keeps the battery firmly in place. The tiny matching transformer is also soldered directly to the metal framework of the speaker.

The small, slide-type power switch and miniature gain-control potentiometer are mounted on the back plate of the speaker baffle. This is convenient, since the device is normally used with the operator standing at the rear of the unit as will be described later. Flexible wire leads are used for connection to the gain control and power switch.

The rear of the speaker is quite close to the back of the baffle and since the case is not designed for speaker mounting screws, a small piece of sponge rubber, about ⅛" thick, was cemented to the back plate of the baffle and when screwed into place this holds the speaker firmly in position. If desired, the speaker face may be cemented to the front of the baffle. The transistors, which probably won't have to be replaced, and the battery may be removed without detaching the speaker from the case.

Output connections are taken to two banana plugs attached to the bottom of the speaker case. These plugs are spaced ¾" apart so the device may be plugged directly into the input terminals of an audio v.t.v.m., as shown in the photograph. The baffle comes equipped with a built-in jack and miniature plug. This jack is connected in parallel with the banana plugs. By means of the miniature plug, the output may be fed to other type meters or to a tube or transistor power amplifier for other applications.



Inside view of the sound level meter with all important parts clearly labeled.

Substitute Parts

The constructor may build this device using the parts given in the parts list; however, some readers may wish to substitute components from their "junk boxes." For instance, CK722 transistors can be employed in place of the 2N107's without any circuit changes or 2N180 transistors may be used. The latter will provide higher gain than the other two types.

Likewise, speakers with other voice-coil impedances can be substituted by using a suitable matching transformer. Different transformers may be connected in the input circuit—the parts list suggesting only two of the available units. An input impedance of 1000 ohms is about right for feeding into the base of the first transistor stage. The author used the less expensive 3.2: 500-ohm transformer, type TR-95, with satisfactory results.

Further, any small speaker may be built into any suitable metal box or cabinet in place of the plastic baffle suggested. Other output connectors than the ones given may be substituted and coupling capacitors can be any value from 1 to 6 μfd.

The unit shown was designed with both satisfactory results and low cost as objectives. The parts for the unit, as described, cost about $7.00.

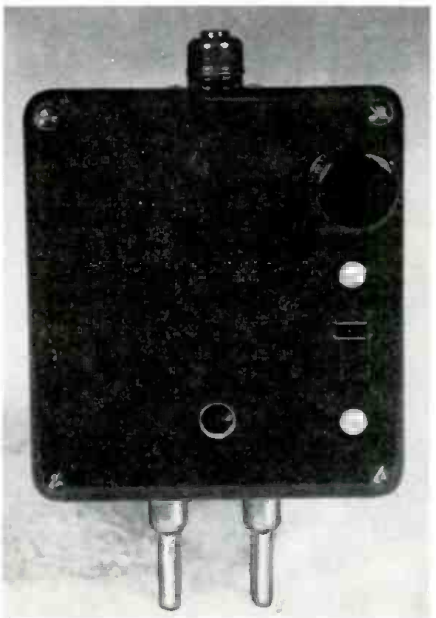
Operating Data

It has been recommended that the speakers of a stereophonic system be placed about 8 feet apart. Also, it has been specified that the listening position be from 12 to 15 feet from the speakers and midway between them. Using these recommendations, the sound balance meter should be set up as shown in Fig. 2. It can be placed on a small table at the listening position. Due to space limitations it may not always be possible to attain the "ideal" embodied in the recommendations, but irrespective of the physical arrangement, the important point concerning balance measurement is that the measuring device be placed at the listening location and oriented so that it is facing toward the mid-position between the two speakers.

Have the power switch, S_1, off and the volume control, R_4, turned all the way down. Set the v.t.v.m. switch to the 0.3-volt range. Feed the output of an audio oscillator, at 1000 cycles, to channel 1 of the stereo system. Adjust the volume control of this channel for moderate sound output from the channel 1 speaker. Stand behind the sound

Front view of the sound level instrument. The banana plugs are at the bottom and the miniature plug and jack, supplied with the speaker case, are at the top of the plug-in unit.

Rear view of the sound level instrument. Note that the miniature volume control potentiometer and the slide-type power switch are attached to the right of the back plate of unit.



Stereo Sound Balance Meter

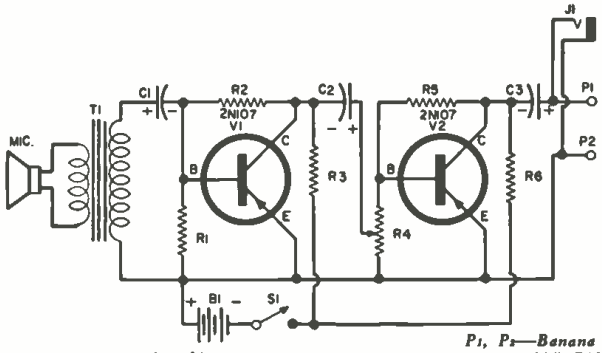


Fig. 1. Complete schematic diagram and parts listing for the sound level meter. Note that V_1 and V_2 may be 2N107's, CK722's, or 2N180's. Parts are not critical and substitutes may be used.

R_1—12,000 ohm, ½ w. res.
R_2—120,000 ohm, ½ w. res.
R_3—24,000 ohm, ½ w. res.
R_4—10,000 ohm miniature pot
R_5—150,000 ohm, ½ w. res.
R_6—7500 ohm, ½ w. res.
C_1—2 µfd., 6 v. elec. capacitor
C_2, C_3—2 µfd., 15 v. elec. capacitor
S_1—S.p.s.t. slide switch
J_1—2-conductor, open-circuit jack (included with speaker baffle)
P_1, P_2—Banana plug
Mic.—2½" PM speaker, 3.2 ohm v.c. (used as microphone)
B_1—15-volt battery (Eveready #411 or Burgess U10)
T_1—Transistor trans. 3.2 ohms to 1000 ohms (Argonne AR-138 or Lafayette TR-95, see text)
Speaker Baffle—3" x 2⅜" x 1⅜" speaker baffle (Lafayette MS-315)
V_1, V_2—"p-n-p" transistor (G-E 2N107. See text for other types)

level meter and throw the power switch on and adjust its volume control to obtain a suitable indication on the audio v.t.v.m. The v.t.v.m. may be switched to the 0.1-volt range if necessary, depending, of course, on the sound level from the speaker. Mid-scale on the meter is a good reference point. Note this meter reading.

Now, feed the oscillator output to channel 2 of the stereo system and again stand behind the sound level meter. Note the meter reading obtained from the channel 2 speaker. If it is higher than the reading noted when feeding the signal through channel 1, decrease the gain control of channel 2. Likewise, if the meter reading is lower, increase the gain control of channel 2. The purpose of this adjustment is to obtain the same reading from both speakers. The volume control of the sound-level unit should not be changed once it is adjusted for a reference reading with the 1000-cycle signal being transmitted through the first channel. When comparing the levels from each channel, as indicated on the v.t.v.m., it is important that these readings be observed from the same position directly behind the sound-level device, otherwise erroneous readings may result due to different sound-wave patterns reflected from the body of the operator when standing in different positions. This is a precaution to be taken when using any type of acoustic sound measuring instrument.

Balance adjustment may also be accomplished by using an audio tone test record on the record player of the system or with a test signal from a magnetic tape instead of the audio oscillator suggested previously.

Another factor to be considered for favorable stereophonic listening is speaker phasing, that is, the speaker cones should move forward and backward in unison. A sound image occurs midway between the two speakers when the sound level and audio frequency reproduced by them are identical and the signals are in-phase. Out-of-phase speakers in the same room cause a certain amount of sound-wave cancellation and results in thin sounding, instead of full bass frequencies.

Feeding the audio oscillator to the input of both channels of a stereo system and adjusting the channel gain controls for equal sound levels from each speaker, the effect of out-of-phase speakers was detected by the author on the sound balance meter. When the speakers were connected from out-of-phase to in-phase condition, the sound level increased 6 db as read on the db scale of the audio voltmeter. The best audio frequency for making this test is 400 cycles since it provides the greatest change in the meter reading. These results will vary with different installations. The important point in any case is to connect the speakers for maximum indication on the meter.

Another use for this sound-level device is in comparing the efficiency of identical speakers. The speakers, in turn, are placed at a distance, say 5 feet, from the sound-level instrument and the relative sound outputs noted on the meter. In making this test, each speaker must be placed successively in exactly the same position, the same frequency (400 or 1000 cycles) must be used, and the same signal level maintained as read across each voice coil with a v.t.v.m. It is preferable to make this measurement with the speakers and test instrument in an open area as far as possible from surrounding objects in order to minimize the effects of reflected sound waves. Also, it is necessary to stand in the same spot behind the sound-level meter, as previously explained.

The reader will now realize that this little instrument can be used for many relative sound-level measurements, both in comparison tests and in ascertaining when a sound level has increased or decreased when altering certain environmental conditions. Besides its use as a sound-level device, it may be employed as a general purpose two-stage amplifier and can be worked into a vacuum-tube or transistor power amplifier.

It was mentioned previously that an a.c.-d.c. voltohmmeter could be used as the indicating meter. An *RCA* "Volt-Ohmyst" was tried and worked satisfactorily. Of course, it is not as sensitive as the audio v.t.v.m. but with the switch in the 1.5-volt position and a higher sound-level output from the stereo loudspeaker, satisfactory balance measurements were made.

The life of the battery will be long since the total current drain is just 1.7 milliamperes. —30—

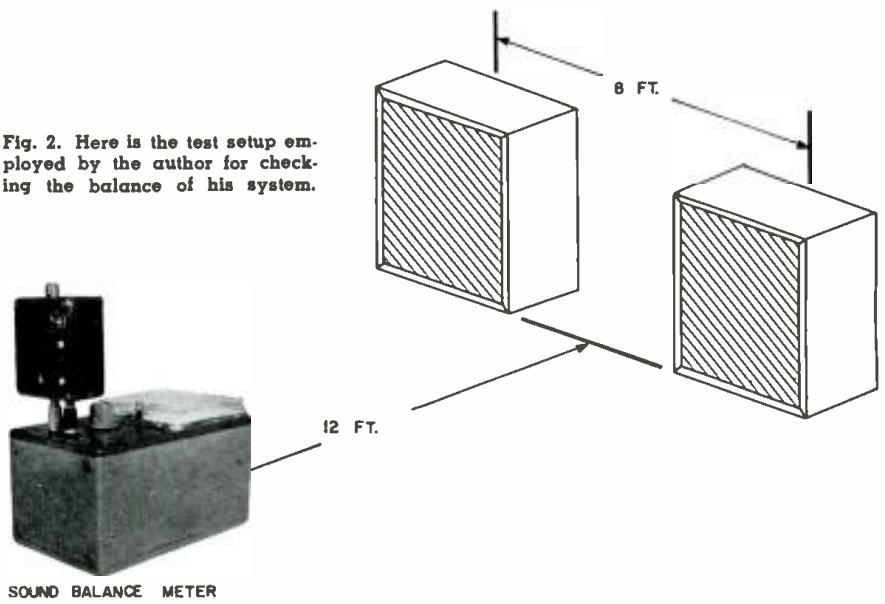


Fig. 2. Here is the test setup employed by the author for checking the balance of his system.

Is the Name Right?

By **WILLIAM LEONARD**

To establish a desirable image and identification in customers' minds, careful choice is important.

MANY THINGS have happened in the transition of TV service from the early days of "easy business" to the present era of tough and complex competition. With the steady broadening of the public's knowledge of TV tubes and circuitry, set owners are better able to appraise the value they get for their TV service dollars.

New faces and new forces have entered the TV service picture since the days when the battle for consumer service dollars was waged almost entirely between service dealers—and their technicians launching out on their own. High on the list of new competitive forces are the drug stores, supermarkets, and filling stations that now take a healthy slice of the service dollar with self-service tube testers.

Following the pattern of other industries that once mushroomed into tremendous size, many dealers fell by the wayside when normal economic forces started to work in TV service. As consumer electronic service gradually shifts from the status of a technical activity to its true economic role as a business, dealers who fail to keep in step with the changing tempo will find it very difficult to maintain a satisfactory volume of profitable business.

Fortunately, thousands of independent service dealers have re-oriented their activities to incorporate sound business practices in the management of their service shops. These dealers have learned to merchandise service. Through trial and error they have found the advertising and promotional methods which, in their areas, help them to maintain the volume of business they must have to operate profitably.

From a merchandising standpoint, consumer service on electronic products still offers some unusual and unique opportunities for the development of small businesses. Consider, for example, the extent of the market for electronic service. In every home there are at least two electronic devices that are in almost constant use. At one time or another, each of these devices will need service. Many electronic products, particularly radios and record changers, are often set aside when they need service because the owner does not know who to call to service them. Many technicians on TV service calls have been astounded when a customer would ask: "Do you know anyone who can repair a radio set?" In one case of record, a customer gave the TV technician five radios to take back to the shop with him when he told her that his firm repaired them too.

A few years ago, in a survey made in a fifty-block area in a midwestern city, it was found that fifteen per-cent of the people contacted had some type of electronic product they would like to have serviced. There were five small TV service shops scattered over this same fifty-block area. Less than twenty per-cent of the people interviewed knew of the existence of these five shops. The survey also indicated that one shop not located in the area —a shop that used a distinctive name and emblem and was aggressively promoted—was getting more service business from that area than all of the five shops that were located in it!

The present general, basic weakness of TV service shops as business establishments is the lack of a definite business personality for the activity as a whole. In appearance, electronic service shops are as different and varied as the faces of the owners. There is no widely used general characteristic in the appearance of service businesses to help the public quickly identify those that service TV, radio, and other electronic devices.

Looking back over the years, there was a time when gasoline stations were as varied in appearance as are the TV service shops of today. Down through the years, the transition in appearance has given the gasoline retailing industry a distinct personality that connotes efficiency, cleanliness, and service.

Similar trends have been at work in practically all other basic retail and service establishments. What once were universally known as grocery stores are now called food marts or supermarkets to designate the broader range of products they handle. While drug stores have clung tenaciously to their original name, the modern drug store is a combination of drug, novelty, hardware and camera businesses, topped off with a sandwich and ice cream bar. *(And sometimes with a tube tester, too!—Ed.)* In both cases, there is a rapid trend toward standardization in appearance that makes for quick and easy identification.

Independent electronic service shops, striving to maintain a dominant position in their multi-billion dollar market, should take a long and sharp look at the psychological advantages that could be gained by making it easier for the public to recognize their type of business.

The second strong deterrent to the development of public confidence in the industry is the conglomeration of names by which service dealers identify their businesses.

Every man who starts a business of his own naturally has a yen to proclaim his ownership of the enterprise. There are some, of course, who do instead adopt names they feel will create customer confidence. Given or first-name designations for an electronic service business may have a strong appeal to the technician who has labeled his establishment with his own first name or nickname, but they seldom ring a bell with the general public. A chap by the name of Mike may be a terrific technician but, when he hangs his name on a service business, he may be competing, in the public's mind, with "Mike's Tavern" or "Mike & Molly's Chili & Hot Dog Emporium."

Obviously, with so many thousands of independently owned service shops active in the business, a dictionary of

(*Continued on page* 108)

New Electronic Range

◀ Electronic cooking for restaurants took another step toward realization recently when *Raytheon* introduced its new commercial-type "RadaRange" oven at a price tag 13 per-cent lower than the previous model. The new Mark III range will sell for $2595. The unit uses two a.c. magnetrons to produce the microwave energy that is used to cook food in a fraction of the time required by conventional methods.

Battery-Powered Artificial Larynx

This "Electro-Larynx" is a new hand-operated portable instrument which artificially vibrates a column of air in the esophagus, from which normal speaking sounds can be produced. The instrument, developed by *Kett Engineering Corp.*, Santa Monica, Calif., is intended as a speaking device for persons who have had their vocal cords removed. The unit is powered by a *Gulton Industries* rechargeable nickel-cadmium battery which can operate the instrument for an entire day. ▼

Recent Developments in Electronics

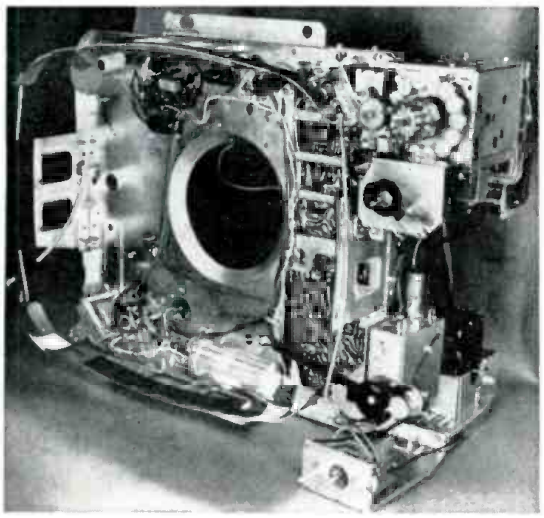
▲

Lightweight TV Camera

This four-pound transistorized TV camera and twelve-pound battery-powered "backpack" TV transmitter have been developed by *Dage Television* to provide the military with completely automatic, lightweight equipment able to transmit live pictures from front lines or remote locations without cables or heavy power supplies. Range is ½ mile.

Original Neutrodyne now at Smithsonian

The original Neutrodyne receiver, recently accepted as part of the permanent exhibit at the Smithsonian Institution, is pictured below with its inventor, Alan Hazeltine. The circuit, popular in the 1920's, uses two neutralized triodes as r.f. amplifiers and reflexed audio amplifiers. A grid-leak triode detector is the third tube. The antenna tuning coil and the two r.f. interstage coils are mounted at the 55-degree angle specified by the inventor to prevent magnetic feedback coupling. ▼

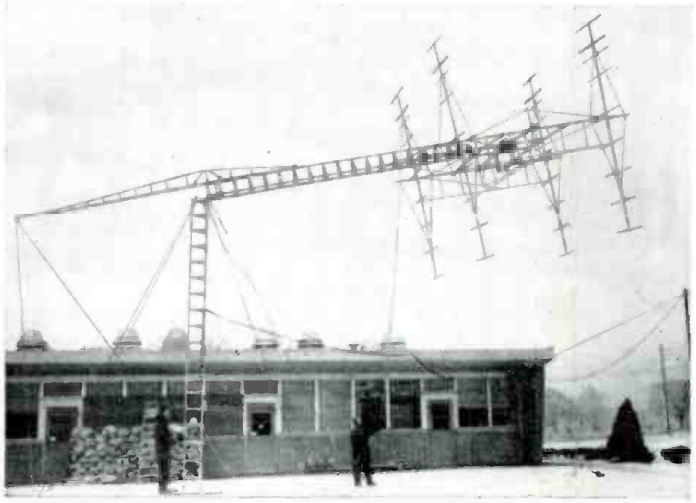


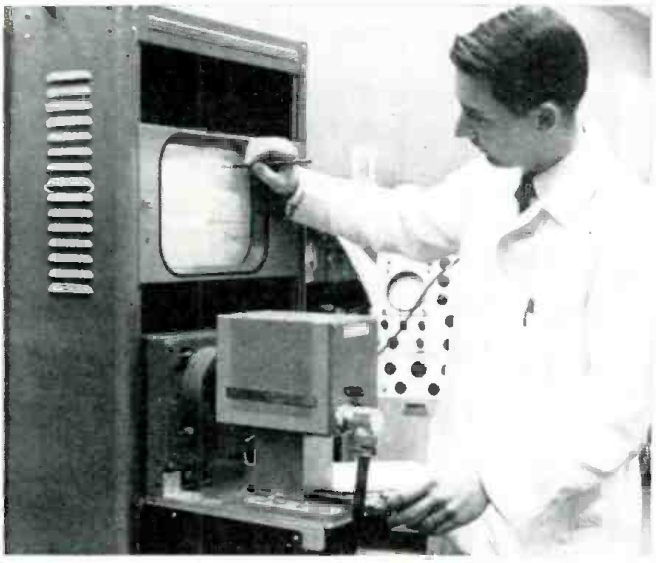
Easy-to-Service TV Chassis

◀ The new *RCA Victor* "Thin Twin" portable TV chassis appears to have been designed with the technician in mind. Shown here is a view of the chassis from the front with the picture tube removed. Work can also be done on the chassis without removing the tube. Printed boards are used on which component identification and interconnections are shown in white ink on the top side.

Antennas Used to Track Satellites

At the Chemical and Physical Research Laboratory of the *Standard Oil Co. of Ohio,* located in a Cleveland suburb, *Finco* antennas are playing a vital role in establishing orbital patterns of "Sputnik," "Vanguard," and "Explorer" satellites. These antennas, coupled to sensitive receiving equipment, were able to easily follow the paths of the Russian "baby planet" and our own moon probes. ▼





▲

Closed-Circuit TV for Transistor Research

Closed-circuit television is being used by development engineers at the *General Electric* Electronics Laboratory to make transistor research faster, easier, and safer. By combining a closed-circuit TV camera and receiver with a special pulse-measuring oscilloscope, transistor evaluation and high-speed circuit development have been stepped-up by as much as 30 per-cent.

Remote TV for Reactor

A miniature television camera atop the loading face shield covering the core of the Sodium Reactor Experiment is adjusted by a technician of *Atomics International.* The camera is attached to an indexing ring which is centered over one of the fuel-element plugs. When the element moves through the ring, the television pickup is made. The tiny lights inside the ring provide illumination. The use of closed-circuit TV has enabled scientists to immediately determine the condition of fuel elements during transfer to the nuclear power reactor's core. ▶

Replacement Problems:
COILS & TRANSFORMERS

By **WALTER H. BUCHSBAUM**
Television Consultant, ELECTRONICS WORLD

Audio, sync, deflection, peaking, i.f., r.f., and power-supply inductors—how to handle them.

THE ease with which deflection yokes, flyback transformers, and many other types of inductors found in TV receivers can be replaced depends on whether a suitable part can be obtained from the local distributor or whether the set manufacturer must be contacted.

In the early days of TV servicing, most deflection yokes, flyback transformers, power transformers, and practically all i.f. coils were special parts available only from the set manufacturer. Today the replacement market is large enough so that manufacturers can design "universal" parts for use on several different makes of receiver. Furthermore, every jobber who carries a line of TV replacement parts also has catalogues, usually supplied by parts manufacturers, that show the correct "universal" replacement for each TV set make and model. Typical of this is the case of replacement flyback transformers. Several manufacturers furnish catalogues listing TV receivers by manufacturer, year, and model together with the number of their recommended replacement flybacks, yokes, etc.

Other inductances in the TV receiver are expressly designed for some special circuit or use unique mounting methods so that a direct replacement is not obtainable from local sources. Sometimes it may be possible to use a "universal" replacement, but then minor circuit changes may have to be made. This article will deal with the selection and installation of replacements for all types of inductances used in TV receivers. The significant electrical and mechanical characteristics for specifying the correct "universal" replacement part will be discussed and hints given as to adjustment, alignment, and circuit changes that might be required as a result of the change.

R.F. and I.F. Inductors

These components are usually defective either because they have open or shorted turns or because they are damaged mechanically. On some tuners the coils can be repaired. Occasionally i.f. coils can be carefully resoldered, but in many cases a complete replacement is necessary. Whenever a coil or transformer in the tuner or i.f. section is replaced, the complete alignment procedure for the entire section must be performed. This is an important consideration when determining the price for replacing a coil that is, in itself, relatively inexpensive.

TV tuner coils: For switch-type tuners, it is sometimes necessary for the entire switch segment to be replaced, especially where mechanical damage is involved. Many jobbers now carry a complete line of replacement parts for widely used tuners but, if the TV set manufacturer uses his own tuner, a replacement from the factory may be required. Turret tuners such as the *Standard Coil* models, can be repaired with relative ease, especially since complete repair kits are now in jobbers' stocks. In many instances, it is possible to exchange the defective coil segment with that of an adjacent, unused channel, which can then be aligned to the desired frequency.

I.f. coils: A typical assortment of jobbers' coil replacements is shown in Fig. 1. It includes traps, i.f. transformers, and even video peaking coils. In the case of single coils, the replacement problem is not serious since most of the replacement coils cover a wide enough tuning range and fit into a standard mounting. When a shielded coil is defective the problem is aggravated. The replacement coil must also be shielded and, if an exact duplicate is not available, the unshielded unit may be mounted in the original shield can. This requires careful soldering and assembly. Single-tuned i.f. stages are usually loaded down by a grid or plate resistor which is designed to give the coil the correct broad-band response. Be sure that the over-all i.f. response curve is not altered by the new coil, otherwise the value of the loading resistor may have to be changed.

I.f. transformers and traps: With these components tuning alone is not the determining factor, but the coupling between windings and the relative "*Q*" of each is very important. These parts are frequently mounted in shield cans. Unless the technician is very familiar with i.f. coil work, only an exact replacement part should be used for an i.f. transformer and trap combination. Replacements for the most popular TV receivers are carried by many distributors, but often the manufacturer alone can supply the correct one.

Audio i.f. (4.5-mc.) components: Except for single coils used as sound i.f. loads, all other transformers, quadrature and FM detector coils must be exact replacements, and again the jobber will have them for the most popular TV models.

R.f. chokes: Standard r.f. chokes are available at the local parts distributor to take care of practically every replacement need. Open choke coils in the tuner or i.f. sections can be replaced by molded, standard chokes, provided the same inductance and current rating are involved. This latter requirement is especially important in the case of filament chokes. These may look the same

as plate chokes, but their current rating must be higher.

Video Peaking Coils

In general, peaking coils are standard items, wound over standard value resistors, and can easily be replaced from jobber stock. Occasionally a TV manufacturer uses a special arrangement, such as winding the peaking coil over one end of the plate-load resistor, which may be a 4-watt wire-wound type. When only the coil of such a combination becomes defective, it can be replaced by a standard coil electrically connected in the same way, provided the inductance is the same. Similarly, when an exact duplicate of inductance and parallel resistance is not available in a single unit, a combination can be made up by using a correct-value peaking coil with a higher resistance and then shunting another resistor across the coil externally. If the parallel resistor is too high, ringing in the video amplifier can occur.

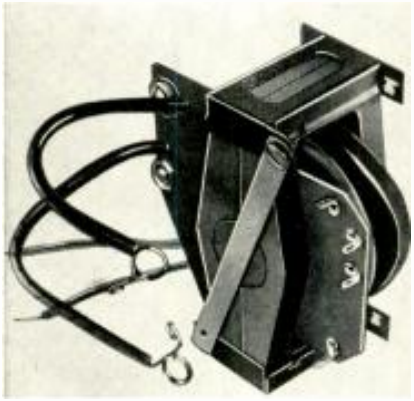


Fig. 2. This flyback type, with powdered-iron core, is used in older sets.

Horiz. Oscillator Coils

There are basically three types of horizontal oscillator and a.f.c. systems in use: the Synchrolock, found in 630-type receivers, the Synchroguide (or pulse-width), and the "ringing-coil" circuit. Each of the first two basic circuits uses a specific type of transformer. The third type uses a single coil and capacitor resonant circuit. Unfortunately, different manufacturers using, for example, the same basic Synchroguide circuit also use slightly different transformers and a variety of mechanical arrangements. The most widely used Synchroguide transformer is housed in a shield can like the one shown in Fig. 7. However, some sets, like certain *Admiral* and *Zenith* models, use the same circuit with the two coils mounted in the open, separately, on a special bracket at the rear of the chassis. When replacing horizontal-oscillator coils, the technician must first be sure of the type of circuit used and then must determine whether the coils are standard units or not.

Most Synchrolock circuits use a standard transformer and thus the replacement available for the 630-type TV set will usually be satisfactory.

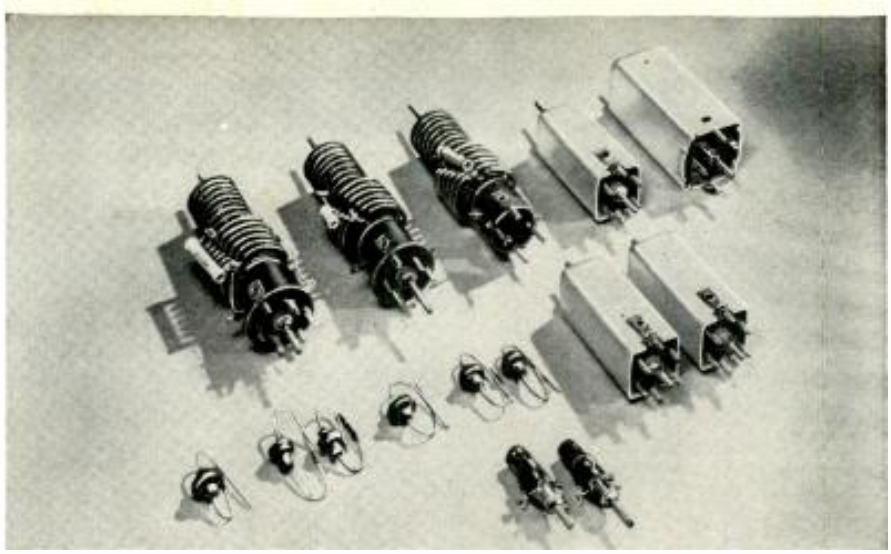


Fig. 1. A typical kit, available from jobbers, of r.f., i.f., and video peaking coils, traps, and transformers for one set manufacturer's line.

These transformers are available from most local parts distributors who carry 630-type components. In the case of the Synchroguide or pulse-width transformers, mounting and the tuning capacitors used externally may determine whether the correct replacement can be obtained from jobber stock or whether the set manufacturer alone can supply it. The technician will be helped in his decision by comparing the circuit diagram of the defective set with that of some 1950 *RCA* models, which use the Synchroguide coils regarded as "standard."

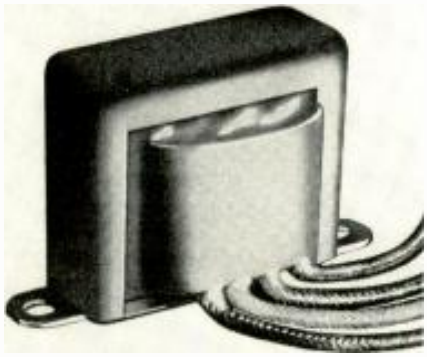


Fig. 3. Open-frame transformer typical of those used in TV vertical circuits.

Fig. 4. Standard, adjustable width and linearity coils look like this.

In replacing the single coil used in the "ringing-circuit" type of oscillator, it is usually possible to get a satisfactory substitute but it may be necessary to change the value of the tuning capacitor in order to cover the correct frequency range. Any new capacitor introduced into the circuit should have the same temperature characteristic as the previous one.

In addition to the three basic circuits just discussed, some of the more recent TV models use special coils in the horizontal-oscillator section and, although some of them are available from jobber stock, many will have to be ordered from the manufacturer. It is usually best to check with the local jobber first.

Whenever the horizontal oscillator and a.f.c. coil is replaced, careful realignment should follow. This should be done with the oscilloscope and v.t.-v.m., in the case of a pulse-width circuit, exactly as directed in the manufacturer's service data. In determining the price for replacing a horizontal-oscillator coil, the cost of such alignment should be figured in.

Flyback Transformers

This component is subject to a host of different defects and, since it can hardly ever be repaired, replacement is relatively frequent. For this reason, most transformer manufacturers offer a full line of replacements. One type is the so-called "universal" transformer which, although not a substitute for every flyback, can be connected to replace a great many different models. Fig. 5 shows four different flyback transformers available with a variety of brackets so that they can be mounted in many different TV sets.

It becomes apparent that these four transformers are capable of providing a wide variety of winding, terminal, and electrical-circuit combinations. For example, in some sets a voltage doubler is used, requiring two sets of filament windings. Some receivers use an auto-transformer. Some use a high-impedance deflection yoke; others a low-impedance yoke. Some use a grounded ferrite core; others either a floating core or else no core at all. Older sets

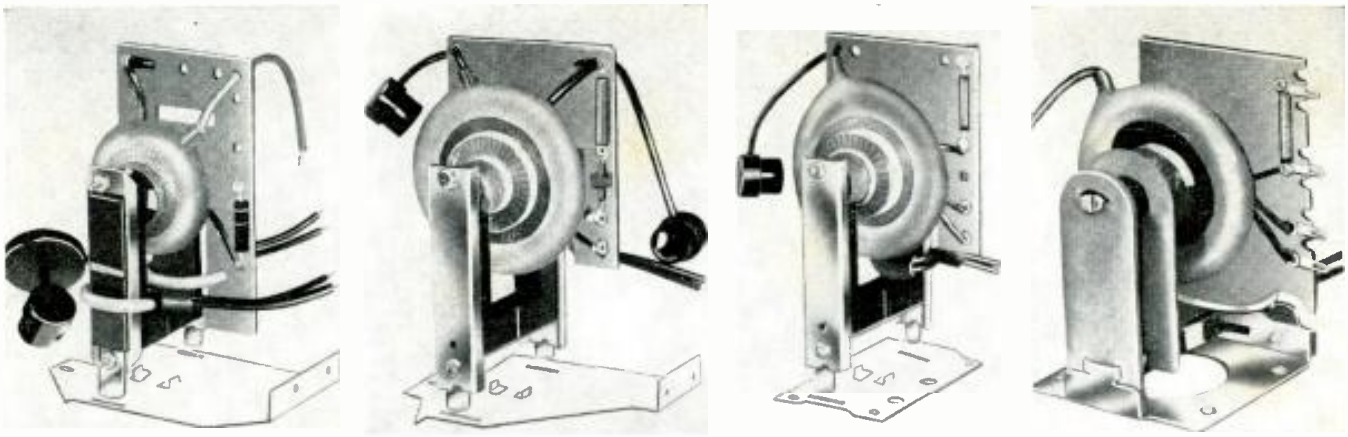


Fig. 5. These 4 flyback transformers highlight the variety available even with "universal" types to fit more than one set.

use a lower *"Q"* transformer, such as the type shown in Fig. 2, drawing more d.c. power and having a powdered-iron core. Some have special windings for a.f.c. or a.g.c. or both. All in all, the best way to obtain the correct replacement transformer is to look up the TV receiver make and model in one of the replacement transformer catalogues and select the available unit that requires the least amount of circuit modification. Even with no actual modification, quite a bit of rewiring and adjustment may be required. The success of the repair can hinge on the amount of care expended along these lines. Some points worthy of particular attention are:

1. Rewire high-voltage rectifier tube filaments. Since arcing and corona most often occur at the rectifier socket, this rewiring must be done with extreme care to obtain smooth solder joints. Replace the anti-corona ring properly, clean off all rosin or dirt and, finally, coat the entire underside of the socket with a good anti-corona dope.

2. Rewire the tube plate cap on the high-voltage rectifier. This, again, must be done with care to avoid sharp points. The entire high-voltage rewiring is often messy and complicated because of the socket arrangement, the connections to the high-voltage capacitor, and the lead going to the CRT.

Rewire deflection yoke leads and other circuit leads. This, again, must be done carefully because there is always a chance of damaging the fine wires going from the transformer windings to the terminals. All leads must be dressed away from the high-voltage windings and the other high-voltage points. It is worthwhile to spend a little extra time on this job and avoid future corona or arcing troubles.

4. Re-adjustment of the width, linearity, and even horizontal-oscillator coils is usually advisable in addition to setting the drive control. Occasionally it seems that these controls do not have sufficient range with the new flyback transformer and then minor circuit changes are indicated. Most technicians are familiar with the trick of using a .02 to 0.1 μf. capacitor across the width coil to get a wider picture. In some instances, the width coil is omitted entirely. When the grid drive cannot be reduced sufficiently with the drive control, a series 33,000-ohm resistor in the output-amplifier grid lead should reduce the drive sufficiently without distorting the picture.

Fig. 6. Typical yoke for 90° or less.

Fig. 7. Shielded Synchroguide xformer.

Fig. 8. Typical coil for EM focus. It may be chosen by CRT type number.

5. On some of the "universal" replacement flyback transformers, a number of different taps are provided to allow variations in width, high-voltage, and feedback to the horizontal a.f.c. circuit. Experimentation may be required to obtain the best combination, but one should realize that, as the high voltage is increased, less width will be available on the screen and *vice versa*. The complexity and possible troubles which are often part of a flyback installation job must be figured into the price you quote your customer.

Yokes and Output Coils

As in the case of flyback transformers, most parts distributors carry a line of replacement deflection yokes and a listing is also available to indicate which yoke type will fit with which transformer and which TV receiver model. A typical replacement yoke is shown in Fig. 6. In some instances the types of deflection yokes available as replacements may not be listed for a particular receiver. Yet, if the important characteristics are known, a good replacement can be selected from among standard yokes. A simple way of selecting a replacement yoke would be to look up the flyback transformer in a catalogue and then look for the yoke recommended by the transformer manufacturer to go with this flyback. One must make sure that the deflection angle of the picture tube and the length of the defective yoke are the same as the replacement. To help determine the correct yoke, we note the most important characteristics:

1. Inductance of horizontal and vertical coils; 2. yoke core material (powdered iron, ferrite, Hypersil, etc.); 3. deflection angle; 4. length of yoke (front to back) and inside diameter; and 5. type of winding (cosine, modified cosine, linear).

To replace width and linearity coils is usually no great problem. Standard inductance values, as for the coil shown in Fig. 4, for both types of coils, are available at parts distributors. Such special combinations as width coils with a.g.c windings are also carried in stock.

A few TV receivers of earlier vintage used tapped width coils and their replacements may have to be obtained

(*Continued on page* 100)

Troubleshooters' Guide

SYMPTOM	CLUES	LIKELY SOURCE OF TROUBLE	CORROBORATIVE TESTS	REMEDY
Buzz in sound. Loudness of buzz decreases when brightness control setting is reduced.	Buzz stops when CRT second anode lead is disconnected.	Imperfect or open aquadag-to-ground connection.	Visual inspection will reveal poor connection between aquadag and grounding spring.	Improve connection aquadag-to-ground.
Buzz in sound. Loudness of buzz is unaffected by brightness control setting.	Buzz disappears when contrast setting is reduced. Picture contrast is unsatisfactory at normal contrast control setting	Weak CRT. (Buzz occurs because excessive contrast setting causes video amplifier to be over-driven.)	Scope check at output of video amplifier will reveal normal amplitude of video signal at normal contrast control settings. Substitute new CRT as final test.	Replace CRT
Blooming (increase in picture size, defocusing, reduction in brightness) takes place when brightness control setting is advanced beyond a certain point.	Voltage test between disconnected CRT 2nd anode lead and ground shows high voltage is normal at all brightness control settings.	Gassy CRT or leakage between CRT electrodes.	Gas test: Check for positive CRT grid-to-cathode voltage just after CRT has been disconnected. Leakage test: If resistance checks don't reveal leakage, test supply voltages to CRT socket with CRT both in and out of circuit. If voltages become abnormal only when CRT is in socket and no circuit trouble can be found, leakage is indicated.	Replace CRT
Picture and raster brightness are excessive and cannot be reduced by turning brightness control counterclockwise.	CRT grid-cathode voltage is positive or insufficiently negative at all brightness control settings with CRT in socket; voltage between CRT grid-cathode socket contacts can be made negative by adjusting brightness control when CRT is withdrawn from socket.	Leakage between CRT control grid and another electrode.	Make resistance checks at 1000-megohm range of v.t.v.m. between CRT grid and other electrodes while tube is still warm.	Replace CRT
Picture contrast insufficient. Brightness of picture and raster is below normal. Normal black tones are not obtainable at any contrast control setting.	Scope check at output of video amplifier shows video signal amplitude is normal.	CRT emission is low or tube is gassy.	Check all CRT electrods voltages; check ion magnet setting; try new ion magnet. If above procedures reveal no defect, check CRT by substitution.	Replace CRT.
Horizontal tearing, critical vertical hold, vertical jitter, other sync symptoms.	Setting of brightness control affects onset of symptoms. Scope check reveals sync compression at CRT grid with CRT in its socket; signal becomes normal when CRT is withdrawn.	Grid-cathode leakage or excessive gas content.	Make tests for gas and leakage as described for "Blooming" symptoms.	Replace CRT.
Sound is week at all channel settings.	Sound volume increases when CRT is removed from socket.	Gassy CRT is loading down low-voltage power supply.	"B+" supply to sound stages rises considerably when CRT is removed from its socket. Tests show coupling capacitor to CRT grid is not leaky.	Replace CRT.
Picture and raster require relatively long time to come on. Picture contrast slowly increases to maximum.	Picture may have silvery appearance.	Defective CRT.	Scope check will show video signal input to CRT has normal amplitude and CRT electrode voltages are correct at time when picture contrast has not become normal.	Replace CRT.
Intermittent picture and raster.	CRT heater does not light when symptoms appear.	CRT heater wires are not properly soldered to base.	Make sure heater socket contacts are not defective by taking filament supply voltage readings from top of socket while tapping the socket gently. If voltage stays normal, "sweat" heater pins on CRT with soldering iron; symptoms should disappear or improve if source of trouble lies here.	Resolder CRT heater pins carefully.
Intermittent picture and raster.	CRT heater remains lit when screen goes dark. High voltage stays normal. Tapping neck of CRT restores picture or raster to normal or causes multiple bars to be seen.	Short between CRT electrodes.	Substitute CRT known to be good.	Replace CRT.

CODES CHART

WIRING

D OR V.C.
- GRN.

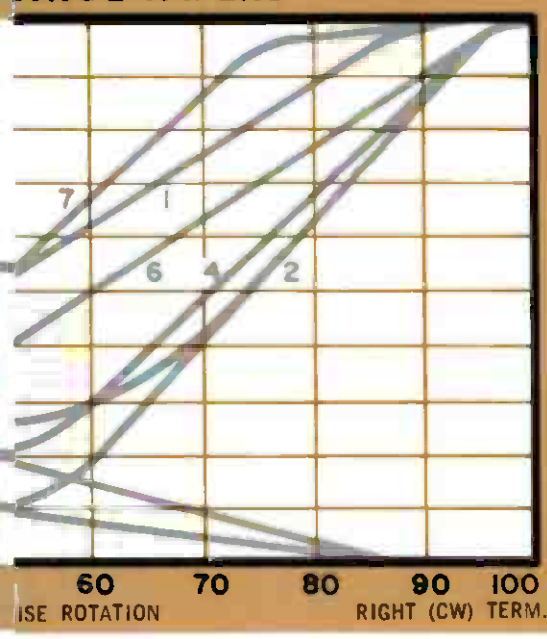
D. OR V.C.
BLK.

--GRN.
D OR
YEL.

QUENCY
) OR DIODE
— GRN.
VIOLET
OR
RN.-BLK.
— WHITE
). OR BLK.

COLOR	CIRCUITS
BLACK	GROUNDS
BROWN	FILAMENTS, HEATERS
RED	B-PLUS
ORANGE	SCREEN GRIDS
YELLOW	CATHODES
GREEN	CONTROL GRIDS
BLUE	PLATES
VIOLET	
GRAY	A.C. LINES
WHITE	OFF-GROUND RETURNS

ITROL TAPERS



Right-Hand Modified-Log—Reverse of 4

Modified-Log (40% R @ Cntr)—Vol. Cont., Ant. Shunt, Bias Cont.

Straight-Line with Slow Changes at Ends—Tone Control

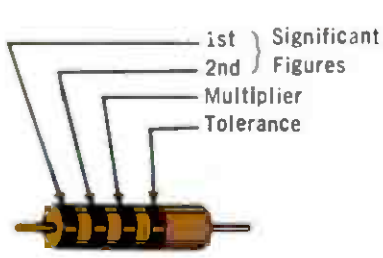
Tapped-Log—Tone Control with Bass Compensation

ELECTRONICS WORLD

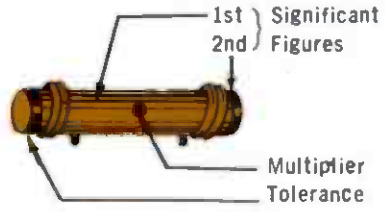
Formerly RADIO & TV NEWS

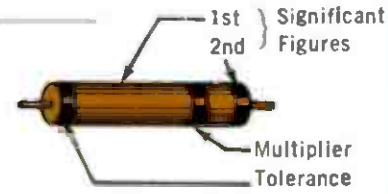
RESISTORS

AXIAL LEADS



RADIAL LEADS





Brown Bodies—Insulated.

Black Bodies—Non-Insulated.

Wire-wound—1st digit band double width.

RESISTANCE IN OHMS

COLOR	DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	1	±20%
BROWN	1	10	±1%
RED	2	100	±2%
ORANGE	3	1000	±3%*
YELLOW	4	10,000	GMV*
GREEN	5	100,000	±5% (EIA Alternate)
BLUE	6	1,000,000	±6%*
VIOLET	7	10,000,000	±12 1/2%*
GRAY	8	.01 (EIA Alternate)	±30%*
WHITE	9	.1 (EIA Alternate)	±10% (EIA Alternate)
GOLD		.1 (JAN and EIA Preferred)	±5% (JAN and EIA Pref.)
SILVER		.01 (JAN and EIA Preferred)	±10% (JAN and EIA Pref.)
NO COLOR			±20%

*GMV = guaranteed minimum value, or −0 + 100% tolerance.
±3%, 6%, 12 1/2%, and 30% are ASA 40, 20, 10, and 5 step tolerances.

PACITORS

TTON
plier
Significant Figures

ldered side)

THROUGH
Significant Figures
- Multiplier
— Tolerance

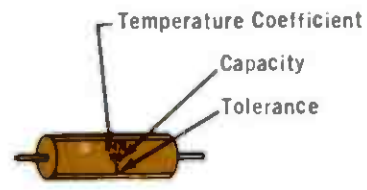
Temperature Coefficient

CAPACITY IN μμ FD.

COLOR	DIGIT	MULTIPLIER	TOLERANCE: 10 μμ FD. or less	TOLERANCE: Over 10 μμ FD.	TEMPERATURE COEFFICIENT PPM/°C	EXTENDED RANGE TEMP. COEFF.: Sig. Fig.	EXTENDED RANGE TEMP. COEFF.: Multiplier
BLACK	0	1	±2.0 μμ FD.	±20%	0(NPO)	0.0	−1
BROWN	1	10	±0.1 μμ FD.	±1%	−33(N033)		−10
RED	2	100		±2%	−75(N075)	1.0	−100
ORANGE	3	1000		±2.5%	−150(N150)	1.5	−1000
YELLOW	4	10,000			−220(N220)	2.2	−10,000
GREEN	5		±0.5 μμ FD.	±5%	−330(N330)	3.3	+1
BLUE	6				−470(N470)	4.7	+10
VIOLET	7				−750(N750)	7.5	+100
GRAY	8	.01	±0.25 μμ FD.		+30(P030)		+1000
WHITE	9	.1	±1.0 μμ FD.	±10%	General Purpose Bypass & Coupling		+10,000
SILVER					+100 (P100, JAN)		
GOLD							

Voltage ratings are standard 500 volts, for some manufacturers, 1000 volts for other manufacturers.

PRINTED VALUE



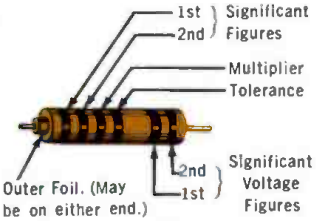
JAN LETTER	TOLERANCE: 10 μμ FD. or less	TOLERANCE: Over 10 μμ FD.
C	±0.25 μμ FD.	
D	±0.5 μμ FD.	
F	±1.0 μμ FD.	±1%
G	±2.0 μμ FD.	±2%
J		±5%
K		±10%
M		±20%

COLOR

PAPER CAPACITORS

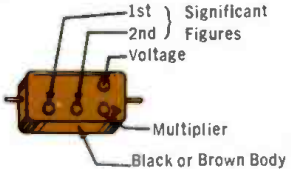
CAPACITY IN μμ FD.			
COLOR	DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	1	20%
BROWN	1	10	
RED	2	100	
ORANGE	3	1000	
YELLOW	4	10,000	
GREEN	5	100,000	5%
BLUE	6	1,000,000	
VIOLET	7		
GRAY	8		
WHITE	9		10%
GOLD			5%
SILVER			10%
NO COLOR			20%

MOLDED TUBULAR

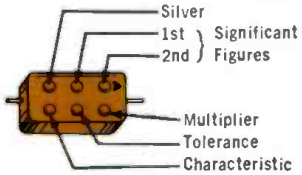


Add two zeros to voltage figures. One band indicates voltage ratings under 1000 volts.

MOLDED FLAT (COMMERCIAL CODE)



MOLDED FLAT (JAN CODE)

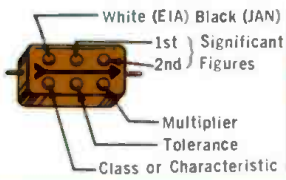


MICA CAPACITORS

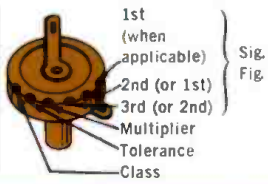
CAPACITY IN μμ FD.				
COLOR	DIGIT	MULTIPLIER	TOLERANCE*	CLASS OR CHARACTERISTIC**
BLACK	0	1	20%	A
BROWN	1	10	1%	B
RED	2	100	2%	C
ORANGE	3	1000	3%	D
YELLOW	4	10,000		E
GREEN	5		5% (EIA)	F(JAN)
BLUE	6			G(JAN)
VIOLET	7			
GRAY	8			I(EIA)
WHITE	9			J(EIA)
GOLD		.1	5% (JAN)	
SILVER		.01	10%	

*or ±1.0 μμ FD., whichever is greater.
**Specifications of design involving Q factors, temperature coefficients, and production test requirements.
All axial lead mica capacitors have a voltage rating of 300, 500, or 1000 volts.

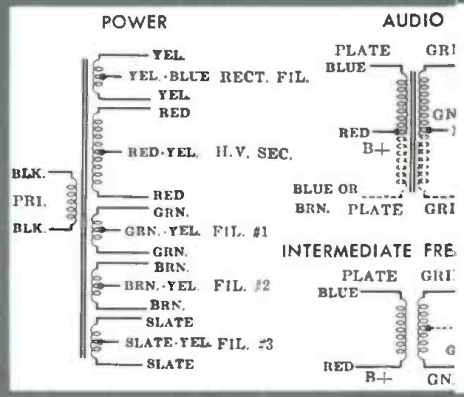
MOLDED FLAT



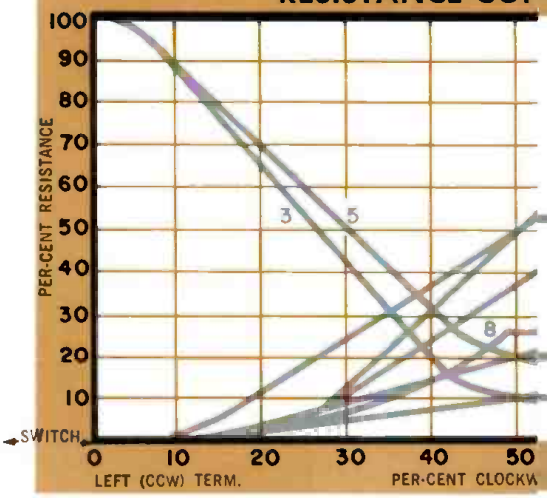
BUTTON SILVER



TRANSFORMERS



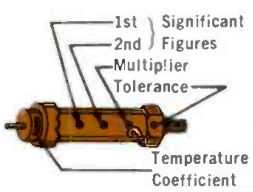
RESISTANCE CON



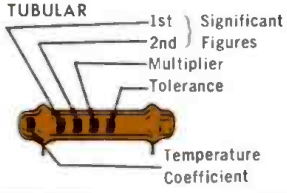
1	Linear—TV Rcvr. Uses	5
2	Semi-Log (10% R @ Cntr)—Audio Volume or Tone	6
3	Right-Hand Semi-Log—Reverse of 2	7
4	Modified-Log (20% R @ Cntr)—Audio Volume or Tone	8

CERAMIC CA

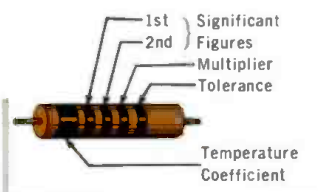
STAND-OFF



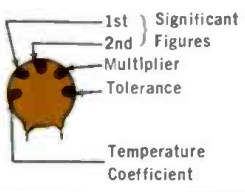
TEMPERATURE COMPENSATING TUBULAR



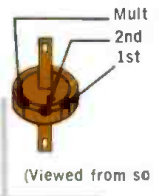
MOLDED-INSULATED AXIAL LEAD



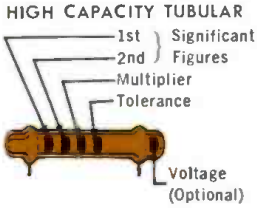
DISC (5-DOT SYSTEM)



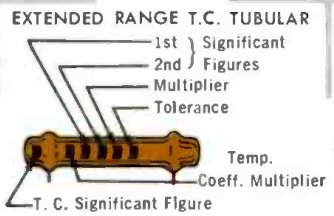
BU



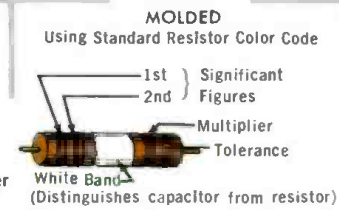
HIGH CAPACITY TUBULAR



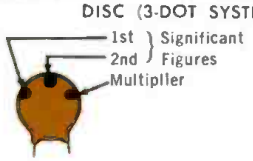
EXTENDED RANGE T.C. TUBULAR



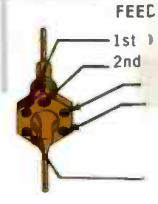
MOLDED
Using Standard Resistor Color Code



DISC (3-DOT SYSTEM)



FEED



to CRT Defects

By SOL HELLER

Handy chart for the TV technician that spots faults originating in picture tube.

SYMPTOM	CLUES	LIKELY SOURCE OF TROUBLE	CORROBORATIVE TESTS	REMEDY
Picture reduced in size vertically and horizontally.	Sweep signals have correct amplitudes. High voltage is normal.	Gassy CRT.	Make gas check as described for "Blooming" symptom. Substitute CRT known to be good.	Replace CRT.
No raster.	Moving ion magnet far back on the tube base causes part of raster to become visible.	Electron gun in CRT is improperly positioned.	Substitute CRT known to be good.	Replace CRT.
Dim picture and raster.	Optimum brightness is obtained only when ion magnet is positioned much closer to base of CRT than it normally is. High voltage is normal.	Low emission in CRT.	Substitute CRT known to be good, if all CRT electrode voltages (including CRT grid-cathode voltage) check normal.	Replace CRT.
Poor interlace.	Symptoms are affected by brightnese control setting.	Poor contact between CRT aquadag and grounding spring.	Visual inspection will reveal defect.	Improve aquadag-to-ground connection.
Negative picture. Pix is negative on all channels, at all settings of a.g.c. and contrast controls; or pix goes negative when brightness or contrast control setting is advanced.	Pix remains negative when one side of transmission line is disconnected. If pix is positive at soma control settings, brightnese and contrast are below normal.	Picture tube is gassy.	Scope-check polarity of video signal at input of CRT. It should be positive if video signal is applied to cathode, negative if it is applied to grid (assuming scope does not invert the signal).	Replace CRT.
Distorted picture and raster. (CRT is all-glass type.) Edges of raster are irregularly shaped.	Re-adjueting linearity and size controls does not eliminate distortion symptoms.	Magnetic field is near CRT.	Check for presence of PM speaker or other magnetic object near CRT.	Remove magnet from vicinity of CRT.
Fuzzy picture.	Focus system adjustments do not eliminate fuzziness.	Defective CRT.	Apply 400-cps signal from audio signal generator to input of CRT. Keep generator output fairly low. If black and white bars seen on CRT are not sharp and distinct, try another CRT.	Replace CRT.
Thin, dark vertical bar in picture and raster. Bar has ragged edges.	Purplish glow, faint hissing sound, in vicinity of aquadag grounding spring.	Corona at aquadag-to-ground connection.	Visual inspection will reveal the trouble.	Improve aquadag-to-ground connection.
Picture and raster sides are distorted. Sides of picture and raster are irregularly shaped.	Distortion cannot be reduced by re-adjustment of linearity and width controls.	Magnetized (metal-cone) CRT.	(A) Rotate yoke. If area of distortion does not rotate along with rest of picture, CRT is probably magnetized. (B) With receiver turned off, move small pocket compass near various parts of metal cone. If deflection of needle toward cone occurs at any time, cone section at which needle points is magnetized.	Connect unshielded filter choke in series with 10-watt light bulb across 117-volt line. Pass flat side of choke back and forth over magnetized area of cone for 30 sec. Move choke several feet from cone before disconnecting choke and bulb from power source. Repeat procedure if necessary.
Picture brightness below normal; pix may look slightly smeary. Some parts of the picture may be dimmer than others.	Visual inspection of external screen surface shows dirt.	Dirt on CRT face, possibly due to its attraction by high electrostatic charge on tube surface.	Wipe screen surface.	Clean CRT face with soft, lintless cloth and plain lukewarm water. Disconnect high-voltage lead and discharge CRT 2nd anode connection to ground before cleaning face, to avoid shock.
Sides of picture and raster have ragged edges.	Faint sizzling sounds are audible in vicinity of CRT.	Arcing between external aquadag coating and ground in glass CRT, due to imperfect contact between aquadag and grounding spring.	Note whether symptoms disappear when aquadag-to-ground connection is improved.	Improve connection by increasing tension of grounding spring or connecting spring to different part of aquadag, if aquadag has been worn away at original point of contact.
Broad horizontal dark and light hum bars are seen in picture and raster.	Bars are seen in raster even when video amplifier is removed or its output shorted to ground through a .1-μfd. capacitor. Scope check reveals substantial 60-cps hum voltage between CRT cathode and ground or grid and ground. Hum signal disappears when CRT is removed from its socket.	Cathode-heater or heater-grid leakage.	(A) Check resistance between suspect electrodes. (B) Feed CRT heaters from ungrounded filament transformers; see if symptoms disappear.	(A) Install a separate heater transformer for CRT if procedure (B) at left eliminates symptoms. (B) Replace CRT.

The Summer Slump: An Appraisal

Is it really a short-term dip? Can it be relieved by expedients or are long-term correctives required?

MENTION the warm-weather business drop-off to thoughtful service dealers nowadays and the automatic nod of agreement you would get a few years ago is not quite as likely to be forthcoming. The phenomenon in question, for which new miracle cures are suggested every year, is too complex to be dismissed with a simple phrase like "summer slump." Since a backache cannot be cured with cough syrup, it is well to consider the nature of the complaint before prescribing treatment.

A sampling of service dealers reveals a wide range of opinion concerning the slow-down, including one extremist view that *there is no such thing*. Furthermore, adherents to this judgment feel that the entire concept is a harmful deception. To a degree, geography may account for seasonal differences. A dealer near a summer resort, where the population rises during the warm months, may do better during this period. Yet many dealers who reject the summer-slump philosophy are not affected by this reverse trend.

The bar graph below approximates one widespread view of the service business year. Dissenters say that this is just an example of how accurate data may be given the wrong interpretation. Extend each vertical bar on the graph downward to about three inches below the page, they claim, and you will get a truer perspective. We then see that, variation notwithstanding, the difference between any two months is not great, with the exception of three or four months after the summer. In effect, instead of a two-month slump, there is a rather uniform year-round trend, interrupted by a deluding *peak* for three or four months.

From this conclusion, some have gone on to a negative, passive attitude. While we do not endorse it, it must be considered. The trouble with many service businesses, this view holds, is that wishful thinking overrides judgment. The dealer tells himself that this peak is his "normal" business period, then pegs the size of his operation on it. When things settle down, he finds he is over his head. The only sensible solution, they claim, is to cut down the scope of the operation to a more realistic level, foregoing the danger of counting on artificial, unworkable business stimulants.

This approach has merit to the extent that it urges caution and a sense of perspective in evaluating one's situation realistically. The "stand-pat" conclusion will not, however, be acceptible to go-getters. One helpful point it suggests is that the type of stimulation needed is not necessarily only of the short-term, summer-month variety. *Year-round* stabilizers must be considered too.

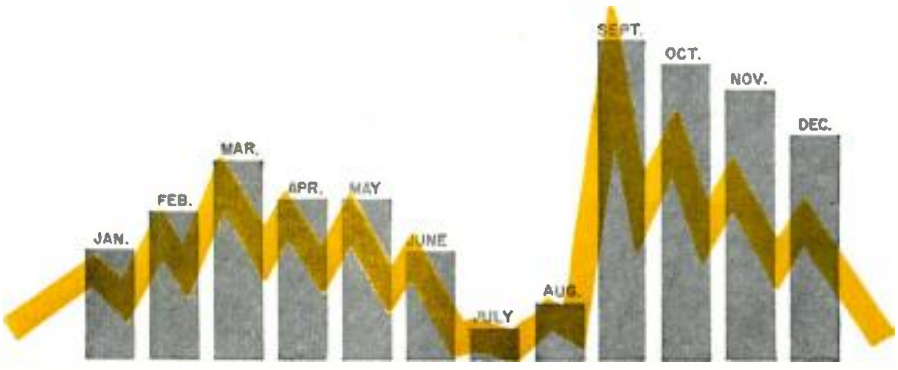
Asked what innovations he uses for drumming up business, one dealer answered, "I don't use gimmicks; I just push like the devil." He hasn't found much help in the inspired suggestions concerning new things to service. For example, working on air-conditioning or refrigeration equipment is a good idea in theory, but he has found that, for an operation of his modest proportions, more modification of his business structure would be required than the potential benefits warrant. Besides, he feels that there is a great deal of consumer resistance to be overcome. The public has come to associate the refrigerator and the air conditioner with another type of technician.

In lieu of entering *another* field of endeavor, he intensifies his use of proven techniques. His mailing list will get heavier-than-usual use. He may run an extra ad or two in the local newspaper. His shop window will get spruced up with an overhaul that includes some prominent signs. In all three of these media, he pushes such themes as battery sales, overhauls of portable receivers, special-inducement checkups on TV receivers and antennas. ("Now's the time to make sure you're in shape for a full season of fall viewing. Don't wait and miss out on the season's opening shows because you need service when our shop is jammed. Take advantage of our warm-weather special, etc.")

In some localities, marine electronic service is an effective counter-agent for a business dip. Once regarded as limited to a few areas, the phenomenal growth of hobby boating has changed things. In addition to the coastal areas, there are many inland portions near bodies of water now involved. The best approach for obtaining this work is roughly parallel to that which has proved successful with automobile radios. Working through or with those who sell or service the boats themselves is the most practical means of entry. Even for the hobbyist, electronic boating gear is becoming increasingly important. Marine radios, direction finders, and related devices are booming. Widely available converters for supplying 117-volt a.c. on board have resulted in the installation of TV receivers and hi-fi gear on many pleasure craft.

When we speak of year-round stabilizers, we are simply using another phrase to cover an area that has been loosely described as "diversified servicing" or "industrial service." One of the most promising of these is 2-way mobile radio, on several counts. To begin with, the field is widespread and still growing. Since users of mobile communications systems operate on a year-round basis, there is little seasonal fluctuation if any. Furthermore, many manufacturers of the equipment used, aware of the service and maintenance problems, are disposed to cooperate with independent electronic technicians and dealers. They will

(*Continued on page* 133)



The "Safari" with hood open ready for use. Sloping glass is beam splitter.

You Can Buy This Transistorized TV

Battery-powered, light, and small—but with a big picture usable outdoors—the set's a true portable.

IT IS MORE than a year since designers have proved, with working models, that the battery-operated, transistorized, portable TV receiver is other than a theoretical possibility. Even so, the prevalent attitude was that mass production and sale at acceptable prices was some time off. For approximately $250—in range with the price of many conventional sets—you can buy the *Philco* "Safari" today.

Before you say, "Who cares? A portable TV set is no good unless it provides the same versatility and convenience that one can get out of a portable radio," look at the facts. The entire receiver is less than 16 inches tall (its maximum dimension) and weighs no more than 15 lbs. with its battery. The latter, a rechargeable alkaline unit that will run the set for about 4 hours on one charge and has a total life up to about 100 hours, may be replaced for about $5. As to size, weight, and battery-replacement cost, then, the "Safari" compares with some of the better, tube-operated portable radios now in use.

As to sensitivity, pictures of good quality have been demonstrated on the second floor of a 30-story, steel-frame building and in an airplane using only the built-in telescoping whip as an antenna. *Philco* guarantees the set will work as well as any other portable in any location where such a receiver will operate. In addition to this, a picture of good size (derived from a small CRT) can be viewed in sunlight without being washed out. Yes, you *can* take it on a picnic if you're within reasonable range of a transmitter. You can also plug it into an a.c. outlet at home or in the office.

Using 21 transistors and a number of diodes, the set's circuits are surprisingly similar to those found in tube TV designs. One of the most distinctive features is non-electronic—the means for obtaining a picture of good size with a small CRT. The latter produces a direct image with a diagonal measurement of approximately 2 inches. An interesting optical system converts this to a reflected, magnified, light-shielded image whose apparent size is about that associated with a 14-inch rectangular tube.

The CRT is mounted facing upward (Fig. 1) in a darkened chamber, projecting light against a sheet of glass (the beam splitter) set at an angle. The surface of this glass that faces the tube is aluminum coated, reflecting 72 per-cent of the picture tube's light output onto the concave mirror. At the same time, the viewer can look through this partially transparent panel, as shown in Fig. 1, at the scene projected onto the magnifying mirror. A good deal of the light output to the viewer is dissipated by the filtering action of the coated glass panel, but this is compensated by the use of a high-brightness CRT. Despite its small size, 10,000 volts is applied to the second anode.

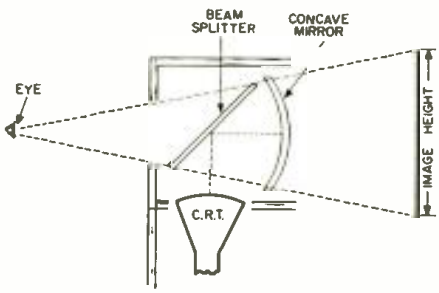
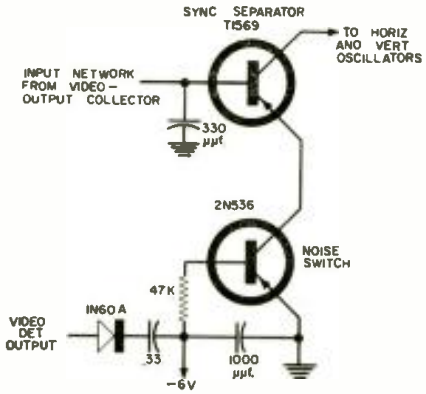


Fig. 1. The optical system magnifies a 2-inch picture, brightly, up to 8 times.

Fig. 2. Novel noise-switch stage and separator triode maintain stable sync.



Apparent image size and viewing distance are both greater than seems physically possible. At a distance of about four feet, there is eight times magnification, filling the opening in the set, with the apparent image—as in the case of any object viewed through a mirror—falling several feet in back of the set.

As to the picture tube, it is a magnetically deflected, electrostatically focused unit. A narrow deflection angle of about 30° keeps deflection power requirements within bounds. The electron gun structure is similar to that used in the manufacturer's S-F (semi-flat) CRT line.

Power supply: The specially developed alkaline battery is an *Eveready* unit developed by *National Carbon Co.* in cooperation with *Philco* engineers. Although its value at full charge is 7.5 volts, this falls somewhat under drain. The receiver is therefore designed about a nominal 6-volt supply. On a.c. operation, a stepdown transformer, two semiconductor rectifiers, and a filter provide the −6 volts needed. A switch permits converting this output to charge the battery, which is accomplished by running the charge function overnight. Obviously, higher voltages will be demanded by some circuits in this design. The d.c. voltage outputs at three other levels are developed from the horizontal-output circuit.

While all the transistors used are *p-n-p* triodes, this phrase can lead to misleading conclusions. From the manufacturing point of view, there is a very wide range of types, including many being introduced for the first time, having been developed specifically for the requirements of this receiver.

Tuner: The three transistors used in the front end are all MADT's (micro-alloy diffused base types). Some units in this category can be operated above 1000 mc. The schematic of this section looks deceptively simple. Remove the tubes from a diagram of a conventional switched-tuner circuit, substitute the r.f. amplifier, oscillator, and mixer *p-n-p*

triode symbols that appear in many portable radios, and you have a fair idea of what the unit looks like schematically. Physically, the separate front end resembles the tuner used in many *Philco* tube TV sets, except that it has been miniaturized. It provides 25 db of gain.

I.f. strip: Four MADT units in the grounded-emitter configuration provide a gain of 70 db with a bandwidth of 3 mc. For adequate selectivity, considerable trapping of adjacent signals is required in these low-impedance circuits. Balanced-T filters are used. The stages are transformer-coupled and stagger-tuned. Alignment adjustment is conventional. A familiar crystal detector provides half a volt of video output.

Video amplifier and a.g.c.: Two stages of video amplification are used. The first, an emitter follower (grounded collector) to provide a high input impedance, does more than one job. Its collector provides d.c. amplification for a.g.c. voltage, which is applied to the r.f. amplifier and the first three i.f. stages through a 3-position sensitivity switch. One input to the sync section also comes from the collector. The audio i.f. take-off transformer is in the emitter circuit, as is the contrast control, which feeds the base of the video-output transistor. To obtain video drive for the CRT in the order of 20 volts, a +12-volt and −12-volt supply are applied to this stage. Signal is fed to the control grid of the picture tube, to which electrode the brightness control is also connected.

Sound section: Of the two audio i.f. stages, the first is a triode amplifier and the second is operated as a limiter. The latter drives a familiar looking discriminator circuit, except that a pair of crystals do the job of a vacuum-tube twin diode. An audio driver is followed by a push-pull output stage similar to those in many portable transistor radios. It drives a 3-inch speaker with 200 milliwatts. A private listening jack for earphones is provided.

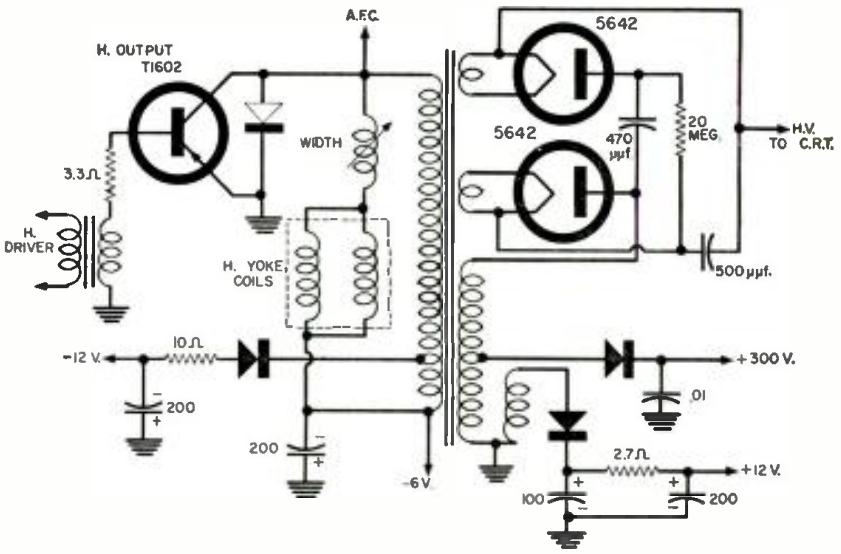


Fig. 3. A 100-to-1 flyback and a doubler provide high voltage. Transformer taps and rectifiers provide d.c. voltages other than 6 volts from battery.

Sync circuit: Signal from the collector of the video-output transistor is applied (pulses positive) to the base of the sync separator (Fig. 2). The emitter of the separator is returned to the collector of another triode, designated as the noise-switch stage. The emitter of the latter stage is then returned directly to ground. The base of the noise switch is returned to ground through a crystal diode and a 100-ohm resistor in the output network of the video detector (base of the emitter-follower first video stage). With this biasing arrangement through the detector circuit, the noise-switch stage is normally in conduction (closed). It thus completes the circuit of the sync-separator stage, which is permitted to operate freely.

When high-amplitude noise pulses that might upset oscillator synchronization appear, they conduct through the 1N60A crystal diode connected to the detector output circuit and are applied to the base of the noise switch, cutting off the latter stage. When this occurs, there is no return for the emitter of the sync separator, and the separator is also cut off for the duration of these undesired pulses.

Vertical section: One output from the collector of the sync separator is coupled to the blocking-oscillator transformer of the vertical oscillator. The vertical-hold control is in the emitter of the latter. The height control is in the collector. This stage drives the vertical-output transistor, type T1601, which is a new high-*beta* unit. The linearity control is between emitter and collector of the output stage. Two feedback loops around this stage are used to stabilize it.

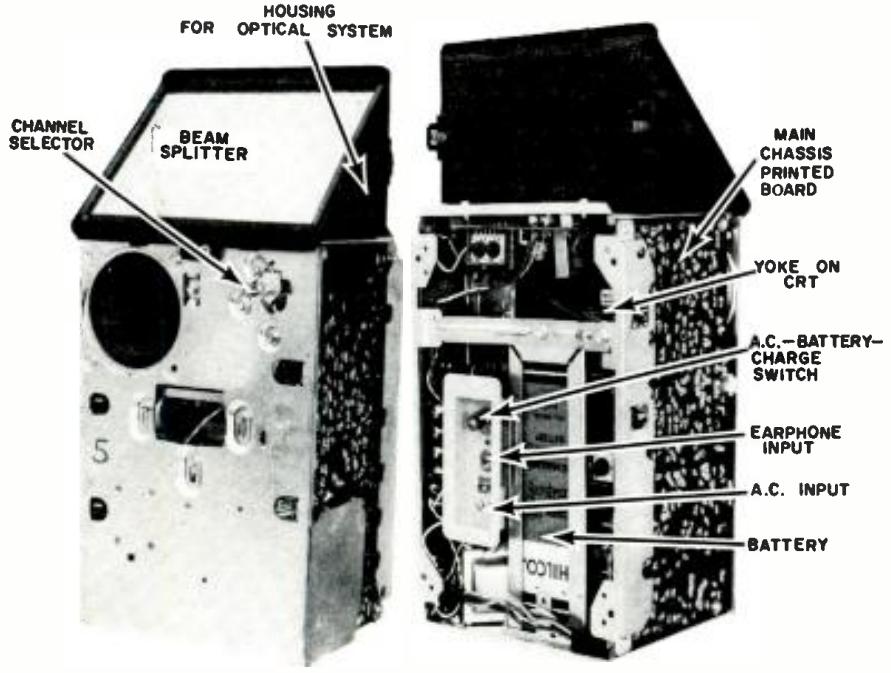
Horizontal section: Another output from the collector of the sync separator goes to a conventional twin-diode phase detector, which consists of two 1N60A crystals. This drives the horizontal blocking oscillator, which is transformer-coupled to a buffer-driver stage. From the latter, another transformer feeds the power transistor used for horizontal output (Fig. 3). The latter drives the yoke's horizontal coils in parallel.

Flyback supply: It has already been noted that voltages different from the −6 volts supplied by the battery or its substitute supply developed from the a.c. line are used in the receiver. These are derived from the horizontal-output system. The use of +12-volt and −12-volt d.c. for the video-output stage has been mentioned. The tuner and i.f. stages also work off the +12-volt line. In addition, +300 volts is needed for the first anode of the CRT and to

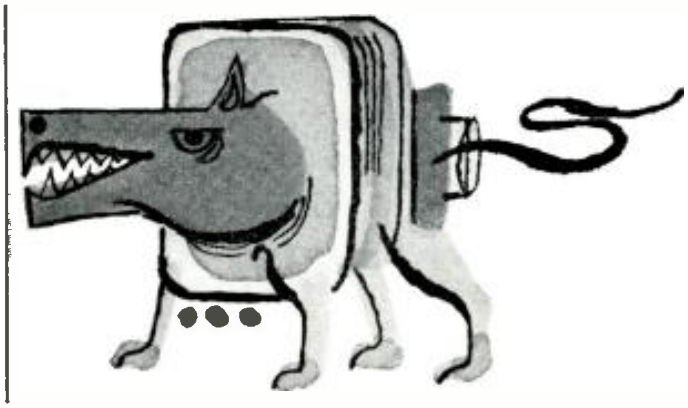
(*Continued on page* 128)

Front view without case reveals optical-system housing and channel selector.

Rear view of set removed from leather case shows function on switch and battery.



Tame TV "Dogs" with Technique



By **WARREN J. SMITH**

Are all jobs involving horizontal oscillator-a.f.c. or a.g.c. circuits battles? These methods may help.

HARRY GRIDLEAK had just buttoned up the portable and was writing the repair bill when Phil George came out of the boss' office. From the downcast expression on his face, Harry guessed that something was amiss. "Trouble, Phil," he asked.

"Yep—TV trouble," Phil replied, "and it just might cost me my job. That's the third time this week the boss has talked to me about being too slow."

"What do you mean by 'too slow'—not getting your share of the work done?"

"That's about the size of it, Harry," he replied. "Take that console I worked on this morning. The trouble turned out to be a bad delay resistor from "B+" to the tuner a.g.c. circuit, but it took me nearly two and a half hours to track it down and make the repair. And that portable yesterday—I spent a good part of the day looking for the lost horizontal sync. Maybe I should take up barbering."

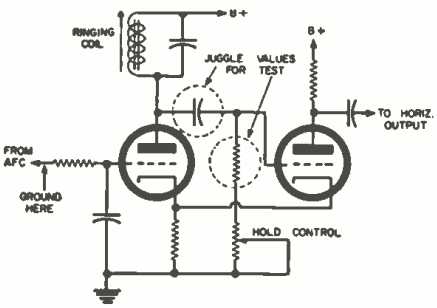


Fig. 1. Key check points for horiz. multivibrator-a.f.c. circuit tests.

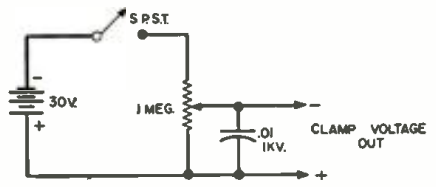
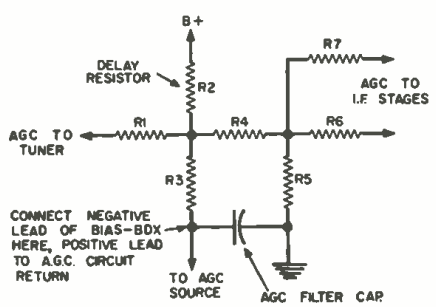


Fig. 2. Variable bias supply provides quick narrowing down of a.g.c. faults.

Fig. 3. The a.g.c. output circuit is a carefully adjusted voltage divider.



"Oh, I don't think it's that bad, Phil. Horizontal sync and a.g.c. (particularly keyed a.g.c.) defects are among the most troublesome problems the average service technician runs into. You could avoid a great deal of unnecessary labor by learning to use a standard circuit isolation procedure."

"Standard isolating procedure?" asked Phil. "I went to school, and a good one, for nearly two years, but I wasn't taught to use a 'standard' procedure for isolating a.g.c. or sync trouble."

"I don't doubt that one bit," Harry replied, "but I'm talking about a procedure developed in practice, not from a textbook. Let's go over to your bench and have a cup of java while we talk this over."

After the coffee was poured and they found comfortable positions on Phil's bench, Harry again picked up the conversation. "Isolating defects to the oscillator or a.f.c. stage of a multivibrator type horizontal circuit is not really too tough. You simply ground out the a.f.c. voltage ahead of the series resistor feeding the oscillator grid and adjust the horizontal hold control over its range. Let me sketch a diagram (Fig. 1) to show you what I mean."

"What if the set doesn't have a hold control, like many of the new portables?" Phil asked. "What do you do then?"

"We'll get to that in a minute. If varying the hold control setting, with the a.f.c. voltage shorted, correspondingly varies the oscillator above and below the sync frequency, then the trouble is in the a.f.c. stage."

"And," Phil joined in, "if the hold control *doesn't* cover the proper range of frequencies, the difficulty is in the oscillator itself, right?"

"Usually, Phil. We'll get to the exceptions in a moment. First let's get back to your question of what to do when the set lacks a regular hold control. In that type of circuit arrangement the horizontal ringing coil is used for frequency adjustment. So all you have to do is vary the coil slug with the a.f.c. shorted out. Simple, isn't it?"

"Yep," Phil agreed, "but does this isolation kink work on all sets?"

"Unfortunately—no. Some of the newer receivers *need* a.f.c. to sync the oscillator, even without trouble in the circuit. But you can get around this by juggling grid load and coupling capacitor values until the ringing coil covers the correct frequency range. I'll mark these components right here (Fig. 1) to help you remember."

"What about keyed a.g.c. fault isolation, Harry? You said a.g.c. was troublesome, and I agree, but how do you tackle it?"

"First let's make a couple more circuit diagrams to simplify things," Harry replied. "The first thing to do when you suspect a.g.c. trouble is to clamp the source point with a variable negative voltage. There are lots of ways of providing this, but I use a home-made bias box (Fig. 2) made up of a thirty-volt mercury battery (for long life), a linear one-meg pot, and a .01-μf., 1000-volt capacitor."

"What's the capacitor for?" asked Phil, slightly puzzled.

"To keep any horizontal keying pulses from appearing across the battery and pot," Harry replied. "Those spikes won't do the battery any good."

"I see. What'll we do after clamping the a.g.c. source?"

"Just adjust the pot slowly through its range and observe the effect on the picture tube. If a normal picture appears at one point, the gremlin is usually in the a.g.c. proper. If you *can't* get a normal looking picture, the trouble is somewhere in the signal circuits."

"That phrase 'signal circuits' covers a lot of ground, Harry. Where at in the signal circuits?"

"Well, it could be almost anywhere—in the tuner, video i.f.'s or detector, or in any one of the stages between the video detector and a.g.c. keyer. That means the a.g.c. filtering and distribution circuits, too."

"How do we narrow it down?"

"We can eliminate the filtering and distribution networks by turning the bias box pot to full tilt and measuring

(*Continued on page* 135)

Facts about Lightning Protection

A property originally worth over $15,000, less than 20 minutes after being struck by lightning. It was burned to the ground.

By **SIDNEY C. SILVER** Service Editor, ELECTRONICS WORLD

What is lightning? What makes it? Is the hazard real or rare? Is effective protection possible? What does this mean to the TV owner or technician?

LIGHTNING is as inevitable a part of the human experience as the earth and the sky that collaborate to create it. No corner of the world is immune to it. Yet knowledge concerning these outbursts of Nature at her most dramatic and most violent is generally inadequate or incorrect.

Many characteristics of this phenomenon will be appreciated better by the electronic technician than by the electrician. With some cause, the public has come to make some sort of association between lightning and television. As an area of interest for the service technician, overlooked though it has been, the matter of protection is a "natural" that goes beyond the simple association just mentioned.

Lightning and its effects are more widespread than is generally realized. It does not move in the direction or manner that is generally believed. Objects most vulnerable during a thunderstorm are often believed to be the safest. The storm conditions and periods when hazards are highest are not widely recognized. How much do *you* know about these celestial bursts of frenetic fury? How often does it really cause trouble? Is effective protection truly possible? How big is a bolt? How many volts of violence does one pack? If you know the answers, you are in scant company.

The development of a thunderstorm, meteorologists tell us, involves the intrusion of a mass of relatively cool air over a layer of moist, warm air hugging the earth. Every high-school physics student knows that warm air tends to rise above cool air. This upward motion generates a formidable amount of static electricity, with the upper masses of moisture becoming positively charged and the lower portions negative. It is the latter cloud charge that concerns us.

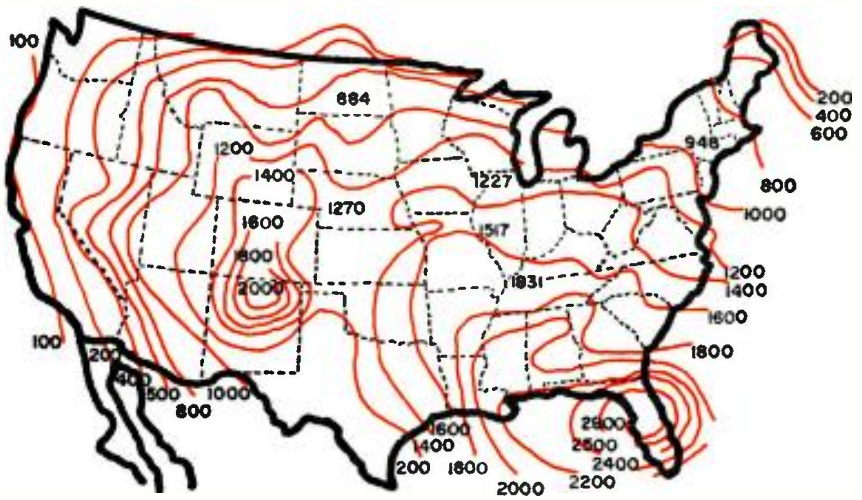
Below this negatively charged entity is a great body of air, effectively a dielectric. Still farther down is the earth itself. In essence, we have an enormous capacitor with the earth forming one plate. With a negative charge on the opposite plate, the shell of the earth becomes positive under a gathering storm cloud. (Under such a cloud in an open field, you may feel your hair stand on end. If you do, dive for the nearest ditch or hug the comforting earth!)

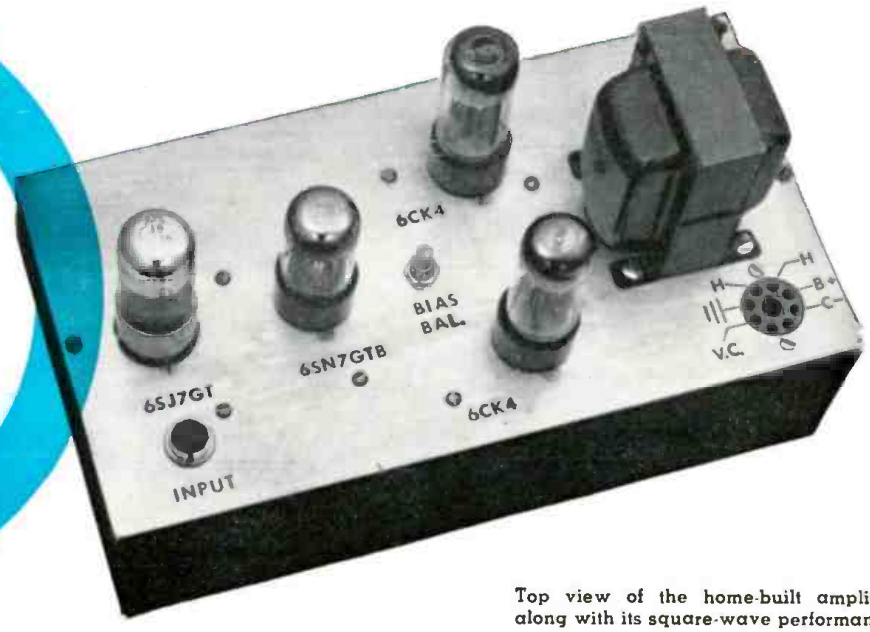
For the giant dielectric to break down, an almost irresistible attraction must build up across it. Indeed the cloud-to-earth potential builds up to millions of volts—perhaps a hundred million. At last, opposition collapses and a ferocious stroke of lightning streaks *upward*.

Yes, upward. Positive to negative current? Well, not exactly. Actually little leaders—fingers of lightning probing for a weak spot—dart down irregularly, often running horizontally for thousands of feet, at only a few thousands of miles per minute. This "slow motion," which we can see, gives us the impression of downward movement. When a leader makes contact with the earth, the current path has been completed. The blinding flash that follows is the main stroke, hurtling skyward at over a million miles a minute, too fast for us to see motion,

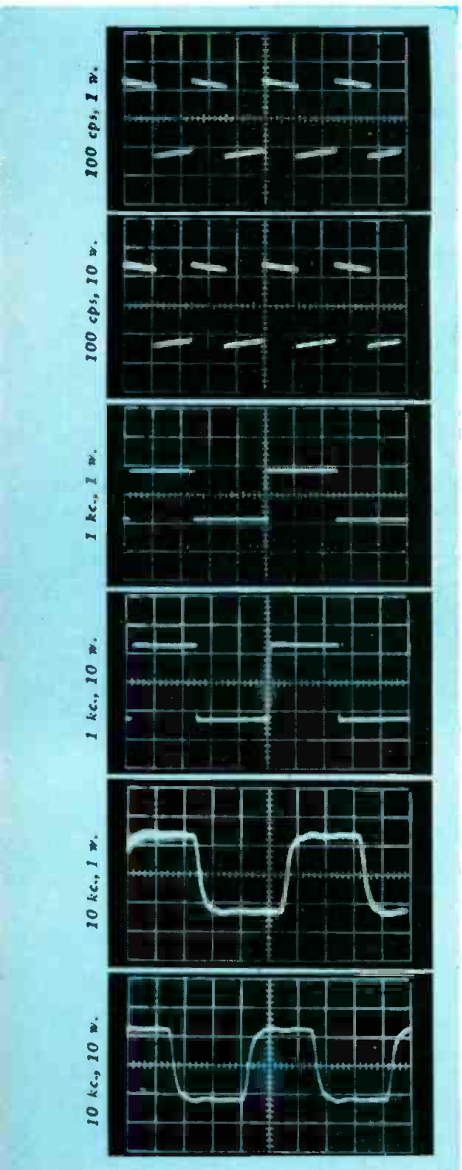
(*Continued on page* 122)

Fig. 1. Based on U. S. Weather Bureau data, this map shows the number of lightning storms occurring over a 20-year period in various parts of the U. S.





Top view of the home-built amplifie along with its square-wave performance



Hi-Fi with Triodes

By **J. N. STILL** / Sylvania Electric Products Inc.

Construction of a 15-watt amplifier with new 6CK4's, which offer the advantage of triode operation plus good efficiency and improved driving requirements.

FROM the dearth of commercial hi-fi amplifiers employing triodes in the output stage, it is obvious that the triode's popularity has been waning in this application. Although fidelity can be achieved with simple circuitry and inexpensive components, the high driving requirements of previously available power-output types imposed additional design problems that could not be overcome economically.

This is not the case with the recently introduced 6CK4. This new cathode-type tube offers all the advantages of triode operation plus good efficiency and improved driving requirements. With the 6CK4 at his disposal, the home builder can now construct a high-performance amplifier at reasonable cost. While the primary purpose of this article is to present and discuss a new amplifier design, let's review briefly the advantages of triode operation.

Advantages of Triodes

Among the "plus" features triodes have to offer the amplifier builder are:

More Uniform Response: An output transformer presents a varying load to the output tubes throughout the audio-frequency range, thus affecting the frequency response of this stage. The low-frequency response may be degraded by the low inductive reactance of the transformer primary winding while the high-frequency response is influenced by the distributed capacity of the transformer. The low effective plate resistance of power-output triodes minimizes these undesired effects, thereby extending and improving uniformity of frequency response.

Damping Characteristics: The load impedance of a loudspeaker varies considerably over the audio-frequency range, with the greatest variations occurring at or near mechanical resonant points. The wide excursions in load impedance due to mechanical resonances are especially objectionable since they cause what is generally known as transient or hangover distortion. This speaker characteristic is sometimes evidenced by excessively high output at particular low frequencies. In order to reproduce transients faithfully and minimize transient or hangover distortion, additional damping must be provided. This is obtained, to some degree, by the internal damping offered by the speaker and the

plate resistance of the output tubes. Obviously, only a limited amount of damping can be obtained with carefully controlled loudspeaker design. Since additional damping is required, it becomes evident that one logical way to obtain it is to provide a low plate-resistance-to-load-resistance ratio through the use of triodes.

Distortion and Inverse Feedback: The transfer curve of an output-type triode is normally fairly linear, thereby minimizing amplitude and harmonic distortion. It can also be seen that phase distortion is greatly reduced since the attributes of triode output tubes contribute to wide, uniform frequency response.

Inverse feedback lessens many of the problems that plague the designer of audio amplifier systems. However, applying large amounts of feedback to insure good performance can give rise to economic and design liabilities. Depending on the amount of feedback used, a more expensive output transformer may be required to maintain the necessary degree of stability. The low effective plate resistance of triode power amplifiers and the many benefits derived therefrom, permit the use of less inverse feedback and provides a cost reduction in favor of the designer, while still maintaining top-notch performance.

Triode-Output Amplifier

The circuit diagram of a complete triode-output amplifier is shown in Figs. 1 and 2. The design features push-pull 6CK4's, preceded by the popular duo-triode long-tailed phase inverter and a pentode first stage. This combination is capable of furnishing a healthy 15 watts output to the load with only .7 volt input.

While miniature tubes will perform as well, the Type 6SJ7GT is used for the first stage of the amplifier. The circuit constants of this stage were carefully chosen to provide minimum distortion and maximum frequency response at the input-signal level required to drive the amplifier to full rated output.

The long-tailed phase inverter was selected because it offered reduced phase shift and made possible an extremely stable feedback loop by eliminating a stage of amplification. The tail, or cathode circuit of the inverter, is connected to the negative side of the bias supply to obtain the greatest possible output voltage from this stage. Among other advantages, this arrangement provides a means of bleeding the bias supply while avoiding the direct-coupled circuit configuration usually employed with the long-tailed inverter. (Direct coupling is a convenience used when all factors involved are relatively constant, such as in commercially manufactured equipment. However, in an amplifier that is to be constructed by the home builder, where parts selection is not controllable, particularly the output transformer, direct coupling may introduce problems.)

The possibility of instability due to low- or high-frequency phase shift is minimized by returning the grid of the cathode-driven section of the inverter tube direct to ground. Only the slightest degree of phase imbalance is evident between the two outputs of the inverter. Low-impedance, direct-cathode coupling also contributes greatly to this characteristic. Frequency response of the inverter, without feedback, is essentially flat through 60,000 cps.

If minimum distortion is to be

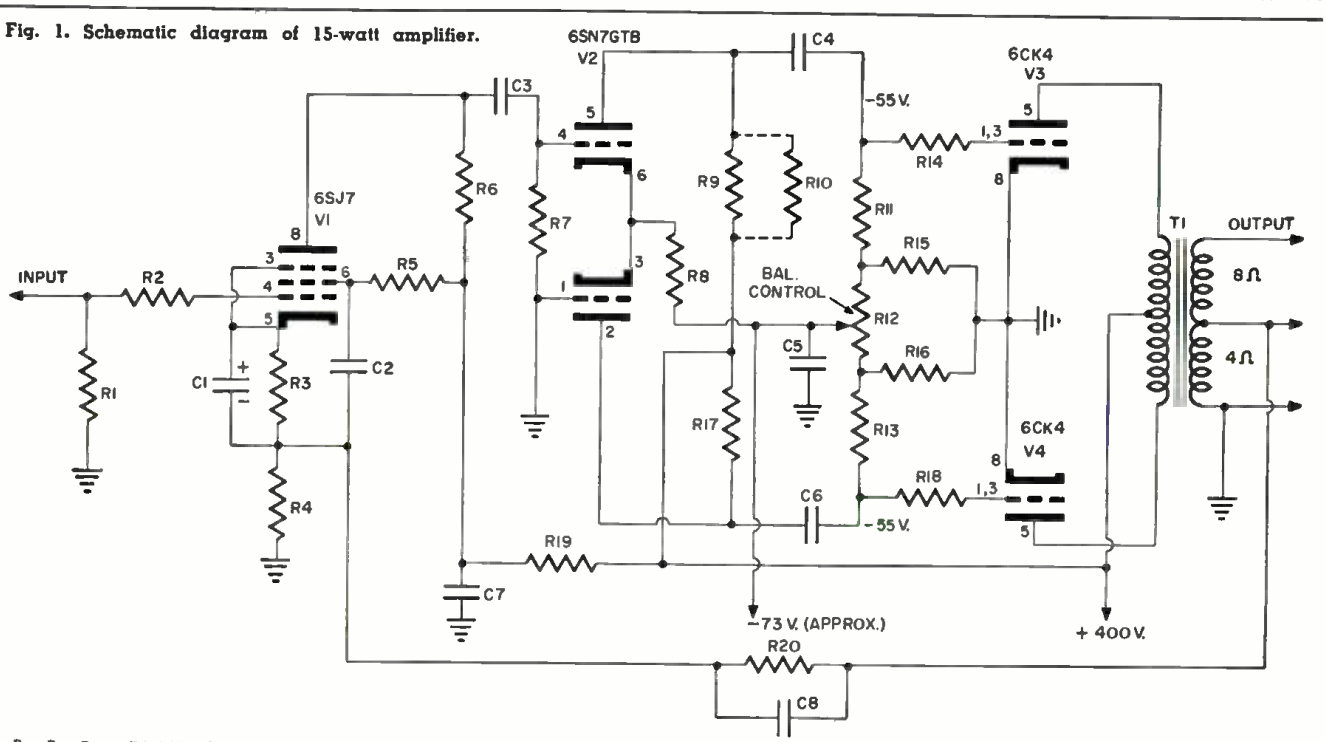
CLASS AB_1—PUSH PULL	I *	II	III	
Plate Voltage	340	400	400	Volts
Grid Voltage	−43.5	−55	−55	Volts
Grid Voltage r.m.s. Signal	30.8	38.2	38.2	Volts
Zero Signal Plate Current	76	60	60	Ma.
Max. Signal Plate Current	124	106	112	Ma.
Load Resistance	5000	7000	6500	Ohms
Power Output **	15	18.2	18.6	Watts
Total Harmonic Distortion	7.8	8.7	8.85	Per-cent
Plate Dissipation (no signal)	25.8	24	24	Watts
Plate Dissipation (with signal)	27.2	24.2	26	Watts
Efficiency	36.8	43	41.5	Per-cent

* Operation not recommended under these conditions since plate dissipation rating is exceeded.

** Measured directly at tubes. Does not reflect output transformer losses.

Table 1. Typical operation data for a pair of 6CK4's in class AB_1 push-pull.

Fig. 1. Schematic diagram of 15-watt amplifier.



R_1, R_8, R_7—470,000 ohm, 1 w. res.
R_2, R_5, R_{11}, R_{18}—3300 ohm, 1 w. res.
R_3—100 ohm, 1 w. res.
R_6, R_{11}, R_{13}, R_{15}—82,000 ohm, 1 w. res.
R_9—7500 ohm, 1 w. res.
R_{14}, R_{17}—22,000 ohm, 2 w. res.
R_{19}—150,000 ohm, 1 w. res. (see text)
R_{12}—50,000 ohm pot ("Balance Control")
R_{16}—150,000 ohm, 1 w. res.
R_{20}—1200 ohm, 1 w. res.
C_1—50 μfd., 25 v. elec. capacitor
C_2, C_4—.25 μfd., 400 v. capacitor
C_3—.05 μfd., 400 v. capacitor (see text)
C_5, C_6—.5 μfd., 400 v. capacitor
C_7—16 μfd., 450 v. elec. capacitor
C_8—370 μμfd., 400 v. capacitor
T_1—Output trans. 6500 ohm pri. to 4, 8, 16 ohm sec. (Thordarson T-22S68 or equiv.)
V_1—6SJ7GT tube
V_2—6SN7GTB tube
V_3, V_4—6CK4 tube

RATINGS (Design-Maximum Values)	
D.C. Plate Voltage	550 volts
Plate Dissipation	12.0 watts
Average Cathode Current	100 ma.
Peak Cathode Current	350 ma.
Grid Circuit Resistance Self Bias	2.2 megohms
AVERAGE CHARACTERISTICS	
Plate Voltage	250 volts
Grid No. 1 Voltage	−26 volts
Plate Current	55 ma.
Transconductance	6500 μmhos
Amplification Factor	6.7
Plate Resistance (approx.)	1000 ohms
Grid Voltage for I_b = .5 ma.	−50 volts
Plate Current at E_c = −38 volts d.c.	10 ma.
Zero-Bias Plate Current E_b = 100; E_c = 0 (Instantaneous Values)	125 ma.

Table 2. Here are the maximum ratings and characteristics of one of the new 6CK4's.

FREQUENCY (cps)	TOTAL HARMONIC DISTORTION (%) 1 watt	10 watts	15 watts
40	.65	.7	1.0
50	.6	.8	.9
100	.6	1.0	.8
1000	.5	.5	.6
2000	.45	.7	.8
5000	.8	.8	.8
7500	.8	.85	.9
10,000	1.0	.95	2.0
15.000	1.0	1.6	4.0

Table 3. Total harmonic distortion for the amplifier described in the text.

achieved with limited feedback, care must be taken to insure that each stage of the amplifier exhibits a flat frequency response without inverse feedback. This condition is absolutely essential if feedback is to be used to reduce distortion rather than as a means of extending frequency response. This principle of relatively flat frequency response with little feedback was one of the important considerations in developing the design of the first stage and the phase inverter.

The only drawback to the long-tailed phase inverter is the possibility of unequal output voltages due to the slightly higher gain of the grid-driven section. This condition can be corrected by reducing the value of load resistance used in the plate circuit of the grid-driven half of the inverter until the outputs are of equal amplitude. As shown in Fig. 1, balance is obtained by shunting the specified load resistance with different value resistors (R_{10}) starting with 150,000 ohms.

Output Stage

The output tubes operate class AB_1, under conditions shown in the third column of Table 1. The two additional columns of data are presented for purposes of comparison. Table 2 summarizes the published rating and characteristics of the Type 6CK4. Fixed bias is employed rather than self-bias in the output stage mainly to obtain those few extra watts of power that would otherwise be lost. A 5000-ohm potentiometer, incorporated in the bias supply, provides a means of adjusting the voltage appearing at the grids of the 6CK4's to the proper operating level of −55 volts, Fig. 2. Static plate-current balance is obtained by adjusting the 50,000-ohm "Balance Control" connected in the grid circuits of the output tubes, Fig. 1. Balance is obtained when a minimum voltage differential exists between the plates of the output tubes. As an alternate system, a 5-ohm sampling resistor could be built into the cathode circuit of each 6CK4.

Earlier in the article it was pointed out how a triode output stage eliminates many of the problems that lead to more complex circuitry and the incorporation of a relatively expensive output transformer. These savings are, of course, reflected in the amplifier described. The transformer used to couple the 6CK4 output stage to the speaker system is a *Thordarson* Model T-22S68, currently selling for about $6.50.

What remains to be said about the output stage can best be covered by describing the over-all amplifier performance.

Performance

When considering an amplifier for home use, it is important to keep in mind the fact that a high average power rating is sought only to insure that the amplifier can provide the high peak power required for faithful reproduction. Actual average power outputs in excess of a few watts are rarely needed in the home and an average output of around 10 watts will more than satisfy all but extreme conditions. The amplifier described is capable of furnishing 35 watts peak power, at the load, thus comparing favorably with the peak power capacity of the best 25-watt pentode amplifiers. This is quite an impressive feat when the fact that the amplifier has an average power-output rating of 15 watts is considered.

Power-response curves at 1 and 10 watts are shown in Fig. 3. The amplifier is virtually flat within the range of 30 to 16,000 cps at 1 watt output. At 10 watts output the amplifier is essentially flat from 40 to 14,000 cps.

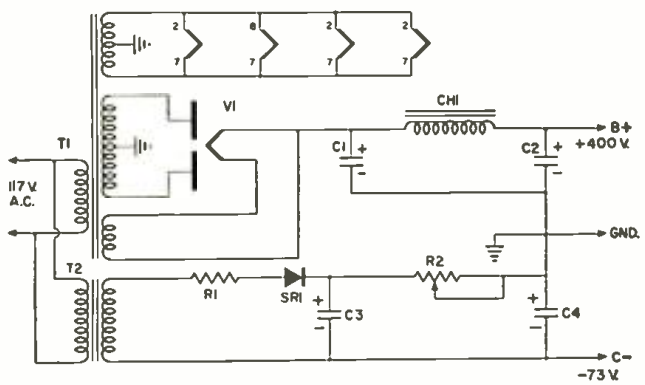


Fig. 2. Complete schematic diagram and the parts values for the associated power supply to be used with the 15-watt amplifier.

R_1—22 ohm, 1 w. res.
R_2—5000 ohm, 4 w. pot
C_1—16 μfd., 500 v. elec. capacitor
C_2—16 μfd., 450 v. elec. capacitor
C_3, C_4—20 μfd., 150 v. elec. capacitor
CH_1—4 hy., 150 ma. filter choke
SR_1—25 ma. selenium rectifier
T_1—Power trans. 400-0-400 v. @ 150 ma.; 6.3 v. @ 3.5 amps; 5 v. @ 3 amps
T_2—Bias trans., 117 v. @ 25 ma.
V_1—5U4GB tube

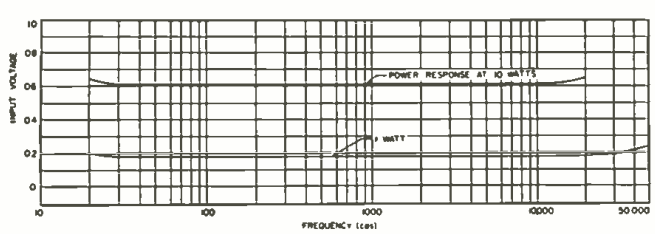


Fig. 3. Power response curves of the amplifier taken at 1 and 10 watts output.

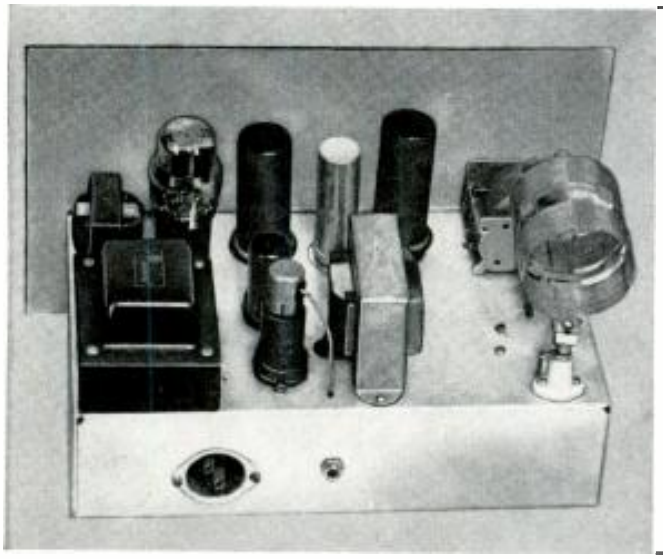
The power sensitivity of the amplifier is also apparent from the power response curves, *i.e.*, approximately .6 volt drive will produce 10 watts output. The amplifier's maximum average power output of 15 watts is obtained with only .7 volt input. The excellent

(*Continued on page* 129)

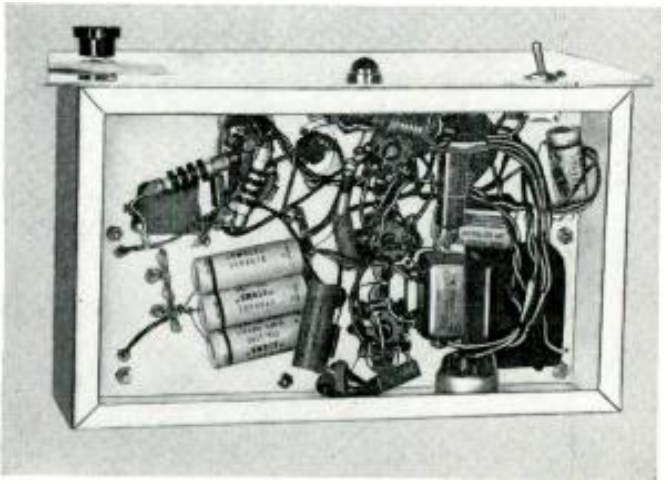
Wireless Neighborhood Baby Sitter

By **THOMAS F. RICHARDSON, JR.**

A power-line carrier-current transmitter that can be picked up easily on a nearby broadcast receiver.



Top view of the chassis of wireless neighborhood baby sitter.



Under-chassis view. Components employed are not critical.

ALTHOUGH several circuits of "electronic baby sitters" have appeared in the literature most of them have been wired intercoms of various types for use within a single dwelling.

In our locale we found that we needed a "neighborhood baby sitter" so that the parents could indulge in bridge sessions and "kaffe klatches" while keeping tabs on nursery doings. Of course, stringing intercom wires from house to house offered one solution to the problem, although not a particularly desirable one.

The answer chosen was "wired wireless" or carrier-current broadcasting. This system has been used for years in college campus broadcast stations and consists of superimposing a modulated r.f. signal on the 117-volt a.c. line. If this principle is correctly applied, a strong signal can be received locally while staying within the FCC rules on limited radiation devices.

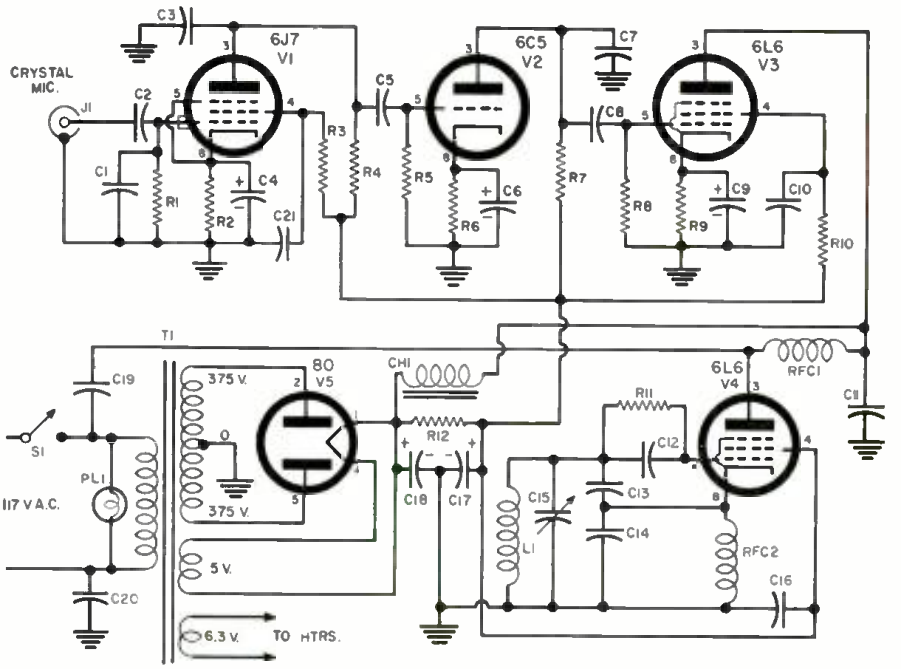
Basically, the "wireless neighborhood baby sitter" is a small broadcast-band transmitter that is placed in the baby's room and the signal can be received on any 117-volt a.c. broadcast receiver. If the schematic shown in connection with this article is followed closely, especially the r.f. portion, the signal produced will be within FCC limits and no license or permission will be required to operate the equipment.

Circuit

The unit as constructed by the author was built from "junk box" parts. The circuit is straightforward

(*Continued on page* 128)

Complete schematic diagram and parts listing for the carrier-current transmitter.



R_1, R_3, R_5, R_8—1 megohm, ½ w. res.
R_2—1200 ohm, 1 w. res.
R_4—240,000 ohm, ½ w. res.
R_6—3300 ohm, 1 w. res.
R_7—22,000 ohm, ½ w. res.
R_9—500 ohm, 5 w. res.
R_{10}, R_{11}—47,000 ohm, ½ w. res.
R_{12}—5000 ohm, 5 w. res.
C_1, C_3, C_7—100 μμfd. ceramic capacitor
C_2—.1 μfd., 400 v. capacitor
C_4, C_6, C_9—10 μfd., 50 v. elec. capacitor
C_5, C_8, C_{10}—.1 μfd., 600 v. capacitor
C_{10}, C_{12}, C_{16}—.001 μfd. mica capacitor
C_{11}—.001 μfd., 1000 v. mica capacitor
C_{13}—300 μμfd. mica capacitor
C_{14}—100 μμfd. mica capacitor
C_{15}—365 μμfd. tuning capacitor (see text)
C_{17}, C_{18}—40 μfd., 450 v. elec. capacitor
C_{19}—.01 μfd., 600 v. capacitor (see text)
C_{21}—.01 μfd., 600 v. capacitor
RFC1, RFC2—2.5 mhy. r.f. choke
CH1—10 hy., 100 ma. filter choke
L_1—80-meter coil (Bud)
PL1—117-volt pilot light
S_1—S.p.s.t. switch
J_1—Phono or mike jack
T_1—Power trans. 375-0-375 @ 100 ma.; 5 v. @ 2 amps; 6.3 v. @ 2.5 amps (minimum specs, see text)
V_1—6J7 tube
V_2—6C5 tube
V_3, V_4—6L6 tube
V_5—80 tube

By JOHN T. FRYE

Servicing Amateur Equipment

IT WAS hot, steaming hot, outside; and Barney was glad to step into the dry coolness of the air-conditioned service shop. He stood in the doorway for a minute wiping the sweat from his freckled face as he exchanged glances with Mac, his employer; then he turned around, bent over with his hands resting on his knees, and said over his shoulder:

"Boss, would you mind giving me a good swift kick?"

"Don't tempt me!" Mac exclaimed; "but why?"

"I pulled a real boo-boo on that service call I just finished. As you know I was returning a TV chassis I had pulled and brought into the shop for complete re-alignment. It belongs to an elderly couple and the man is very hard of hearing. He uses an earphone connected to the speaker with the wires running beneath the rug over to his chair. He was sitting in this chair when I went in, but he didn't say anything except to nod.

"I explained to his wife what we had done to the set as I slid the chassis into the cabinet and hooked things up. Before putting on the back I plugged in a cheater cord and turned the set on. Everything was fine except for one thing: there was the darndest loudest 60-cycle hum you ever heard. It actually shook the floor! I glanced up at the old gentleman. He was sitting there with the earphone in his ear and a pleased smile on his face. Obviously he was hearing nothing wrong. Maybe he was deaf to the low frequency.

" 'Don't you notice that loud hum?' I asked the woman."

" 'Why, no; I don't hear anything unusual,' she said."

"Was it possible the hum had been in that set so long she had become accustomed to it? Nope, I couldn't sail for that. I know a speaker without a cabinet baffle can't do justice to a 60-cycle frequency; but we *couldn't* have overlooked a hum that loud. It must be moving the speaker cone a quarter of an inch, I thought. Something must have happened between the time I turned the set off in the shop and the time I turned it on in the house.

"Turning the volume up and down had no effect. Neither did changing channels. All the tubes were tight in their sockets. I pulled the first audio tube. No difference. All the filter capacitors must be wide-open. Reluctantly I decided the chassis had to come out again, and I reached around and turned the set off. The hum didn't stop! In desperation I jerked off the cheater cord. The hum kept right on humming. I really began to believe I had popped my cork.

"At this moment I happened to glance up and saw the old gentleman reach around behind his chair and pull a cord out of a wall socket. Instantly the hum ceased. Following that cord with my eyes, I saw it went to a little cushion on which his feet were resting. It was one of those vibrator pillows. No wonder my 'hum' had been shaking the floor!"

Mac chuckled aloud as Barney finished the story. "I'll bet you really felt silly," he chortled.

"Well," Barney answered, grinning at the memory, "all three of us had a good laugh when I explained what had been bothering me. They were so used to the humming of that vibrator pillow they didn't notice it at all. Did anything interesting happen while I was out?"

"A kid was in here trying to get me to work on his ham transmitter. I told him we didn't do that sort of work in the shop but that possibly you might help him out on your own. Here's his address and call."

"Yep, I know him," Barney said as he glanced at the slip of paper. "He's only had his Novice call a couple of months. You know something? Getting ham equipment repaired is becoming quite a thing."

"How come?"

"In the old days practically all amateurs built their own equipment, both receivers and transmitters. When they designed, built, and spent several weeks de-bugging their rigs, they were in an excellent position to take care of any trouble that popped up later. Today we have a whole new breed of hams. Practically none of them build their own receivers and an increasing number don't even build their transmitters. As soon as they get their license they go down to the store and buy a complete station. All they have to do is connect the receiver and transmitter up to the antenna and plug in the key or mike and they're in business. All goes well until something conks out in the equipment. Then they feel as helpless as if they had to depend on themselves to repair their TV set or their watch."

"But a ham's got to pass an examination on transmitter and receiver theory to get his license."

"True, but you're the last one I need to tell there's a lot of difference between having an elementary grasp of radio theory and possessing the practical experience and confidence needed to tackle a sick communications receiver or complex modern transmitter."

"Hm-m-m-m, I see what you mean. On the other hand, the average radio and TV service technician isn't prepared to take on the job. He, too, lacks experience with high-powered transmitters. There's a lot of difference between working with r.f. circuits handling only microwatts of power and working on a transmitter in which a tube's grid circuit is likely to be handling more power than the plate circuits of receiving tubes. The service technician has had only limited experience with tubes operating in class C or class B. The TV technician is accustomed to working around high voltage, but he is not eager to mess with the lethal combination of high voltage *and high current* found in transmitters.

"Having no license himself, he can't make on-the-air tests without the owner present. Ordinarily he will have no transmitting antenna available at the shop. He is unable to fall back on one of his most trusted servicing techniques: the substitution of parts known to be good for doubtful parts. How many service shops have a stock of transmitting tubes, high-voltage filter capacitors, or modulation transformers?

"Finally, there's the matter of charging for the work. Remember the service technician is in business to make money, not to amuse himself. His time at work must bring in a calculated return if he is to stay in business. If he charges his regular rate for the time he must spend 'boning up' on the particular transmitter to be repaired, the owner will quite likely have a whopping big bill. On the other hand, the service technician can't afford to charge less than he could make working at his specialty: receiver service. Keep in mind it's not to his discredit that he knows little of transmitter circuits. He is a specialist in radio and TV service. Even a superb brain sur-

(*Continued on page* 139)

Author Jones is shown with the stereo system described below. The two preamps are at the bottom of the tape deck carrying case, the two 10-watt amplifiers are on the shelf between the two speakers, and the common power supply is at the left.

Complete construction data on a semiconductor stereo system which provides 20 watts of hi-fi power output.

By **DWIGHT V. JONES**
Semiconductor Products Dept.
General Electric Company

All-Transistor Stereo Tape System

EDITOR'S NOTE: *For those of our readers who are interested in constructing the unit described below, we would like to point out that there are nine transistors used in each of the two channels, plus four silicon rectifiers in the power supply. The four power transistors are* Delco *types available directly from local* Delco *distributors at about $6.00 apiece. The other transistors and rectifiers are readily available and are less expensive. The total cost of semiconductors alone may run between $70.00 and $80.00 for this unit.*

In spite of the above, however, we feel that this article is important even to those who may not duplicate the circuit since it shows what can be done with transistors and transistor circuitry at this time.

TWENTY watts of electrical energy is available from this system for driving your living room speakers; also adequate tone controls to compensate for variations in components, program material, and the human ear at different listening levels. This system consists of a stereophonic tape deck, two tape preamplifiers, two 10-watt amplifiers, two 8- or 16-ohm speaker systems, and a common power supply, as indicated in the block diagram of Fig. 7.

Transistors offer many advantages in high-fidelity circuits since there is no problem with microphonics or hum pickup from filaments as we have with tubes. Transistors are inherently low-impedance devices and thus offer better matching to magnetic pickups and loudspeakers, for more efficient power transfer.

Preamplifiers

The two preamps consist of two identical units with the circuitry of Fig. 1. Both preamplifiers use a common 18-volt battery supply. The circuit of Fig. 1 consists of three direct-coupled transistor stages. The first two stages have a feedback bias arrangement for current stabilization of the two stages. The 330,000-ohm resistor from the emitter of V_2 provides this d.c. current feedback to the base of V_1. The output stage is well stabilized with a 5000-ohm emitter resistance, R_8.

The negative feedback from the collector of V_2 to the emitter of V_1 is frequency selective to compensate for the standard NAB (formerly NARTB) recording characteristic. The preamplifier frequency response from a record-

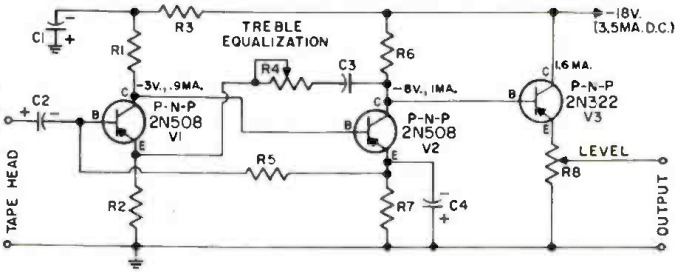


Fig. 1. Complete schematic diagram and part listing of one of the tape preamplifiers employed. Note two identical units are required for system.

R_1—15,000 ohm, ½ w. res.
R_2—47 ohm, ½ w. res.
R_3—1500 ohm, ½ w. res.
R_4—25,000 ohm linear taper pot ("Treble Equalization")
R_5—330,000 ohm, ½ w. res.
R_6—10,000 ohm, ½ w. res.
R_7—3000 ohm, ½ w. res.
R_8—5000 ohm audio taper pot ("Level Control")
C_1, C_2—20 µfd., 20 v. elec. capacitor
C_3—.01 µfd. ceramic capacitor
C_4—100 µfd., 6 v. elec. capacitor
V_1, V_2—"p-n-p" transistor (G-E 2N508)
V_3—"p-n-p" transistor (G-E 2N322)
NOTE: This listing is of parts required for ONE of the preamps. For the complete stereo system as described by the author, TWO such units must be built and the above parts duplicated.

Fig. 2. Response curves for the tape preamplifier unit.

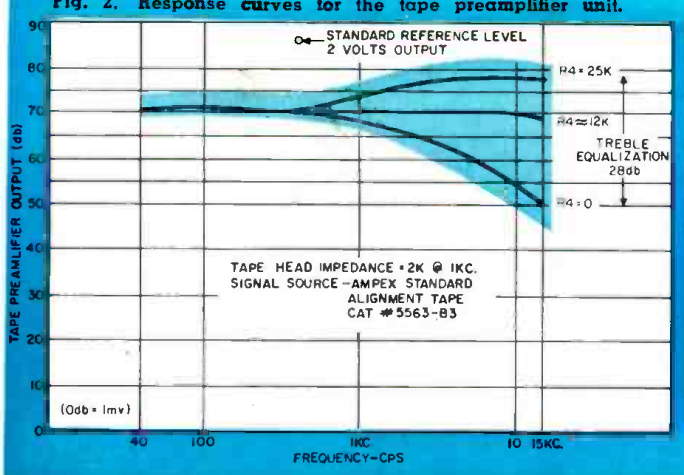
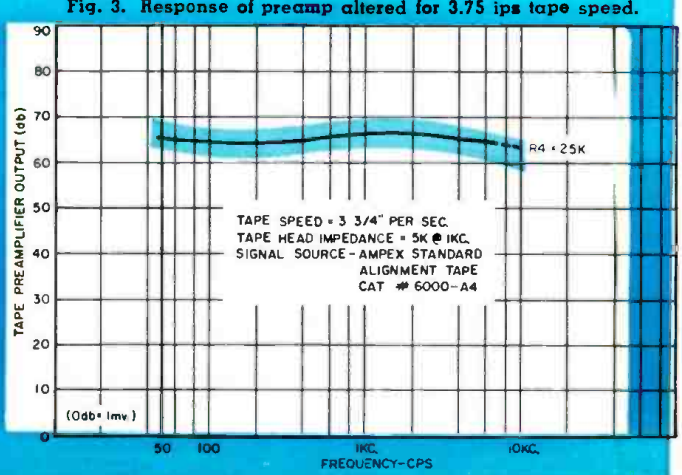


Fig. 3. Response of preamp altered for 3.75 ips tape speed.



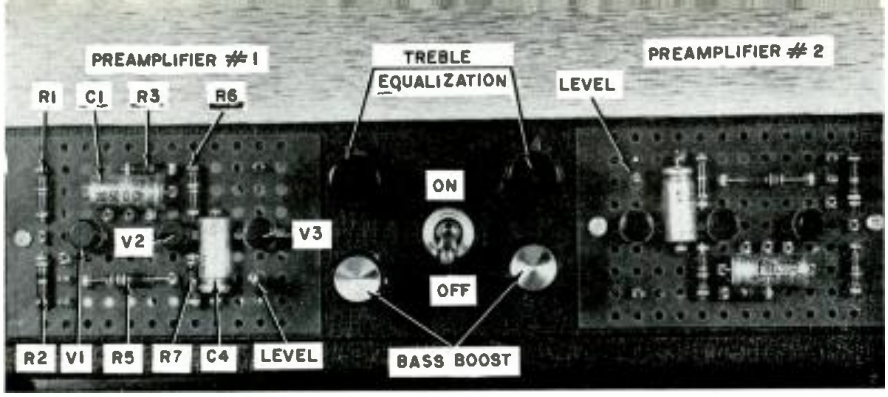
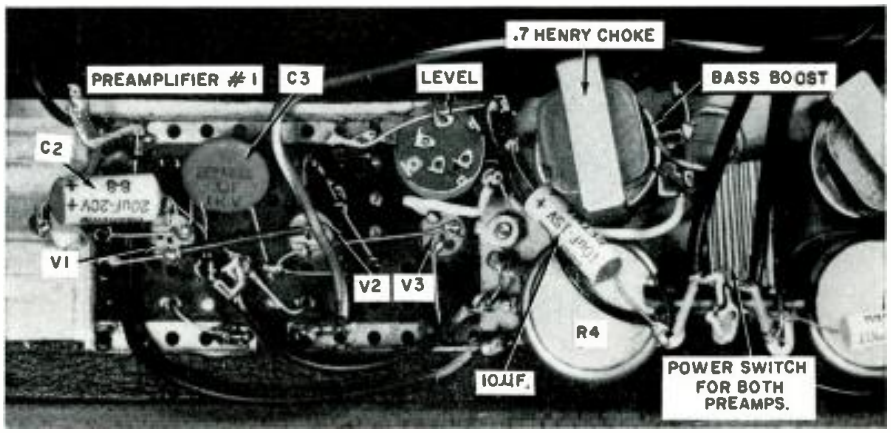


Fig. 4. Both tape preamps along with tone control circuits are shown here.

Fig. 5. Close-up view of rear of one preamp and the tone-control circuits.



ed tape at 7.5 ips is shown in Fig. 2. The flat response from a standard recorded tape occurs with the treble control, R_4, at mid-position or 12,000 ohms. There is 7 to 8 db of treble boost with the control at 25,000 ohms maximum position and approximately 20 db of treble cut with R_4 equal to zero.

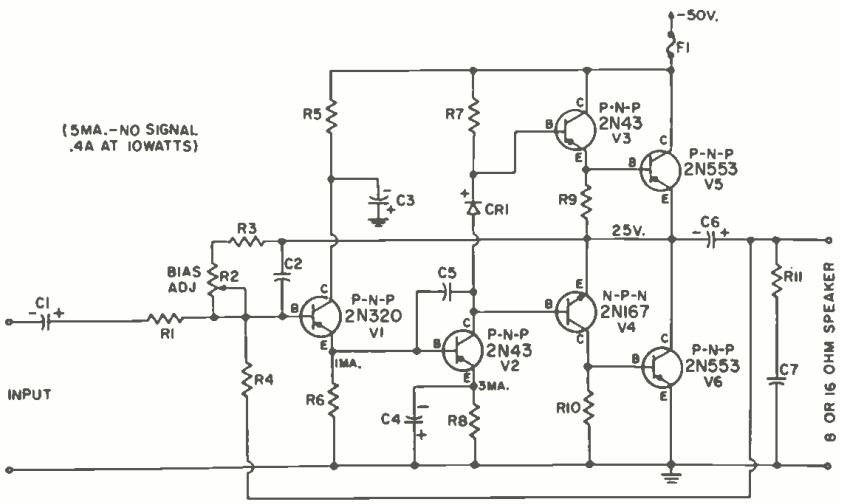
The preamp output is approximately 2 volts with the input being the maximum 400-cycle recorded level for 2 per-cent distortion on the tape (Standard Reference Level). The total harmonic distortion of the preamp at this level is under .2 per-cent. With a preamp output of 4 volts at 400 cycles, the total harmonic distortion is still less than 1 per-cent as actually measured.

This preamp will accommodate a variety of tape head impedances since it gives an equalized output for a 2000-ohm head at 1000 cps and also a 6000-ohm head. The input impedance of the preamp increases with frequency because of the frequency selective negative feedback to the emitter of V_1. The impedance of the tape head also increases with frequency but is below that of the preamp. The input impedance of the preamplifier is approximately 70,000 ohms at 1000 cps.

The 2N508 was used in this preamp because, basically, it is a high-gain low-noise transistor. This transistor operates in a circuit designed to achieve a good signal-to-noise ratio (S/N). The S/N of this preamp is approximately 60 db. The noise level will vary with respect to head structure, shielding, and physical layout of the tape deck, amplifiers, etc.

The emitter-follower stage gives a low-impedance output for a cable run to the power amplifier and acts as a buffer so that any preamp loading will not affect the equalization characteristic. A linear taper was used for R_4, the treble control, and an audio taper for R_5, the level control.

The preamplifier of Fig. 1 may be altered to compensate for tapes re-



R_1—3000 ohm, ½ w. res.
R_2—100,000 ohm pot ("Bias Adjust")
R_3—150,000 ohm, ½ w. res.
R_4—24,000 ohm. ½ w. res.
R_5—39,000 ohm. ½ w. res.
R_6—1500 ohm. ½ w. res.
R_7—8200 ohm. ½ w. res.
R_8—470 ohm, ½ w. res.
R_9, R_{10}—1000 ohm. ½ w. res.
R_{11}—22 ohm, ½ w. res.
C_1—20 μfd., 20 v. elec. capacitor
C_2—100 μμfd. ceramic capacitor
C_3—25 μfd., 50 v. elec. capacitor
C_4—100 μfd., 6 v. elec. capacitor
C_5—.001 μfd. capacitor
C_6—1000 μfd., 50 v. elec. capacitor
C_7—.2 μfd. paper capacitor
CR_1—1N91 germanium diode
F_1—½ amp. fuse
V_1—"p-n-p" transistor (G-E 2N320)
V_2, V_3—"p-n-p" transistor (G-E 2N43)
V_4—"n-p-n" transistor (G-E 2N167)
V_5, V_6—"p-n-p" transistor (Delco 2N553)
NOTE: This listing is of parts required for ONE of the amplifiers. For the complete stereo system as described by the author, TWO such units must be built and the above parts duplicated.

Fig. 6. Complete schematic of one of the two identical 10-watt power amplifiers.

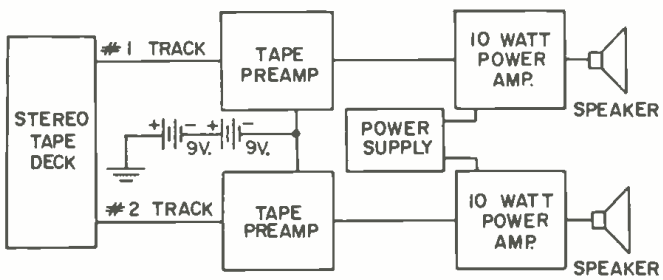
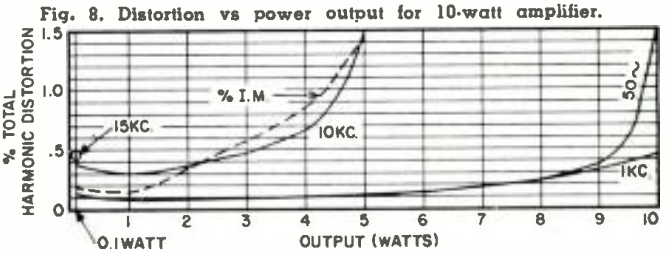


Fig. 7. Block diagram of the complete stereo tape system.

Fig. 8. Distortion vs power output for 10-watt amplifier.



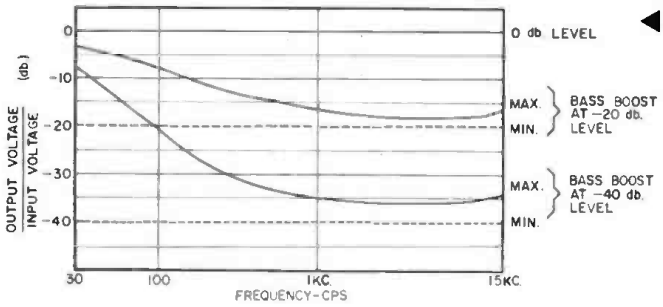


Fig. 9. Curves at the left show the frequency response of the bass-boost circuit employed at −20 and −40 db.

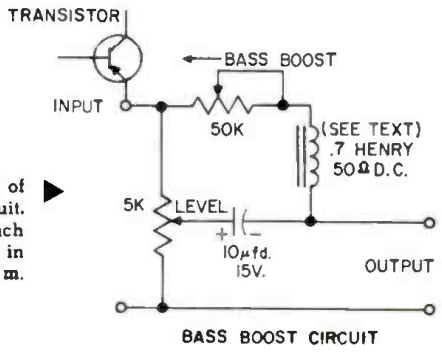


Fig. 10. Schematic of the bass-boost circuit. Note that two such circuits are used in the stereo system.

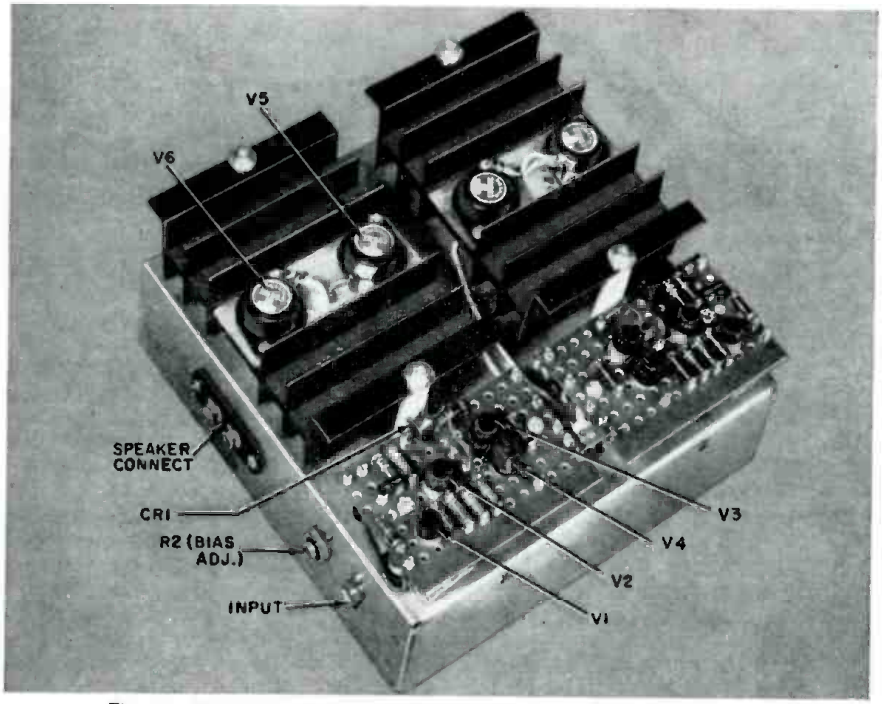


Fig. 11. Top view of the two 10-watt transistorized power amplifiers.

This is to compensate for the non-linear response of the human ear as represented by the now-familiar Fletcher-Munson curves. The ear requires a higher level for the low-frequency sound to be audible as the frequency is decreased and also as the over-all spectrum level is decreased.

The usual circuits that are employed to accomplish this attenuate the over-all audio spectrum independent of the level control and then with a variable network the low-frequency attenuation is decreased—giving bass boost. This means that circuit gain has been sacrificed to obtain bass boosting. Frequency sensitive feedback around one or more stages is another method used to accomplish bass boost.

The new simplified bass-boost circuit shown in Fig. 10 gives the desired result without sacrificing circuit gain or adding gain stages.

This circuit is more easily adapted to transistor circuitry since it requires a very low drive impedance for optimum performance. It is quite practical to attain this low impedance (less than 50 ohms) from a transistor in the emit-

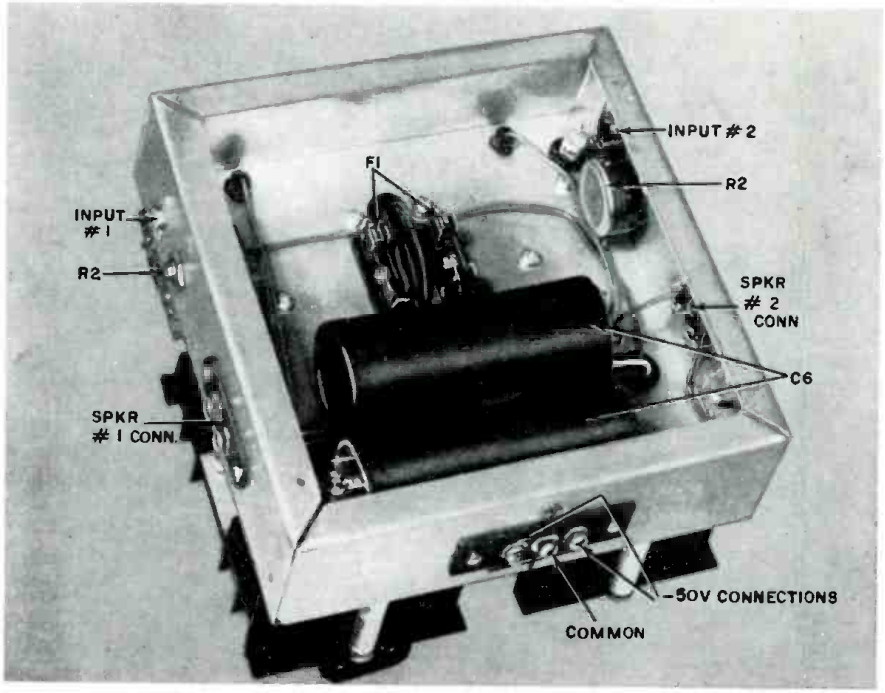
corded at 3.75 ips by setting R_1 at 25,000 ohms and making the feedback capacitor (C_3) .02 μfd. In addition, the 47-ohm resistor (R_2) from the emitter of V_1 to ground was shunted with .5 μfd. to attain the response shown in Fig. 3. The value needed for this shunt capacitor will depend somewhat on the high-frequency response of the tape head being used, since this capacitor contributes to increased circuit gain above 3000 cps.

Bass-Boost Circuit

A bass-boost circuit using three passive components in conjunction with the level control is included in the design. This gives the operator independent control of the level or amount of bass boost desired or the level control can be used as a loudness control. This circuit has the advantage of simplicity, economy, and has its best application in transistor circuits since it requires a very low driving impedance.

It is usually desirable to have some method of boosting the level of the lower portion of the audio spectrum as the over-all sound level is decreased.

Fig. 12. Bottom view of the chassis housing both the power amplifiers.



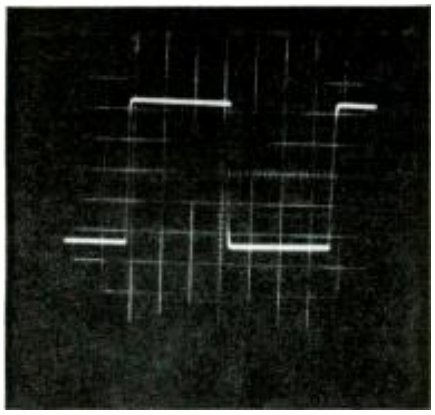
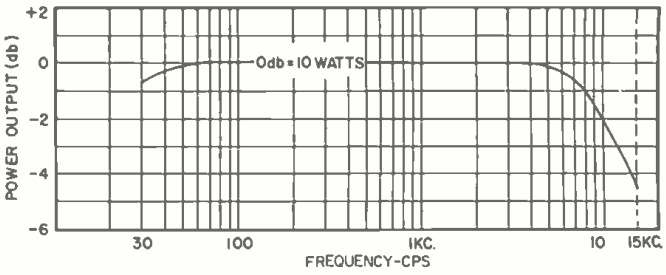
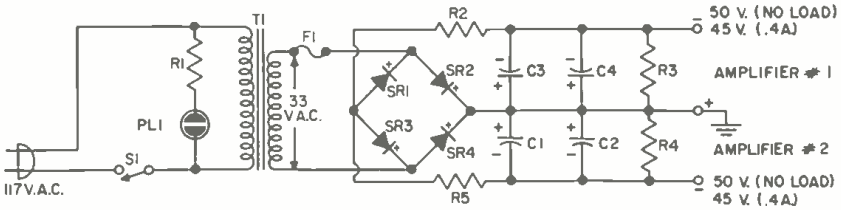


Fig. 13. One-kc. square-wave response.

Fig. 14. The curve at the right shows the maximum power response of one of the power amplifiers at the level at which clipping begins.





R1—180,000 ohm, ½ w. res.
R2, R5—2 ohm. 5 w. res.
R3, R4—47,000 ohm, ½ w. res.
C1, C2, C3, C4—1500 μfd., 50 v. elec. capacitor
SR1, SR2, SR3, SR4—Silicon rectifier (1N1115)
T1—Rectifier power trans. 117 v. pri.; 33 v. @ 3 amp sec. (Triad F-61U or equiv.)
F1—2 amp fuse
S1—S.p.s.t. switch
PL1—1/25th watt neon bulb (NE-51)
NOTE: This supply will power both amplifiers.

Fig. 15. Complete schematic diagram of the single power supply unit required.

ter-follower connection, as shown in Fig. 10.

Fig. 9 shows the frequency characteristics of this circuit. With the level control set for zero attenuation at the output there is no bass boost available, but as the output level is attenuated, the available bass boost increases.

Fig. 9 shows the frequency response (lower dashed curve) when the output is attenuated 40 db and the bass-boost control is set for minimum (50,000 ohms). The solid curve immediately above represents the frequency response when the bass-boost control is set at maximum (zero ohms). Thus a frequency of 30 cps can have anything from zero to 27 db of boost, with respect to 1000 cps, depending on the adjustment of the bass-boost control.

All components used in the construction are standard with the exception of the inductance, which weighs about 1 ounce and has over-all dimensions of about 1" x ¾" x ¾". The coil is wound on standard nickel-steel laminations that are used for transistor transformers. The author obtained the 0.7-henry inductance by using the green and yellow leads on the secondary of *Argonne* transistor transformer No. AR-128.

This circuit about fulfills the requirements set forth in the article "Is a Loudness Control Necessary" by Burt Hines published in the July 1958 issue of Radio & TV News. This article indicated a separate loudness control would not be needed if a bass control could provide "something like 25 to 30 db at 40 cycles." Fig. 9 shows that approximately 25 db of boost can be obtained with this circuit. The Fletcher-Munson contours of equal loudness level show most of the contour changes involve a boost of the bass frequencies at the lower levels of intensity. Therefore, this circuit combination seems to fulfill the requirements of level control, bass boost, and loudness control.

The circuit can be added to the emitter-follower and level-control output of Fig. 1 since it has the same driving impedance, as shown in Fig. 10.

With this addition, the preamp of Fig. 1 now has the necessary treble and bass control to compensate for listening levels, deficiencies in the program material, or deficiencies in pick-up, speakers, etc.

The construction and component layout of the two preamplifiers with this bass-boost circuit is shown in Fig. 4. Fig. 5 shows the construction on the back side of one of the preamps.

Power Amplifiers

A great deal of effort has gone into the development of transformerless push-pull amplifiers using vacuum tubes. Practical circuits, however, use many tubes in parallel to provide the high currents necessary for direct driving of low-impedance speakers.

The advent of power transistors has given new impetus to the development of transformerless circuits since transistors are basically low-voltage, high-current devices. The emitter-follower stage, in particular, offers the most in-

(*Continued on page* 134)

Fig. 16. Top view of the common power supply chassis.

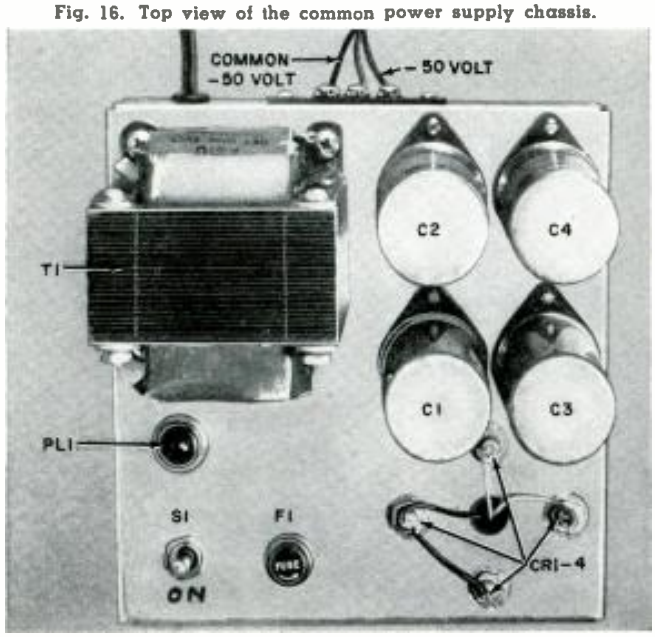
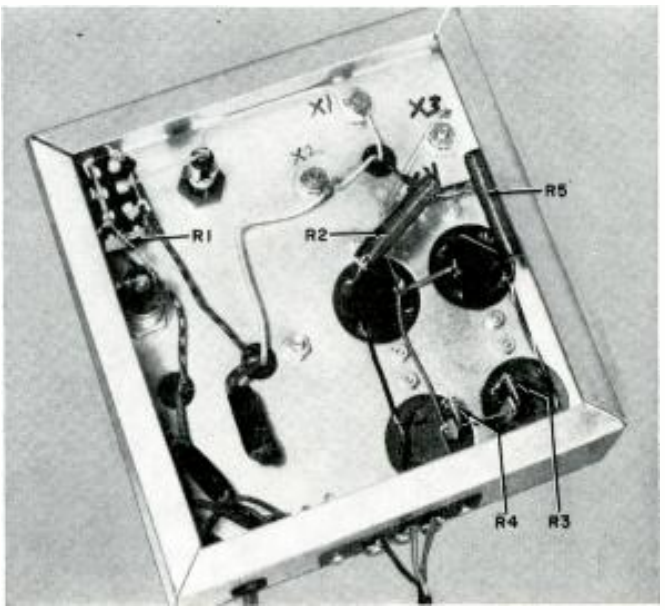


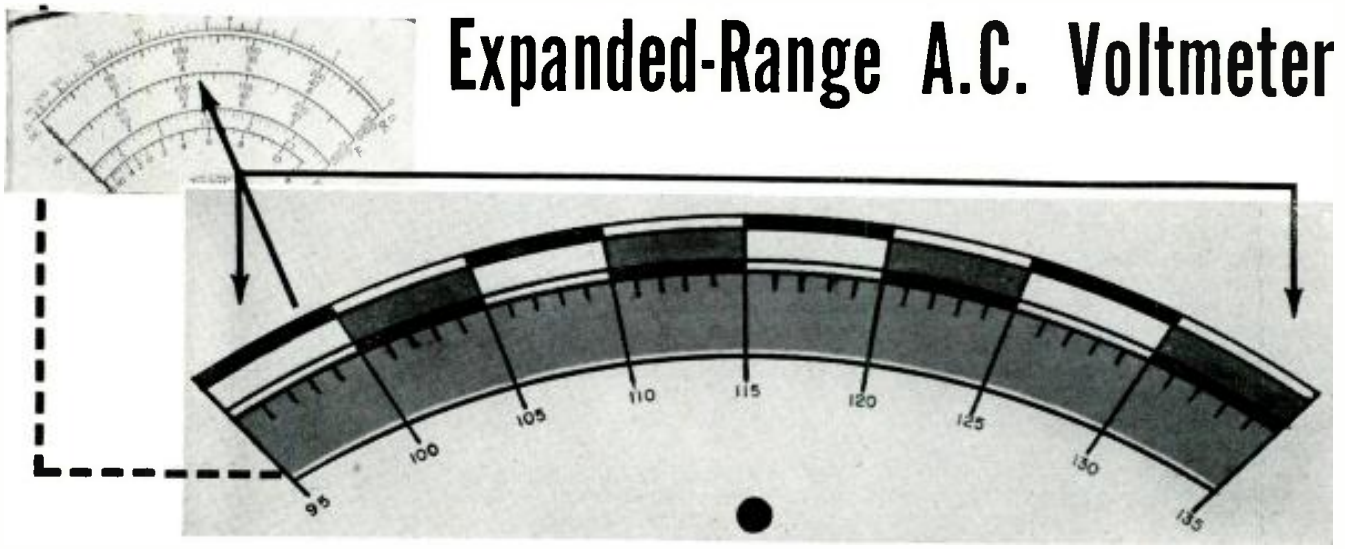
Fig. 17. Bottom view of the common power supply unit.



For those critical line-voltage or other a.c. checks, a handful and a half of parts build this

By PAUL S. LEDERER

Expanded-Range A.C. Voltmeter



THE DESIGN of most electronic devices operated from the conventional a.c. line is based on a voltage value of 117 volts. Substantial deviations from this nominal value produce obvious effects, but even relatively small variations may have results that are significant, if less noticeable. For example, manufacturers of vacuum tubes generally recommend operation of tube heaters within ±10% of rated value. To meet this requirement, the a.c. supply voltage would have to be within the same percentage limits. Operation below rated voltages may prolong the life of the tubes, but the reduction in gain and power output, which is cumulative in most receivers, can make quite a difference. Operation above rated values increases gain and output, but reduces tube life considerably, by a percentage greater than that of the over-voltage condition.

In the case of certain gas-filled devices, including some tubes in this category, deviation of operating voltages beyond the ±10% limits may mean complete failure. Incandescent lamps are highly sensitive to fluctuations of the kind under consideration. For a typical lamp, a 10% increase in operating voltage above the rated value can produce 30% more light output—but can also reduce life of the lamp by 75%.

Since the importance of maintaining a reasonable line-voltage stability is generally recognized in industrial and laboratory situations, voltage regulating and/or monitoring devices are frequently employed to maintain the rated value with relative independence of power-line fluctuations. In sprawling residential sections, however, large variations do occur despite the efforts of light and power companies to minimize them. The author knows of an outbreak of TV troubles in one area, for example, that turned out to be caused by low line voltage and nothing more.

Before remedial measures for an unstable a.c. line can even be considered, there is first the problem of establishing the difficulty, which, of course, means measuring the a.c. line voltage. This sounds quite simple. However, the device usually used by the technician is, at best, an a.c. voltmeter with a range of 0-150 volts. In other cases, the most convenient available scale is 0-300 or 0-500 volts. On such instruments, a variation of ±10% of 117 volts generally represents no more than ±2 divisions on the scale. This narrow spread, somewhat inconvenient to read in any case, represents the desired limits of variation in an inadequate way even if the instrument has been calibrated carefully for accuracy at 117 volts itself.

The best solution is a meter that would cover a relatively limited range of voltages, say no more than 20% below the rated line voltage and no more than 20% above it, but would portray this range on an expanded scale that would permit both ease and close accuracy in reading. Actually commercial, expanded-scale, a.c. voltmeters that indicate only from about 90 volts to about 130 volts do exist. They are excellent, but would be considered rather expensive by most service technicians, hams, and experimenters.

Fortunately a good indicator of this sort can be put together at relatively little cost. The most expensive item is a 0-1 milliampere d.c. meter, which is quite likely to be on hand. A zener diode that costs between $3 and $4 is also required. In addition, there are a few resistors, a capacitor, and a selenium rectifier. Thus the finished product can be made quite compact. While it may not have the outstanding accuracy of the commercial unit, the author's version has been calibrated so that accuracy is within ±2 volts over a range from 95 to 135 volts. Since this is about 2%, it will more than suffice for the purpose.

Concerning operation of the circuit, shown in Fig. 1, we have a bridge with resistors in three of its four legs (R_2, R_3, and R_5) and the zener diode, CR_1, in the fourth leg, with the milliammeter arranged to sense bridge imbalance. The zener diode may be compared to a voltage-regulator tube in one respect that is important to this circuit: the voltage drop across it remains constant over a wide range of current variation. Thus, we can choose component values so that, when a certain d.c. voltage is applied across the entire bridge (enough so that the diode will begin to show its constant-voltage character), the bridge is balanced.

The point chosen at which the bridge is to be balanced is the lowest voltage we wish to measure. Now, when the d.c. voltage applied across the bridge is increased, the drop across the zener

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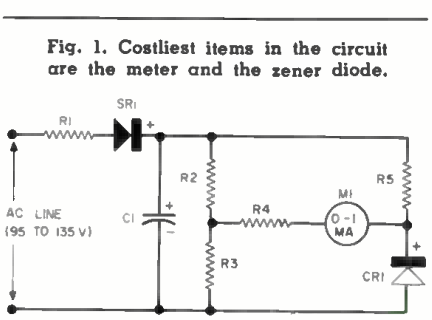
Fig. 1. Costliest items in the circuit are the meter and the zener diode.



R_1—22 ohm, 1 w. composition res.
R_2—10,000 ohm, 1 w. composition res.
R_3—4400 ohm, 1 w. composition res. (see text)
R_4—10,000 ohm, 1 w. composition res. (see text)
R_5—100,000 ohm, ½ w. composition res.
C_1—20 μf., 250 v. elec. capacitor
M_1—0-1 ma. meter
SR_1—Selenium rectifier, 25 ma. (or higher) @ 135 v.
CR_1—Zener diode (Hoffman 1N1320)

Add A.F.C. with a Silicon Diode

By STEWART K. GIBSON

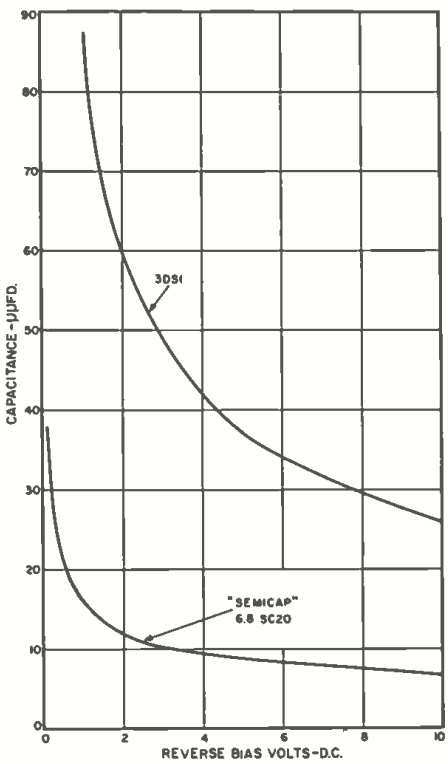
Use the new silicon junction diode whose capacity varies with voltage to add a.f.c. to an FM receiver.

ALTHOUGH most high-quality FM tuners manufactured during the past few years have included automatic-frequency control (a.f.c.) to simplify tuning, there are thousands of receivers, particularly of the less expensive type, which do not incorporate this desirable feature. Many of these sets really need automatic-frequency control, not only to combat warm-up drift which makes retuning several times during the first half hour of operation essential, but also to combat the backlash and wind-up in the tuning drive which makes it nearly impossible to tune critically without long practice. We've even run across one or two models that never did settle down, even after several days of continuous operation! With the addition of silicon-diode automatic-frequency control, even the most "ornery" receiver becomes well behaved.

Actually, when we use a silicon-junction diode for automatic-frequency control we are utilizing a characteristic of the junction diode which semiconductor engineers have striven to minimize, *i.e.*, its capacity. Unlike the point-contact silicon diode which can be designed with such low shunt capacity that it may be used as a sensitive microwave detector or mixer, the silicon-junction diode has sufficient shunt capacitance to seriously limit the diode's application at high frequencies. Happily, for our requirement, this capacity is not constant[1] varying with the reverse voltage applied. Thus a typical diode with $\frac{1}{10}$th of a volt of d.c. reverse bias may have an effective capacity of over 30 $\mu\mu$fd., while increasing the bias to 1 volt will decrease the capacity nearly 50 per-cent. It is this variation of capacity with voltage which will be used for automatic-frequency control.

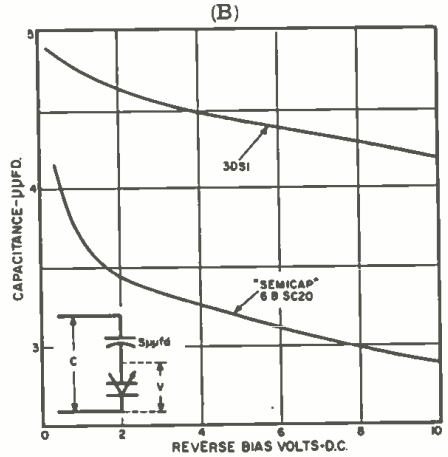
Fortunately, the two FM detectors most often encountered, the discriminator and the ratio detector, in addition to detecting the instantaneous frequency modulation applied to the signal at the transmitter, produce a d.c. component which is dependent not only on the signal strength of the carrier, but also on the frequency of the signal. In the normal configuration of either of these circuits, this d.c. voltage output is zero when the incoming signal is exactly "in tune" with the detector, while detuning only a few kilocycles on one side of resonance produces a positive voltage output and detuning on the other side of resonance provides a negative output. Thus we develop a voltage which not only indicates when the receiver is not properly tuned, but one that has a sense of direction, *i.e.*, signals its polarity whether the tuner is above or below resonance. If a slight increase in the capacity of the tuning capacitor causes the detector to put out a negative d.c. voltage and this voltage is applied to the silicon-junction diode "capacitor," the diode capacity will decrease. Of course, this decrease will be determined both by the amount of detuning and the received signal strength, so for an increase of $\frac{1}{10}$ of a micromicrofarad in tuning capacity, there might be a 10 $\mu\mu$fd. change in the diode capacitance.

Fig. 1. (A) Capacitance of typical silicon junction diodes. (B) Circuit capacity with a 5-$\mu\mu$fd. capacitor in series with diode.



(A)

(B)



If we now connect the diode "capacitor" across the oscillator section of the tuning capacitor in the FM receiver and again retune slightly, the voltage developed off-resonance by the detector will be fed to the diode and change its capacity to compensate for the detuning. However, this capacity change will bring the signal back closer to resonance and thus reduce the control voltage again. A change of $\frac{1}{10}$th of a micromicrofarad in the tuning capacitor's capacity will thus cause a final compensating change of *slightly less* than $\frac{1}{10}$th of a micromicrofarad in the diode capacitance. In other words, the capacitance change in the diode can restore the tuning *almost* to resonance, but never all the way. Of course, the stronger the signal, the greater will be the voltage developed for a given amount of detuning and the wider the tuning range over which the signal will be pulled back closer to resonance with no audible degrading of the received signal.

Suitable Diodes

Although any silicon-junction diode should be usable as a voltage-tuned capacitor, most available data covers the use of medium-current, hermetically sealed units, such as *International Rectifier Corporation's* series of diodes rated at 250 ma. maximum in conventional rectifier service, including the 3AS1 (1N599) with a 50-volt peak inverse voltage limit and the 3DS1 (1N602) with a 200-volt peak inverse maximum[2] and specially designed units such as *International Rectifier's* "Semicap" and *Pacific Semiconductor's* "Varicap" series. Two typical curves of capacitance *versus* reverse bias voltage are shown in Fig. 1A. Note that the capacitance range of these units is far greater than required at the FM-band frequencies where the total capacitance to tune the entire FM band, 88 to 108 mc., in only 10 to 20 $\mu\mu$fd.; so we may modify the curves by putting a small capacitor in series with the voltage-tuned one. Fig. 1B shows the effect on the curves of Fig. 1A of a 5-$\mu\mu$fd. series capacitor. Note too that this also serves as a capacity divider, reducing the amount of local oscillator voltage appearing across the junction diode "capacitor."

As the oscillator of the FM receiver is the primary frequency-control element, the r.f. and detector circuits having relatively broad response, it is customary to apply a.f.c. control only to the oscillator stage. Our silicon-junction diode may be connected across

the oscillator coil in several different ways, but in each case provision must be made to permit application of a few volts of reverse bias to the diode and for the a.f.c. control voltage to work against this. As a positive voltage is easier to obtain in most receivers, both of the sample circuit configurations of Fig. 2 have been arranged for positive bias. This bias can be from 1 to 10 volts with no great effect on performance, although a voltage in the neighborhood of 1½ to 2 volts will give excellent control in most of the applications.

The positive bias may be taken directly from "B+," as indicated in Fig. 2B, adjusting the value of the resistors to drop the available voltage to the required low level, while in some sets the circuit shown in Fig. 2A will permit the connection of the r.f. choke directly to a bypassed i.f. cathode which has the required voltage available. It is not necessary that the voltage applied as bias have outstanding long-time stability due to the self-compensating characteristics of the circuit, although a direct r.f. feedback path or audio

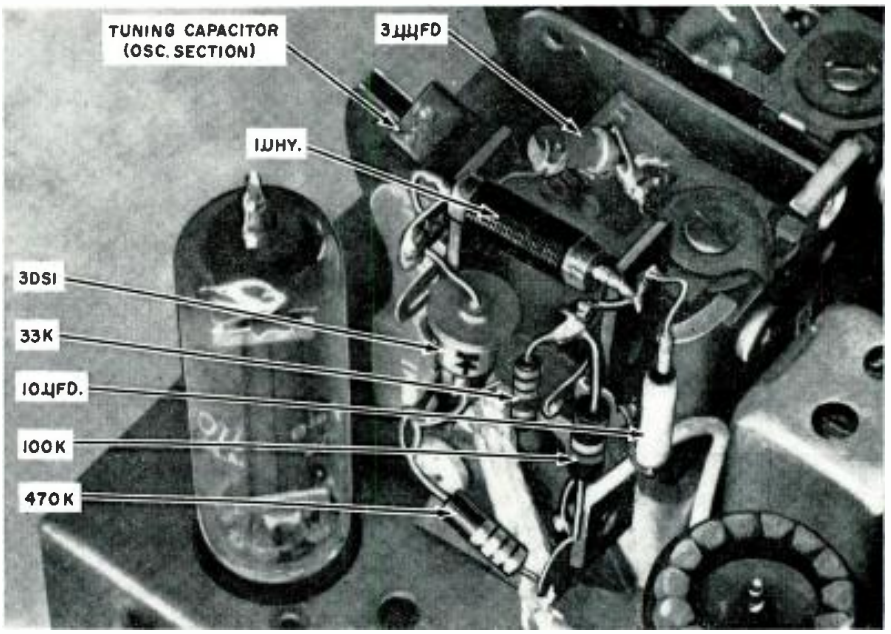


Fig. 3. All the major a.f.c. components can be mounted conveniently adjacent to the oscillator section of the tuning capacitor. The a.f.c. filter circuit is located underneath the chassis adjacent to the volume control of the set.

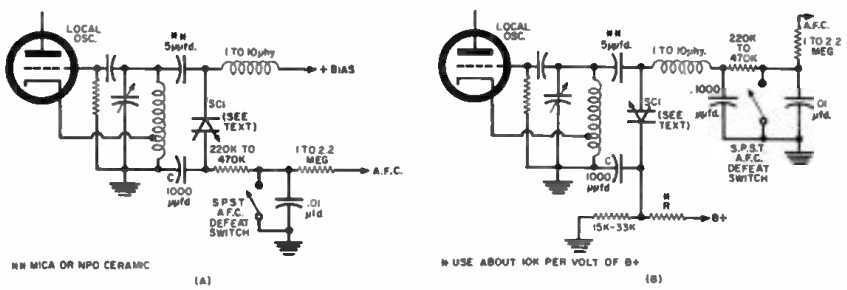


Fig. 2. Sample circuit configurations that may be employed with positive bias.

modulation should be avoided. It is, of course, desirable to connect the junction diode to the oscillator tank circuit with reasonably short leads and the capacitor (*C*) shown in the low side of the diode in both of the Fig. 2 diagrams should provide a fairly direct signal ground.

A Typical Case

Let's convert a typical receiver and see what sort of troubles we encounter. The *Emerson* 602 is an a.c.-d.c. FM receiver, designed to a price and manufactured in fairly large numbers. Its dial-cord drive has enough spring in it to make some units rather difficult to tune and its thermal instability makes the addition of a.f.c. quite desirable. The relatively open construction is ideally suited for its adaptation to diode a.f.c.

To start, we will assume that the set is in alignment and operating properly. If not, this is of course the starting point. With the set aligned and performing normally, let us first examine the oscillator circuit. It is essentially conventional, although it uses a 12BA7 pentagrid oscillator-mixer tube instead of the triode oscillator which is more commonly found in current tuners. The oscillator coil is mounted underneath the chassis and is connected directly to the rotor of the rear section of the tuning capacitor, while the trimmer is mounted on the top side, as is the 3-μμfd. fixed ceramic capacitor.

It is physically convenient to mount a pair of terminal strips on the rear surfaces of the tuning capacitor, using short self-tapping screws and the holes thoughtfully provided by the capacitor manufacturer. By carefully disconnecting the ground end of the 3-μμfd. shunt capacitor, which is soldered to the variable capacitor frame, we can use it for coupling to the tuned circuit. Fig. 4 shows the oscillator circuit before and after, while Fig. 3 pictures how the components actually look in place. The author's arrangement of parts is not necessarily optimum, as we made this particular modification a little more open than others so it would photograph better.

For the 1.5- to 2-volt bias needed we decided to tap down from the 6 volts available at the 35B5 output tube's cathode. A voltage divider consisting of a 100,000-ohm and a 33,000-ohm resistor gave the 1.5 volts while a 10-μfd., 3-volt miniature electrolytic across the bottom end filtered out any audio modulation which might have caused trouble.

After tying in the bias supply, a jumper was clipped across the .01-μfd. capacitor in the a.f.c. filter line, equivalent to closing the "a.f.c. defeat" switch, and the set was turned on and allowed to warm up for a few minutes. Stations which had come in relatively close to the proper dial calibrations were now off somewhat, particularly at the high end of the dial, due to the reduction of the fixed capacitance across the oscillator coil, but the set was brought back to calibration by adding capacitance *via* the oscillator trimmer.

We now went hunting for a pick-off point for the a.f.c. voltage. Checking the alignment instructions, it was found that there was indeed a point where the required positive or negative voltage could be obtained for the a.f.c., but because the 6S8GT was used as a multi-purpose detector and amplifier with one of the diode cathodes permanently connected to the grounded-triode amplifier cathode, the plus or minus voltage was not based on a ground reference but was "half way up" on the 33,000-ohm detector load resistor (Fig. 5A). An obvious solution was the installation of a 6AL5 double-diode in a conventional ratio-detector circuit, but limited space suggested that we try to adapt crystal diodes to our requirement. Checking through the files for typical circuits we arrived at Fig. 5B, but found we could omit both the crystal shunt resistors and the *RC* elements in the tertiary coil circuit, as shown in Fig. 5C. Perhaps the 1N34 crystals were matched more carefully than customary, for after over five weeks of continuous operation, balance is still satisfactory, but we have followed Fig. 5B in other cases.

Performance

With the circuit modifications of Fig. 5C installed, we now connected the unused diode plates and cathode of the 6S8 to the grounded cathode and ran the a.f. lead from the top of the volume control to the a.f.c. filter. After re-

moving the "a.f.c. defeat" jumper, the set was turned on and gave thoroughly *unsatisfactory* performance. A quick check with a vacuum-tube voltmeter on the a.f.c. line showed that we were getting proper a.f.c. voltage but that it was of the wrong polarity. In other words, when we increased the capacity of the tuning capacitor slightly, the a.f.c. voltage went positive and amplified the change. The solution was to reverse the diode connections to the secondary of the detector coil, "XX" in Fig. 5C, so that the phase-determining circuit would deliver voltage of the proper polarity.

Having made this "correction," we were so pleased with the performance of the receiver, with its new-found ability to cling to a signal, that we didn't recheck the i.f. alignment for several days. When we finally did, we followed the normal alignment procedures for the set, but somewhat more easily than originally, as it was not necessary to establish an off-ground reference point for the ratio-detector alignment. Of course, it was necessary to put back the "a.f.c. defeat" clip lead for the over-all alignment check, but we never did actually install the defeat switch on this unit, for we found that the set's limited sensitivity made it easy to tune-in all available stations in our area by tuning beyond the weak station blanketed by a strong one and then coming back until the lower power signal locked in. This unit has been run for many weeks now, both intermittently and continuously. Its performance, although not its audio quality, ranks with that of much more costly receivers.

Other Examples

Frequency modulation receivers with conventionally circuited balanced-ratio detectors do not, of course, require the detector modification just detailed, nor do sets equipped with discriminator detectors. A good example of the latter, and one well worth adding a.f.c. to, is the *Browning* Model RF-12A, an AM-FM tuner with completely separate AM and FM channels. Here, too, the silicon-junction diode "capacitor" and its associated components can be conveniently mounted on the rear of the tuning capacitor—the back section is the oscillator gang on this set too—and the required bias can be taken from the cathode of the mixer section of the 7F8 through a 100,000—33,000-ohm divider. As there is no audio component, a .01-μfd. ceramic bypass capacitor will provide adequate filtering.

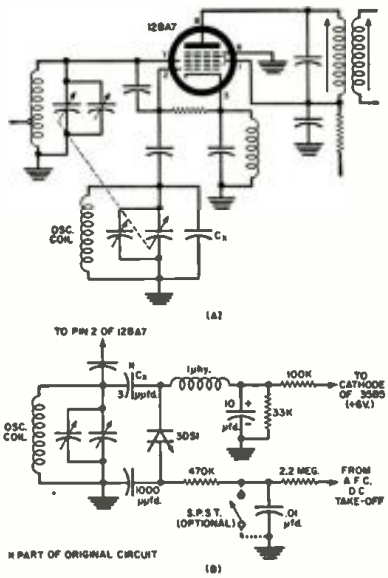


Fig. 4. Oscillator circuit discussed (A) before and (B) after the modification.

With a discriminator, the a.f.c. control voltage is supplied from the ungrounded cathode of the detector, Fig. 6, and is taken off after the de-emphasis network. Incidentally, the de-emphasis resistor in the *Browning* is 100,000 ohms instead of the 68,000 customarily used with a 1000-μμfd. capacitor and if you plan to convert a *Browning* RF-12A to a stereo tuner, which you can do quite easily at the same time you add the a.f.c., it is also suggested that you replace the 100,000-ohm resistor with a 68,000 ohm unit or shunt it with 150,000 ohms to provide somewhat increased high-frequency response.

It is also possible to apply junction-diode a.f.c. to many television receivers following the same procedures although here it will be necessary to introduce the junction diode and its associated components into the packaged tuner assembly, a not always simple procedure unless full re-alignment equipment is available and, of course, the frequency control signal must be taken from the discriminator or ratio detector used for sound detection. In sets using other types of audio detection, such adaptations are not too practical.

We are thoroughly convinced that the few dollars and hours required to add silicon-junction-diode automatic-frequency control to "almost any old FM set" is well worthwhile.

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1. *Smith, H. R.:* "*Semiconductor Variable Capacitors,*" RADIO & TV NEWS, *December, 1958.*
2. "*Rectifier News,*" *Published by International Rectifier Corp., El Segundo, Calif., Feb.-Mar. 1958 issue.*

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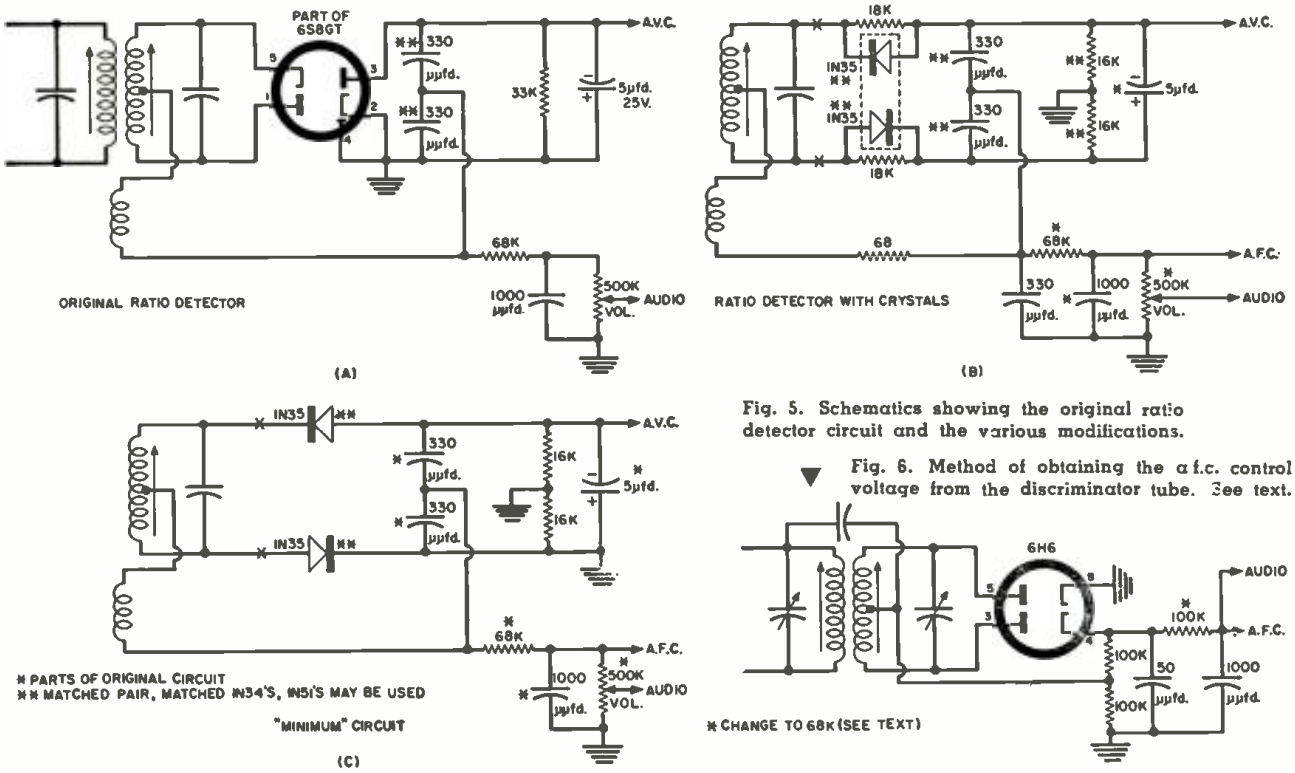

Fig. 5. Schematics showing the original ratio detector circuit and the various modifications.

Fig. 6. Method of obtaining the a f.c. control voltage from the discriminator tube. See text.

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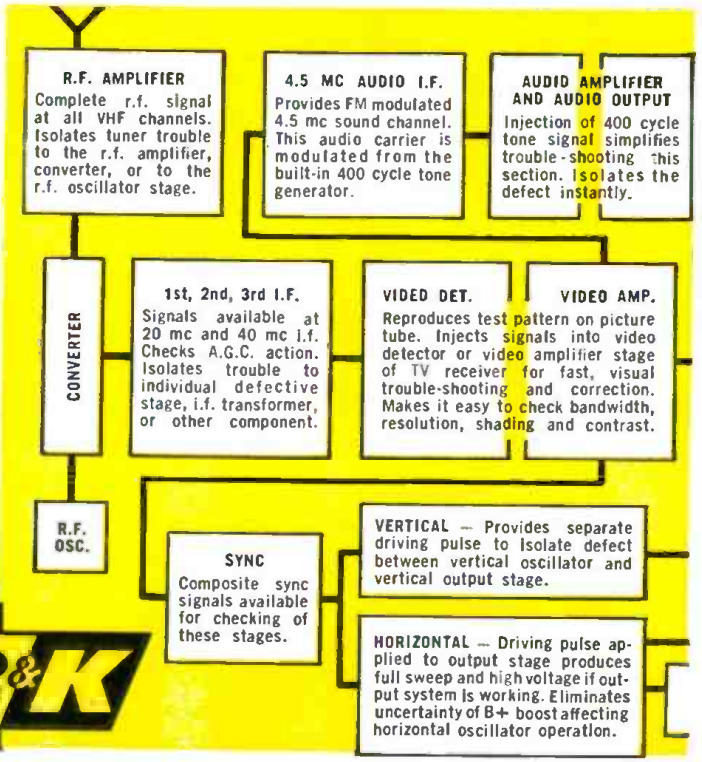

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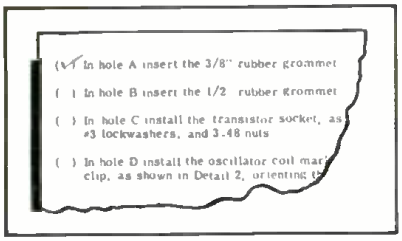

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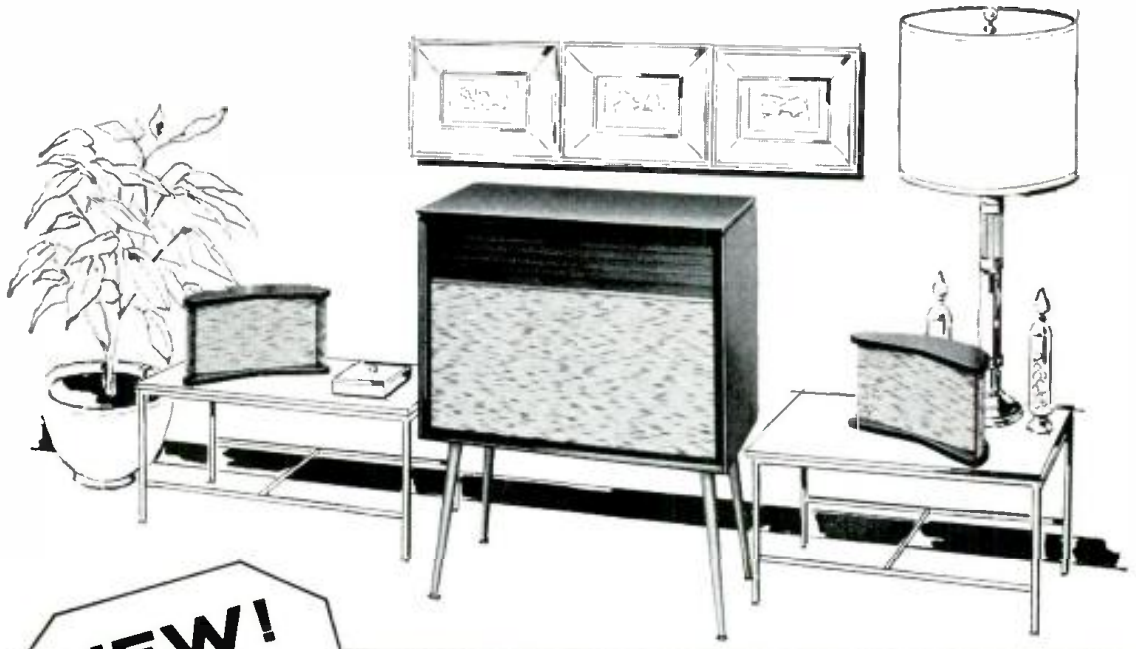

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TR-1A SPECIFICATIONS—Frequency Response 7.5 IPS ±3 db 50-12,000 cps. 3.75 IPS ±3 db 50-7,000 cps. Signal to Noise Ratio: Better than 45 db below full output of 1.25 volts /channel. Harmonic Distortion: Less than 2% at full output. Bias Erase Frequency: 60 kc (push-pull oscillator).

MODEL TR-1AH: Monaural and half-track stereo record/playback with fast forward and rewind functions. Shpg. Wt. 35 lbs. **$149.95**

TR-1AH SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 40-15,000 cps. 3.75 IPS ±3 db 40-10,000 cps. Signal to Noise Ratio: 45 db below full output of 1 volt /channel. Harmonic Distortion: Less than 2% at full output. Bias Erase Frequency: 55 kc (push-pull oscillator).

MODEL TR-1AQ: Monaural and quarter track stereo with record/playback fast forward and rewind functions. Shpg. Wt. 35 lbs. **$149.95**

TR-1AQ SPECIFICATIONS—Frequency Response: 7.5 IPS ±3 db 40-15,000 cps. 3.75 IPS ±3 db 40-10,000 cps. Signal to Noise Ratio: 40 db below full output .75 volts /channel. Harmonic Distortion: Less than 2% at full output. Bias Erase: 55 kc (push-pull oscillator).

NOW! FULL STEREO CONVERSION FOR TR-1A OWNERS

MK-4 Half-Track Stereo Conversion Kit: Modifies TR-1A monaural tape recorder to include function of record and playback of half-track stereo program material. Consists of a TE-1 tape preamplifier, a stereo head array plus components and instructions to convert TR-1A to TR-1AH. **$62.95**

MK-5 Quarter-Track Stereo Conversion Kit: Modifies TR-1A monaural tape recorder to include function of record and playback of quarter-track stereo. Allows playing stereo both ways on standard tape for twice the playing time or four times playing time with monophonic recordings. Consists of a TE-1 tape preamplifier, a stereo head array plus components and instructions to convert TR-1A to TR-1AQ. **$62.95**

HEATHKIT

monophonic or stereo Hi-Fi

HEATHKIT®

Program Sources

NEW

MODEL FM-4

$34.95

SPECIFICATIONS—Tuning Range: 88—108 mc. Quieting Sensitivity: 2.5 uv for 20 db of quieting, 3.5 uv for 30 db of quieting, 25 uv for maximum quieting (45 db). IF Frequency: 10.7 mc. Image Ratio: 45 db. AFC Correction Factor: 75 kc per volt. AM Suppression: 25 db. Frequency Response: ±2 db 20-20,000 cps. Harmonic Distortion: Less than 1.5%, 1100 uv, 400 cycles 100% modulation. Intermodulation Distortion: Less than 1%, 60 cycle and 6 kc mixed 4:1 1100 uv, 30% modulation. Antenna: 300 ohms unbalanced. Output Impedance: 600 ohms (cathode follower). Output Voltage: nominal .5 volt (with 30% modulation, 20 uv signal). Power Requirements: 105-125 volts 50/60 cycle AC at 25 watts. Overall Dimensions: 4¼" H. x 13¼" W. x 5½" D.

MODEL PT-1

$89.95

NEW HIGH FIDELITY FM TUNER KIT (FM-4)

This superbly designed unit incorporates advancements in circuit design with features asked for by hi-fi fans everywhere. Better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with defeat switch, flywheel tuning and prewired, pre-aligned and pretested tuning unit . . . bring you the finest in FM listening entertainment. The exceptionally clean chassis layout, pre-aligned IF transformers and the prewired, pre-aligned tuning unit insure ease of construction with no further need of alignment after the unit is completed. The five tube circuit features a generous power supply utilizing a silicon diode rectifier for cool running operation and low power consumption. The attractive styling of the FM-4 features a vinyl-clad steel cover with leather-like texture, soft black front panel, set off with brushed-gold trim and new soft evenly-lit dial scale. A multiplex adapter output is provided. Feature for feature the FM-4 offers the most outstanding dollar value in FM entertainment available today. Shpg. Wt. 8 lbs.

MONOPHONIC-STEREO AM-FM TUNER KIT (PT-1)

Outstanding features in both styling and circuitry are combined in this 16-tube deluxe stereo AM-FM combination tuner to bring you the very finest of program sources for your listening enjoyment. Features include three printed circuit boards for easy construction and high stability—wired, pre-aligned 3-tube FM tuning unit—built-in AM rod antenna—tuning meter—automatic frequency control (AFC) with on-off switch—and flywheel tuning. Other features include variable AM bandwidth, 10 kc whistle filter, tuned-cascode FM front end, FM AGC and amplified AVC for AM. AM and FM circuits are separate and individually tuned so they can be used simultaneously for stereo applications. Cathode follower outputs with individual level controls are provided for both AM and FM, with a multiplex adapter output provided. A tuning meter and flywheel tuning combined with two edge-lit slide rule scales provide effortless tuning. Styling features vinyl-clad steel cover in black with inlaid gold design and soft black, rigid die-cast panel set off by brushed gold trim, black knobs with gold inserts. Shpg. Wt. 24 lbs.

MODEL BC-1A

$26.95

HIGH FIDELITY AM TUNER KIT (BC-1A)

Delivers AM broadcast reception comparable to FM quality. Features a special detector using crystal diodes and broad-band IF circuits for low signal distortion. Prealigned RF and IF coils eliminate the need for special alignment equipment. Sensitivity better than 3 microvolts for one volt output. Two output levels provided. Built-in power supply. Special antenna supplied, also provision for outside antenna. Shpg. Wt. 9 lbs.

MODEL FM-3A

$26.95

HIGH FIDELITY FM TUNER KIT (FM-3A)

Featuring broad-banded circuits for full fidelity and better than 10 microvolt sensitivity for 20 db of quieting, the FM-3A pulls in stations with clarity and full volume. Incorporates stabilized temperature compensated oscillator, built-in power supply, pre-aligned IF transformers and ratio detector. The pre-assembled tuning unit is pre-aligned. Two output levels provided. Shpg. Wt. 8 lbs.

AUTOMATIC HI-FI RECORD CHANGER KIT (RP-3)

Combining automatic convenience with turntable quality through unique and simple design the Heathkit RP-3 handles your records with the finest of care for full fidelity reproduction. The unique "turntable pause" feature during change cycle and smooth friction clutch start prevents record damage. Proper weight distribution and low pivot point friction of the tone arm minimize arm resonance, tracking error, and record wear. All record changer kits come equipped with changer base, stylus pressure gauge, 45 RPM spindle, and necessary wire.

STEREO MODEL RP-3S: Equipped with Shure diamond stylus magnetic cartridge providing frequency response of ±4 db from 30 to 14,000 CPS. Shpg. Wt. 19 lbs. **$74.95**

MONAURAL MODEL RP-3-LP: (monaural microgroove recordings only): Equipped with Fairchild Magnetic diamond stylus cartridge. Shpg. Wt. 19 lbs. **$74.95**

MONAURAL MODEL RP-3: Features a GE VRII magnetic cartridge with diamond LP and sapphire 78 stylus. Shpg. Wt. 19 lbs. **$64.95**

SPECIFICATIONS—Operates from: 105-130 volts 60 cycles. Wow and Flutter: Less than 0.18% peak at 33-1/3 RPM. Turntable Speed: Accurate within ±2%. Change Cycle: Completed in 9 seconds. Dimensions: 13½" wide x 12" deep, 5" above and 3" below mounting board. Motor Type: 4 Pole hum shielded. Type of Drive: Friction. Record Speeds: 4 speeds. Automatic and manual 33-1/3, 45, 78 RPM. Manual only—16 RPM. Variations in Tracking Force: Less than 0.9 gram from first record to tenth record. Controls: "ON-OFF" switch. Manual Reject. "Speedminder" (automatic speed selection and indexing). Manual speed selector (4 speed). Finish: Midnight Gray. Base: Maple (unfinished). Mounting Board: Birch (unfinished).

NEW from the HEATHKIT AUDIO LABS

a complete line of monophonic and stereo

HEATHKIT® **Hi-Fi Amplifiers**

MODEL SA-3

NEW **$29.95**

NEW LOW COST STEREO AMPLIFIER KIT (SA-3)

The answer to budget cost stereo is now found in the all-new Heathkit SA-3 Stereo Amplifier. All the convenience of complete dual channel control can now be yours at a fraction of the cost of comparable equipment. The high level preamplifier section of the SA-3 provides complete control for both channels. Ganged tone controls provide convenient "boost" and "cut" action for base and treble while dual concentric volume controls make possible precise channel balancing. A channel reversing switch and a speaker phasing switch allows optimum performance. Two separate inputs are provided for each channel to accommodate ceramic cartridge phonographs, AM-FM tuners, or tape recorder. Program source may be reproduced in either monophonic or stereo form. A really big package of stereo performance for the small investment!

SPECIFICATIONS—Power Output: 3 watts per channel. Power Response: ±1 db 50 cps—20 kc at 3 watts output. Total Harmonic Distortion: less than 3% 60 cps—20 kc. Intermodulation Distortion: less than 2% at 3 watts output using 60 cycle and 6 kc signal mixed 4:1. Hum and Noise: 65 db below full output. Controls: dual clutched volume, ganged treble, ganged bass, 7 position selector, speaker phasing switch, on-off switch. Inputs: (each channel) tuner, crystal or ceramic phono. Outputs: (each channel) 4, 8 and 16 ohms. Finish: black with gold trim. Dimensions: 12½" W. x 6¾" D. x 3¼" H.

MODEL EA-1

NEW **$15.95**

NEW "ECONOMY" 3 WATT AMPLIFIER KIT (EA-1)

More than enough for room filling volume . . . ideal for getting started on a low cost individual component system. Designed for use with ceramic cartridge record players, tuners, tape recorders, etc. Built-in preamplifier provides you with all the necessary tone and volume controls for adjusting the sound reproduction to your personal taste. Smart appearance, quality components, assemble it in a few hours for years of trouble-free enjoyment. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Power Output: 3 watts. Input Sensitivity: 100 mv for 3 watts output. Power Response: 60-20,000 cps with less than 3% total harmonic distortion at full output. Frequency Response: ±3 db, 20-40,000 cps at 0.5 watt output. Hum and Noise: 70 db below full output. Power Supply: transformer operated full wave rectifier. Inputs (2): crystal or ceramic phono cartridge, tuner. Output Impedance: 4, 8 and 16 ohms. Dimensions: 3¾" H. x 9½" W. x 6" D.

MODEL EA-3

NEW **$29.95**

NEW! 14-WATT HI-FI ECONOMY AMPLIFIER (EA-3)

From HEATHKIT audio labs comes an exciting new kit . . . New Styling, New Features, Brilliant Performance! Designed to function as the "heart" of your hi-fi system, the EA-3 combines the preamplifier and amplifier into one compact package. Providing a full 14 watts of high fidelity power, more than adequate for operating the average system, the EA-3 provides all the controls necessary for precise blending of musical reproduction to your individual taste. Clearly marked controls give you finger-tip command of bass and treble "boost" and "cut" action, switch selection of three separate inputs, "on-off" and volume control. A hum balance control is also provided.

NOTE THESE OUTSTANDING SPECIFICATIONS: HARMONIC DISTORTION, less than 2% (20 cps-20 kc) at 14 watts. I.M. DISTORTION, less than 1% (60 and 6,000 cps, 4:1) at 14 watts. FREQUENCY RESPONSE, 20 cps-20 kc, ±1 db at 14 watts. HUM & NOISE, mag. phono input, 47 db below 14 watts, tuner and xtal phono input, 63 db below 14 watts.

PREAMPLIFIERS

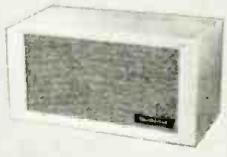
Model WA-P2 "Master Control" hi-fi preamplifier kit, 7 lbs. **$19.75**
Model SP-2 Mono-Stereo (2 channel mixer) Preamplifier kit, 15 lbs. **$56.95**
Model SP-1 Single Channel version of SP-2, 13 lbs. **$37.95**
Model C-SP-1 Converts SP-1 to SP-2, 5 lbs. **$21.95**

HEATHKIT®

POWER AMPLIFIERS

Model UA-1 "Universal" hi-fi 12-watt amplifier kit, 13 lbs. **$21.95**
Model W-4AM Single Chassis 20-watt hi-fi amplifier kit, 28 lbs. **$39.75**
Model W-3AM Dual Chassis hi-fi 20-watt amplifier kit, 29 lbs. **$49.75**
Model W-7M "Extra Performance" hi-fi 55-watt amplifier kit, 28 lbs. **$54.95**
Model W-5M high fidelity 25-watt amplifier kit, 31 lbs. **$59.75**
Model W-6M high fidelity 70-watt amplifier kit, 52 lbs. **$109.95**

SPEAKER SYSTEMS



Model SS-3 "Basic" fir hi-fi speaker system kit, 26 lbs. **$34.95**
Model SS-2 "Basic Range" hi-fi speaker system kit, 26 lbs. **$39.95**
Model SS-1B "Range Extending" hi-fi speaker system kit, 80 lbs. **$99.95**

Model HH-1 "Legato" hi-fi speaker system kit, 195 lbs. **$299.95**

HEATH COMPANY, Benton Harbor, Michigan
a subsidiary of Daystrom, Inc.

NEW: Heath Now Puts 2-Way Radiotelephone Communications in Reach of Everyone

Citizen's Band Transceiver Kit

NEW: No Radio Operators License Necessary!

NEW from the HEATHKIT COMMUNICATIONS LABORATORIES

- Designed to meet all FCC requirements for new 11-meter "Citizens Band" class D operation.
- Any U.S. citizen 18 or older eligible for license.
- No theory to study—no tests to take.
- Hundreds of uses in business or pleasure.
- Top quality components—proven performance—easy to build.

SPECIFY FREQUENCY CHOICE

CLASS D CITIZEN'S BAND FREQUENCIES

26.965 mc	27.035 mc	27.115 mc	27.185 mc
26.975 mc	27.055 mc	27.125 mc	27.205 mc
26.985 mc	27.065 mc	27.135 mc	27.215 mc
27.005 mc	27.075 mc	27.155 mc	27.225 mc
27.015 mc	27.085 mc	27.165 mc	*27.255 mc
27.025 mc	27.105 mc	27.175 mc	

*This channel shared with Class C Radio Control.

NEW

MODEL CB-1

Includes transceiver, microphone, and special power cords.

$42.95

First and only kit of its kind . . . designed to meet all FCC requirements for two-way radio telephone communication on new class D 11-meter "citizens band" . . . any U.S. citizen eighteen or older eligible for license . . . no code test, no radio theory exams, no knowledge of specialized operating procedures required . . . just fill out simple form included with kit and mail to FCC for registration. The Heathkit CB-1 Transceiver is light, compact, simple to assemble, easy to use. Buy two or more units, have your own communications system . . . talk with family, friends, associates from your car, home, boat or office . . . cover distances from one to ten miles depending on location and type of installation (extensively field tested). A flick of a switch selects "transmit" or "receive" while single receiver tuning control selects any of 23 assigned channels . . . third knob controls volume and turns set on and off. With separate vibrator power supply available from Heath, along with two special power cords included with kit, you can convert transceiver from fixed location at home or office to mobile operation in cars, boats, etc., in minutes, after initial installation, with no tools or adjustments. There's a Heathkit accessory antenna for any application, mobile or fixed. Kit comes complete with microphone, station identification card which fits in plastic window at end of cabinet, all pertinent FCC regulations and application forms, a sheet of adhesive-back letters and numbers to affix call letters in space provided on front panel, and crystal for one channel. Specify your frequency choice or we will supply crystal of appropriate frequency. The famous Heathkit quality coupled with the market-shattering low price of this kit make it truly a value of a lifetime. Shpg. Wt. 10 lbs.

SPECIFICATIONS—Receiver Type: Superregenerative detector w/rf stage. Power Input: 5 watts to plate of final RF amplifier (FCC maximum). Transmitter Frequency Control: Third overtone type quartz crystal operating within 0.005% of marked channel frequency between 32 F and 140 F. Modulation: AM plate modulation automatically limited to less than 100% (FCC requirements). Power Supply: 117 V 50/60 cycle, AC. 6 V battery using Model VP-1-6 Vibrator Power Supply or 12 V battery using Heathkit VP-1-12. Power Requirements: 117 volts 50/60 cycle AC 35 watts; 6 V battery w/VP-1-6, 6.5 amps.; 12 V battery w/VP-1-12, 4.0 amps. Total B + requirements, 260 volts at 60 ma; total heater requirements, 6.3 volts at 1.8 amps. or 12.6 volts at 0.9 amps. Power Rectifier: 2 silicon diodes in full wave voltage doubler circuit. Microphone: Combination hand-held and desk type, ceramic element, plastic case, with cord and connector. RF Output Impedance: 50 ohms. Speaker Size: 4 inch (round). Undistorted Audio Power Output: Approximately 1 watt. Line Cords: Two supplied, one for AC operation, one for battery operation. Power circuits automatically switched when appropriate line cord is plugged in. Cabinet Dimensions: 8" H. x 6" D. x 9¾" W.

ANTENNAS

MODEL CBU-1 "UTILITY" ANTENNA

Low cost, portable antenna for CB-1 Transceiver for temporary installations, mobile or fixed, where maximum coverage is not required. Rugged clip for mounting on eaves-trough of house or rain gutters of cars, trucks, etc. Bracket supplied for mounting on transceiver or any flat surface. 45½" base-loaded, antenna with 12' connecting cable comes complete, ready to use. Shpg. Wt. 3 lbs. **$9.95**

MODEL CBM-1 "MOBILE" ANTENNA

For CB-1 Transceiver permanent mobile installations where greatest coverage is desired. Easy to install double chain-type bumper mount spring base—no cutting or drilling. Easily adapted to boats, etc. ¼ wave whip antenna approximately 9' from mounting surface to tip—supplied with clip for securing in semi-horizontal position to clear obstructions. Kit is complete with 102" whip in 2 sections, 15' connecting cable and all necessary hardware. Shpg. Wt. 7 lbs. **$19.95**

MODEL CBF-1 "FIXED LOCATION" ANTENNA

A ¼ wave "ground plane" type antenna for CB-1 Transceiver using 4 radial elements as the "ground plane" and 1 vertical element as the radiator. Excellent coverage, essentially non-directional, making it ideal for communications between fixed and mobile units. Antenna measures 9' 4" from bottom of mounting bracket to top of vertical radiator. Radial length 9'. Kit is complete with 50' connecting cable and easy to install mounting clamp. Shpg. Wt. 7 lbs. **$19.95**

POWER SUPPLIES FOR MOBILE USE OF CB-1:

MODEL VP-1-6 Vibrator Power Supply kit for 6 volt batteries. Shpg. Wt. 4 lbs. **$7.95**

Model VP-1-12 Vibrator Power Supply kit for 12 volt batteries. Shpg. Wt. 4 lbs. **$7.95**

NEW

MODEL CO-1

$7.95

(batteries included)

NEW TRANSISTOR CODE PRACTICE OSCILLATOR KIT (CO-1)

Your best buy in a high quality code oscillator, the CO-1 is ideal for Boy Scouts or beginning radio hams. Practice code by authentic CW tone or blinker light. Switch selects built-in speaker or light. Contactor provided for practice keying or any standard key can be connected. Completely transistorized for long battery life. Powered by two standard flashlight batteries. Batteries included. Shpg. Wt. 3 lbs.

TRANSISTOR PORTABLES

. . . and other Do-It-Yourself Hobby Kits

Model XR-1P Transistor Portable Radio kit. . . 6 lbs. **$29.95**
Model CR-1 Crystal Radio kit. . . 3 lbs. **$7.95**
Model BT-1 Battery Tester kit. . . 2 lbs. **$8.50**
Model ET-1 Enlarger Timer kit. . . 3 lbs. **$11.50**
Model BR-2 Broadcast-Band Receiver kit. . . 10 lbs. . . (less cab.). . **$18.95**
Model RC-1 Professional Radiation Counter kit. . . 8 lbs. **$79.95**

MODEL XR-1P

MARINE KITS . . .

For Fun and Safety Afloat

Model DF-2 Two Band Transistor Radio Direction Finder kit 9 lbs. **$69.95**
Model FD-1-6 Fuel Vapor Detector kit (6 v.). . . 4 lbs. **$35.95**
Model FD-1-12 Fuel Vapor Detector kit (12 v.). . . 4 lbs. **$35.95**
Model MC-1 Marine Battery Charge kit. . . 16 lbs. **$39.95**
Model PC-1 Power Converter kit. . . 8 lbs. **$24.95**

MODEL DF-2

NEW from Heath Test Equipment Labs

New—Electronic Ignition Analyzer Kit—IA-1A

MODEL IA-1A
$59.95

- A Fraction of the Cost of Comparable Instruments
- Shows "Picture" of Entire Ignition System Performance on Cathode Ray Screen
- Shows Primary or Secondary Circuit Patterns
- "Trouble-Shoot" Complicated Ignition Faults in Minutes

A revolutionary development in the automotive tune-up field. Heathkit offers the small garage owner, service station operator or hobbyist an ignition analyzer with qualities and features of scopes costing several times as much (comparable to instruments costing as much as$750.00). The savings you realize through do-it-yourself kit assembly are only part of the story. Heath engineering know-how and tremendous buying power play an important role in keeping prices at rock bottom. Yet, this scope, as with all Heathkits, is designed to be "beginner built". A few hours of your spare time . . . and you're in business. The IA-1A lets you check the complete ignition system of an automobile in operation by merely connecting two leads to observe the tell-tale spark pattern of the cylinders. Can be used with the car under load and in motion by adding a vibrator power supply. Shows condition of coil, condenser, points, plugs and ignition wiring. A switch selects either primary or secondary circuit patterns; or alternately provides choice of parade or superimposed secondary patterns. It will also indicate coil reserve, a poor spark plug, defective wiring and will even identify the offending plug or wire. Also detects breaker point bounce, a defective condenser, or will allow setting of the dwell-time of the points. The IA-1A is simple to use, with a minimum of controls, yet is completely flexible for all types of internal combustion engines with coil ignition and accessible breaker points. Shows complete engine cycle or just one cylinder at a time. Test leads and comprehensive instruction manuals are supplied with kit. Shpg. Wt. 20 lbs.

NEW MODIFICATION KIT FOR OWNERS OF MODEL IA-1 IGNITION ANALYZERS:
Gives you switch selection of either primary or secondary circuit patterns; or alternately provides choice of parade or superimposed secondary patterns. Kit includes test lead modification parts and comprehensive instructions for modification and use. Shpg. Wt. 2 lbs. Heathkit MK-6. **$4.95.**

A COMPLETE LINE OF INSTRUMENT KITS

OSCILLOSCOPES

Model OM-3 "General Purpose" 5" oscilloscope kit..22 lbs.....**$39.95**
Model O-12 "Extra Duty" 5" oscilloscope kit...22 lbs.....**$65.95**
Model OP-1 "Professional" 5" DC oscilloscope kit...34 lbs.....**$179.95**

METERS

Model V-7A Etched Circuit VTVM kit...7 lbs.....**$25.95**
Model AV-3 Audio VTVM kit...6 lbs.....**$29.95**
Model MM-1 20,000 ohms/volt VOM kit...6 lbs.....**$29.95**
Model AW-1 Audio Wattmeter kit...7 lbs.....**$29.50**
Model M-1 Handitester kit...3 lbs.....**$17.95**

GENERATORS

Model TS-4A TV Alignment Generator kit...16 lbs.....**$49.50**
Model CD-1 Color Bar and Dot Generator kit...13 lbs.....**$59.95**
Model SG-8 RF Signal Generator kit...8 lbs.....**$19.50**
Model TO-1 RF Test Oscillator kit...4 lbs.....**$16.95**
Model LG-1 Laboratory RF Generator kit...16 lbs.....**$48.95**
Model AG-9A Audio Generator kit...10 lbs.....**$34.50**
Model AG-10 Sine-Square Generator kit...12 lbs.....**$49.95**
Model AA-1 Audio Analyzer kit...13 lbs.....**$49.95**

TEST INSTRUMENTS

Model TC-3 Tube Checker kit...12 lbs.....**$39.95**
Model CC-1 Cathode Ray Tube Checker kit...10 lbs.....**$24.95**
Model T-4 Visual-Aural Signal Tracer kit...5 lbs.....**$19.95**
Model C-3 Condenser Checker kit...7 lbs.....**$19.50**
Model CM-1 Direct Reading Capacity Meter kit...7 lbs.....**$29.50**
Model CT-1 In-Circuit Capaci-Tester kit...5 lbs.....**$7.95**

Plus many more quality instruments for every need!

A COMPLETE LINE OF HAM GEAR

FIXED STATION

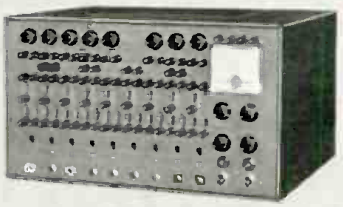
Model DX-20 CW Transmitter kit...19 lbs...**$35.95**
Model DX-40 Phone and CW Transmitter kit...25 lbs.....**$64.95**
Model DX-100-B Phone and CW Transmitter kit...107 lbs.....**$189.50**
Model VHF-1 "Seneca" VHF Ham Transmitter kit...56 lbs.....**$159.95**
Model TX-1 "Apache" Ham Transmitter kit...110 lbs.....**$234.95**
Model RX-1 "Mohawk" Ham Receiver kit 66 lbs.....**$274.95**

MOBILE

Model MT-1 "Cheyenne" Mobile Ham Transmitter kit...19 lbs.....**$99.95**
Model MR-1 "Comanche" Mobile Ham Receiver kit...19 lbs.....**$119.95**
Model MP-1 Mobile Power Supply kit 8 lbs.....**$44.95**
Model PM-2 Power Meter kit...2 lbs.....**$12.95**
Model AK-7 Mobile Speaker kit...4 lbs.....**$5.95**

NEW EDUCATIONAL ELECTRONIC ANALOG COMPUTER KIT (EC-1)

- 9 DC operational amplifiers—3 initial condition power supplies
- 5 coefficient potentiometers—repetitive solution oscillator
- Electronically regulated power supply



NEW from the HEATHKIT INSTRUMENT LABORATORIES

HEATHKIT EC-1

$199.95

Filling a multitude of needs in the fields of education and electronics, the model EC-1 puts advanced engineering techniques within easy reach of the average individual or institution. An assortment of precision components and patch cords are provided for setting up many complex problems. Solutions are read directly on the panel mounted meter or on an external read-out device such as the Heathkit OR-1 DC Oscilloscope. An informative manual is provided, illustrating operating procedures and basic computer information as well as showing how to set up and solve typical problems. Shpg. Wt. 43 lbs.

NEW 5" DC OSCILLOSCOPE KIT (OR-1)

- Identical DC coupled vertical and horizontal amplifiers
- 5ADP2 flat-face CRT—edge-lit graticule
- Transformer operated silicon diode power supply

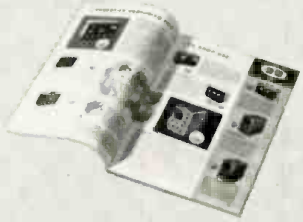
HEATHKIT OR-1

$119.95

Offering all the features of a high quality DC oscilloscope, the model OR-1 is ideal as a read-out indicator in computer applications as well as many types of testing and development work. Features DC to 200 kc (1 db point) bandwidth, 0.1 V (peak-to-peak) per CM sensitivity (uncalibrated). Normal frequency coverage is from 5 to 50 kc in four overlapping ranges. Critical voltages are regulated with gas-filled VR tubes. Coupling may be either AC or DC as selected by the input attenuator switch. Many uses in industrial, educational and medical fields. Shpg. Wt. 21 lbs.

Free Catalog

Over 100 easy-to-build kits are illustrated and described in the latest Heathkit catalog. If you are among the thousands interested in saving one-half or more on hi-fi, test, marine, or ham radio instruments, send for your free copy today.



COMING SOON! ELECTRONIC ORGAN KIT...

. . . an instrument that will excite the entire musical world. Engineered to familiar Heathkit perfection, and styled for the most discriminating taste . . . yet simple to assemble and priced for the average home. Interested? Send your name and address, we'll rush information as soon as available. No obligation.

HEATHKIT

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Enclosed find ( ) check ( ) money order. Please ship C.O.D. ( )

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On Parcel Post Orders include postage for weight shown. All prices are NET F.O.B. Benton Harbor, Michigan, and apply to Continental U.S. and Possessions only. 20% Deposit required on all C.O.D. orders.

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a subsidiary of Daystrom, Inc.

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		TOTAL	

HEATHKITS are also available at your Dealer see listing on next page

Air Force Honors Hams

550 hams thanked for IGY project volunteer work.

A GOVERNMENT thank-you went out recently to some 550 radio hams throughout the world for their volunteer work in an International Geophysical Year project. Certificates bearing the official thanks of the Air Research and Development Command of the Air Force, the National Academy of Sciences, and the American Radio Relay League, were sent to radio operators in 30 countries. These hams were the sole source of data for an IGY radio propagation project throughout a two-year period.

Although more than 1300 radio operators expressed interest in the ionospheric research project, only half that number earned certificates. They merited recognition by faithfully monitoring signals and reporting results twice a month to a special office set up in Wethersfield, Conn., by ARRL.

Most amateurs listed stations they could hear or contact, and also reported periods when transmission was interrupted. Some ran their transmitters constantly as beacons. One ham spent his own funds on a pair of 100-foot towers in Colliersville, Tenn., just for the project.

Up to 30,000 punched cards were prepared each month from the amateurs' reports for machine processing at the Air Force Cambridge Research Center. Each reported contact and each negative report went on individual cards for tabulation and evaluation.

The amateurs' work "provided invaluable and otherwise unobtainable—without a lengthy and very expensive program—data on world-wide communications," said Dr. Wolfgang Pfister, principal investigator for the project and chief of the Ionospheric Characteristics Branch, Ionospheric Physics Laboratory, at AFCRC's Geophysics Research Directorate.

"They have contributed much," he continued, "toward understanding transmission modes in the frequency bands of 50 mc., 144 mc., and 200 mc., and toward understanding of trans-equatorial scatter communication, the sporadic-E layer, and reflection from the aurora.

"Scientists have been investigating the nature of radio waves since the turn of the century, yet despite this there is still a great deal we do not know about their behavior," the Air Force physicist declared.

The project was the responsibility of Mason P. Southworth, himself a radio ham with call letters W1VLH. He was in charge of recruiting the volunteer operators, gathering the data for the project, and preparing the punched cards that were employed. —30—

How to keep your profits from going to the "dogs"!

AVOID CALLBACKS DUE TO PREMATURE TUBE FAILURE...

...when you replace a defective horizontal output tube check operating cathode current.

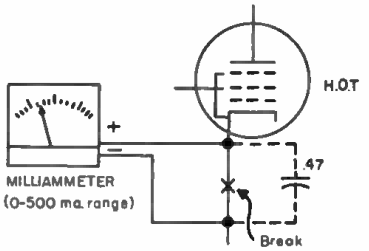
Premature horizontal output tube ("H.O.T.") failure can be caused by excessive cathode current—*higher than recommended by the manufacturer*—due to misadjustment or defective components in the horizontal output stage. Whenever you replace the "H.O.T.", protect your profits with these precautions: (1) measure "H.O.T." cathode current; (2) if excessive, find the trouble and fix it; and (3) adjust Horizontal Drive, Width, and Linearity.

Keep your hard-earned profits to yourself. Take time to check "H.O.T." cathode current. And, do as most successful service technicians do: always replace defective horizontal output tubes with *power-to-spare* RCA tubes. They pay off in fewer callbacks, finer reputation, and bigger profits.

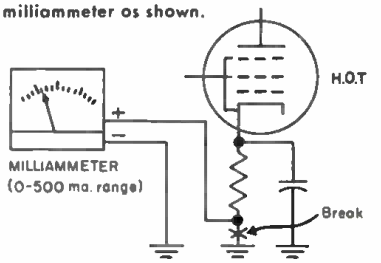
RCA-6DQ6-A—typical of RCA's excellent tube quality. Mount structure is designed to give maximum heat dissipation, prevent "hot spots" on the plate, allow cooler operation of the grids—help cut callbacks! Available at your RCA Tube Distributor.

RCA **RADIO CORPORATION OF AMERICA**
Electron Tube Division *Harrison, N. J.*

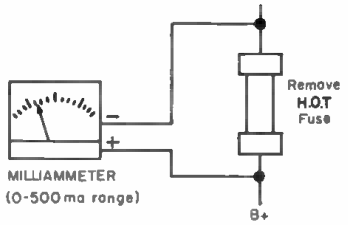
4 SIMPLE WAYS TO MEASURE "H.O.T." CURRENT



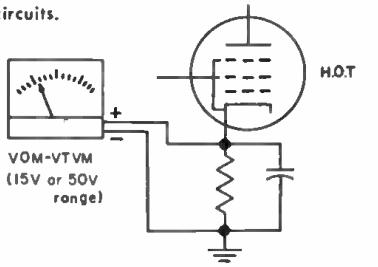
Disconnect cathode circuit at the "H.O.T." socket. Connect 0.47 μf capacitor and dc milliammeter as shown.



If "H.O.T." circuit has bypassed cathode-bias resistor, connect milliammeter as shown.



Remove "H.O.T." circuit fuse. Connect meter across fuse holder as shown. Indicated current will be slightly higher than actual cathode current because it includes boosted "B" current to vertical oscillator and/or other circuits.



Measure dc-voltage across "H.O.T." cathode-bias resistor. Voltage should not exceed value shown in service data for the set. Compute cathode current by dividing the voltage by the resistance.

TYPICAL RCA "H.O.T." TYPES AND MAX.▲ DC CATHODE CURRENT (MILLIAMPERES)	
6AU5-GT	110
6AV5-GA	110
*6AV5-GT	110
*6BG6-G	110
6BG6-GA	110
*6BQ6-GT	110
6BQ6-GTB/6CU6	112.5
*6CB5	200
6CB5-A	220
*6CD6-G	200
6CD6-GA	200
6DQ5	285
6DQ6-A	140
12AV5-GA	110
12BQ6-GTB/12CU6	112.5
12DQ6-A	140
17BQ6-GTB	112.5
17DQ6-A	140
*19BG6-G	110
19BG6-GA	110
*25BQ6-GT	110
25BQ6-GTB/25CU6	112.5
25CD6-GA	200
25CD6-GB	200
25DN6	200

*Discontinued RCA Type—Replaced by RCA "A" or double-branded version.

▲Values shown are measured with the receiver operating at a line voltage of 117 volts, 60 cycles.

Hi-Fi-Audio Product Review

ELECTROSTATIC TWEETER

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. has just introduced its own patented electrostatic 3-element tweeter which is designed to be used with any speaker system.

Capable of high-frequency response from 5000 to beyond 25,000 cps, the

three electrostatic elements provide a 120-degree dispersion angle. The unit has a built-in 5000 cps crossover network and built-in a.c. power supply to provide the necessary high voltage for electrostatic speaker operation.

The tweeter is currently being offered in three finishes: Model SK-150 in mahogany, SK-151 in walnut; and SK-152 blonde. Full details and price information are available from the company on request.

STEREO AMPLIFIER-PREAMP

Pilot Radio Corporation, Long Island City 1, N. Y. is now in production on a new 40-watt stereophonic amplifier-preamp which has been designated as the 245-A.

The new unit is a two-channel instrument featuring the firm's exclusive automatic shut-off that turns off the complete system when the changer finishes playing the last record. The unit also has the company's "Trolok" which permits ad-

justment of the separate bass and treble controls for each channel, simultaneously or individually.

A turntable-record-changer switch enables the user to connect both a record changer and a turntable to the amplifier and use either. The 245-A also features seven pairs of inputs for all stereo or monophonic sources, a speaker selector control, electronic crossover which feeds low frequencies to channel *A* and high frequencies to channel *B* for monophonic bi-amplifier use.

Power output is 40 watts, 20 watts per channel (80 watts peak); frequency response is ± 1 db from 20 to 20,000 cps; harmonic distortion is less than 1%; and hum and noise is 80 db below full output.

The unit measures 14 13/16" high, 14 11/16" wide, and 12¼" deep. It is housed in a vinyl-clad steel enclosure with a brushed-brass dress panel with gold-plated frame and heavy-duty knobs.

TWIN-CONE SPEAKERS

The High Fidelity Products Division of *North American Philips Company, Inc.,* Hicksville, N. Y. has announced a new series of "Twin-Cone" speakers which feature magnets of "Ticonal" steel.

The new magnets in the T-7 series are made of a high coercivity alloy which provides the highest possible

concentration of flux densities in the voice-coil air gap. Weight for weight, "Ticonal 7" is about 30% more powerful than conventional magnets.

These new "Norelco" speakers are designed with an extra long air gap so that the coil is completely enclosed by a homogeneous magnetic field even at peak amplitudes. Constant impedance is also maintained. Normally, the circuit of an amplifier output stage is designed for a specific speaker impedance, but the latter increases as the frequency rises and at resonance. With these new units the voice-coil impedance is held constant throughout the entire frequency range by means of a copper ring fitted into the air gap. The ring acts as a shorted turn which induces a bucking current into the voice coil, reducing that current and lowering the impedance to its proper level.

There are seven speakers in the new line ranging from 12" units to 5" octagonal and 6" x 9" oval types. Full specs

on any or all of these units will be supplied by the manufacturer on request.

FISHER MULTIPLEX ADAPTER

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. is in production on a multiplex adapter for reception of the compatible stereo broadcasts transmitted by the *Crosby* multiplex system.

The adapter, Model MPX-10, is designed to be used with any stereo sound system and may be connected directly to FM or AM-FM tuners equipped with a multiplex jack. The circuit incorporates a highly balanced matrix stage

which provides complete separation of the two stereo channels. Special feed-through connections permit standard AM and FM signals to pass through the adapter when multiplex stereo is not being received.

The unit may be used without modification with the *Fisher* 90-R, 90-T, FM-90X, 101-R, and 90-R tuners and the Ambassador II, Futura II, Executive, President II and President III consoles. A custom cabinet to house the adapter, finished in mahogany, blonde, or walnut, is available at extra charge.

LANSING LOUDSPEAKERS

James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif. recently demonstrated its new line of linear efficiency loudspeakers to the audio press.

The new component line includes the Model LE8 8" extended-range unit whose frame is designed for front mounting to a baffle. The diameter is 8" and the depth 4⅜". The Model LE10 is a 10" low-frequency driver which can be front mounted on a baffle. Depth is 4⅛". The high-frequency driver, Model LE-30 measures 5$\frac{1}{16}$" in diameter and is 2$\frac{5}{16}$" deep. It, too, is designed for front mounting. A companion dividing unit, Model LX3, for use with LE10 and LE30 speakers, measures 3¼" x 3¼" x 2¾".

All of the speakers have been engineered specifically for performance in enclosures of small size. The company is offering a series of companion enclosures which are available with or without the speakers installed. The enclosures are being offered in ten different finishes.

For complete information on the speakers and/or enclosures, write the manufacturer direct.

COMPONENTS CABINET

As an answer to the problem of where to house hi-fi components *Allied Radio Corporation*, 100 N. Western Ave., Chicago 80, Ill. has just intro-

duced a deluxe components cabinet which it is offering in assembled or pre-finished kit form.

The cabinet is designed to hold a record changer on its base, tuner,

amplifier, and records—everything except the speaker. Features of the enclosure include exceptionally rigid construction, tongue-in-groove joints, selected woods with hand-rubbed furniture finish in a choice of mahogany, limed oak, or walnut, tapered legs with brass ferrules, and brass door handles. The full-length doors have smooth-acting, magnetic latches.

The cabinet measures 27" high, 33½" wide, and 16" deep. In kit form the unit is catalogued as Stock No. 79 DZ 267C while the completely assembled version is Model KN-1400.

NEW "IRISH" TAPE

ORRadio Industries Inc., Shamrock Circle, Opelika, Ala. has announced the addition of a new series to its "Irish" line of magnetic recording tapes.

The "Continental Series" offers the 5¾" reel with longer lengths of tape. The reel was designed especially for the many European recorders now appearing on the U. S. market. The new lengths can be used on practically all American-made recorders as well.

The new series is available in the following numbers, all on 5¾" reels: No. 195 Brown Band (850 feet); No. 211 Green Band (850 feet); No. 300 Shamrock (850 feet); No. 601 Mylar Long Play (1150 feet); No. 602 Acetate Long Play (1150 feet); and No. 724 Double-Play (1650 feet).

SCOTT AM-FM TUNER

H. H. Scott, Inc., 111 Powdermill Road, Maynard, Mass. is currently

marketing a low-cost AM-FM tuner which incorporates many of the features of the firm's more expensive models.

The Model 320 has wide-band FM circuitry to provide high selectivity with freedom from drift, wide-range AM circuitry, and silver-plated "front end" for maximum sensitivity and reliability.

The r.f. circuitry is heavily silver plated to insure high sensitivity and minimize cross-modulation caused by strong local stations. The convenient front-panel level control provides accurate adjustment of tuner audio output. There is a separate output for tape recorders.

Dept. P of the company will supply complete information and technical specifications on the Model 320 upon request.

NEW HEATH FM TUNER

Heath Company, Benton Harbor, Mich. has just added an all-new FM tuner to its line of audio equipment in kit form.

The Model FM-4 offers better than 2.5 microvolt sensitivity, a.f.c. with defeat switch, flywheel tuning, plus a prewired, pre-aligned, and pre-tested tuning unit. Provision is made for plugging in a multiplex adapter without circuit alterations.

This five-tube tuner is housed in a vinyl-clad steel cover of leather-like

texture. The front panel is styled in black, set off by a brushed-gold trim and evenly lighted dial scale.

The FM-4 comes complete with all parts and assembly instructions.

"DISSIMILAR" TRIODE

CBS-Hytron of Danvers, Mass. has announced the development of a dissimilar-section double-triode which combines, in a single envelope, the first two stages of preamplification for high-fidelity disc or tape equipment.

The Type 7247 includes a hi-mu triode with low hum and noise output which is to be used as an amplifier for low-level inputs and a medium-mu triode, having characteristics similar to those of the 6C4, which is suitable for cathode-follower or large-signal phase inverter service.

This 9-pin miniature utilizes special design techniques to minimize hum and microphonics. It has folded-coil heaters and precise grid and mica tolerances. Twin 150-ma. heaters may be connected in series or parallel for operation at 12.6 or 6.3 volts.

Complete technical data on this new tube is available from the company's Advertising Service, Parker Street, Newburyport, Mass. Ask for Bulletin #E-317.

MATCHED SPEAKER KIT

Cletron, Inc., 1974 East 61st St., Cleveland 3, Ohio is now offering a matched set woofer-midrange-dual tweeter with controllable *LC* network in kit form.

The Model C-33812 has been engineered as a compatible set. It features the company's "Flex-edge Cathedral" woofer with full 1" excursion at 16 cps; an 8" midrange unit which covers the frequencies to 8000 cps with axial sensitivity of 95 db; and dual 3" tweeters for coverage to 18,500 cps.

The kit comes complete with a suggested enclosure diagram. Further information on the Model C-33812 kit will be supplied on request.

WEATHERS' "HARMONY" SPEAKER

Weathers Industries of Barrington, N. J. has come out with two unique speaker systems which the company suggests can be used together for three-channel stereo reproduction, if desired.

The "Harmony" unit is a small 4-ohm system which provides 3 watts continuous and 10 watts on peaks. Frequency response is 70 to 15,000 cycles and the system is housed in a unique black leatherette case measuring 11" x 9¼" x 3⅝". It weighs 3½ pounds.

Designed to be used with one or more of these smaller speakers is the "Hideaway" bass speaker which can be located any convenient spot in the room. This is an 8-ohm unit with frequency coverage from 30 to 100 cycles. It will handle 10 watts continuous and 25 watts on peaks. The enclosure is finished in ebony and measures 16½" x 16½" x 5½". There is a built-in *RC* crossover network. The unit requires a small, separate basic 10-watt amplifier for its operation.

For prices and additional information on these new speaker systems, write the manufacturer direct.

AUDIO CATALOGUES

KLIPSCH "POCKET FACTS"

Klipsch & Associates, Inc., 116 Louisiana St., Hope, Ark. is offering a handy pocket-sized booklet covering its loudspeaker systems for stereo or monophonic applications.

The publication also includes information regarding speaker placement and circuitry for achieving a third channel derived from two tracks.

Copies of "Pocket Facts" will be sent without charge upon written request.

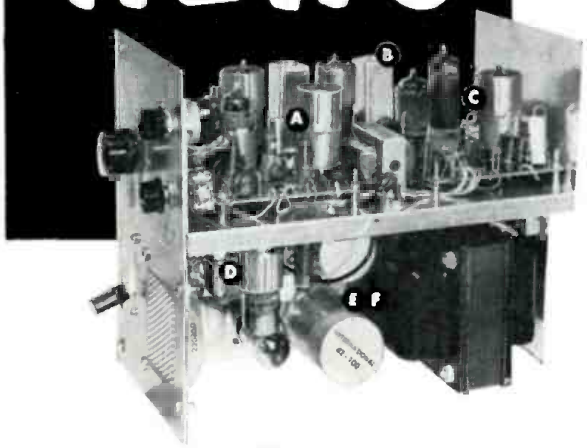
COLORFUL HI-FI BROCHURE

Electro-Voice, Inc., Buchanan, Mich. has just issued a colorful new guide to its line of high-fidelity speakers, enclosures, and systems.

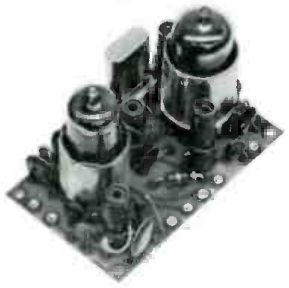
In addition, Catalogue 134 contains an introduction to stereophonic sound and illustrates proper placement of speaker systems. Copies of this catalogue are available on request either from the firm's distributors or from the company direct.

—30—

BIG NEWS for CITIZEN BANDER KIT FANS!



Yes! Your own design and your own construction of 2-way Citizens Radio is now possible with dependable International components. Everything is pretuned and prewired for you. Just order the parts you need and combine them with components you already have . . . or order a complete package made up of the sub-assemblies illustrated and easy-to-follow instructions. Get in on the fun and many practical uses of Citizens Radio! Order what you need today!



A RF Converter Unit (Printed circuit prewired) Two-tube crystal controlled converter. Converts Citizens frequencies to range of tunable IF. Can be used with IF unit (B) or any communication receiver. 6BA6 RF and 12AT7 mixer-oscillator. Shipping weight 2 lbs. $14.00

B IF Unit (Printed circuit prewired) Consists of mixer and tunable local oscillator feeding 262 KC IF stage. Includes noise-limiter and squelch circuits. 6AN8 mixer-oscillator, 6BA6 IF amplifier, diode detector, 6AL5 noise-limiter/squelch. Designed to work with units A and C. Makes dual conversion receiver. Shipping weight 2 lbs. $16.00

C Audio Unit (Printed circuit prewired) Consists of speech amplifier for crystal microphone, first audio for receiver and power amplifier/modulator stage. Designed to follow unit B. 6AN8 speech amplifier/audio, 6AQ5 power amplifier modulator. Includes output transformer but not speaker. Shipping weight 2 lbs. $13.50

D Transmitter Unit (Printed circuit prewired) Oscillator and amplifier. Crystal controlled .005% tolerance to meet FCC regulations. Requires Unit C for modulation. 6AU8 tube. Shipping weight 2 lbs. Complete with crystal and tube. $14.50

E Power Supply 115 VAC only (not prewired). Consists of all parts necessary to construct a power supply to operate Units A, B, C and D. Shipping weight 10 lbs. $12.00

F Power Supply 3-way 6 VDC, 12 VDC or 115 VAC (not prewired). Same as E but will operate from any of three different power sources. Shipping weight 10 lbs. $20.00

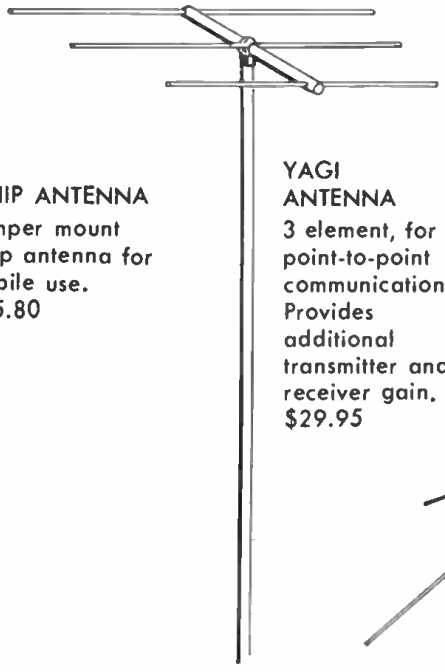
G Cabinet (all metal) Includes all necessary hardware, switches, speakers, panel, case, etc., to combine Units A, B, C, D and E or F into a complete receiver-transmitter assembly. Complete with instructions. Shipping weight 10 lbs. $20.00

INTERNATIONAL CRYSTAL MFG. CO., INC.

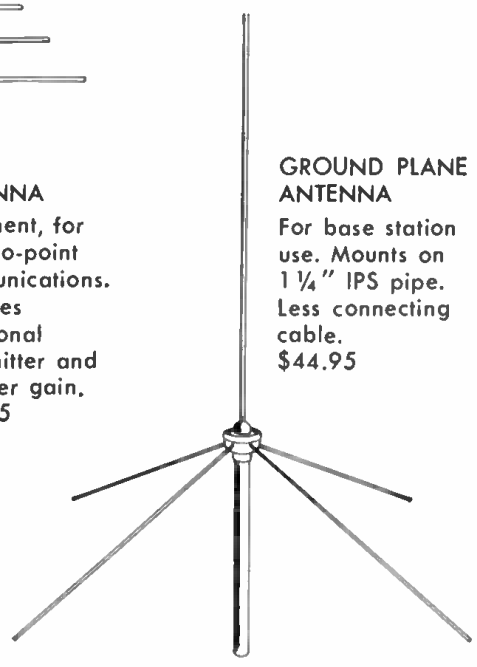
18 N. LEE • OKLAHOMA CITY, OKLA.

DESIGN YOUR OWN CITIZENS RADIO
with International Components
. . . *AND THESE ACCESSORIES*

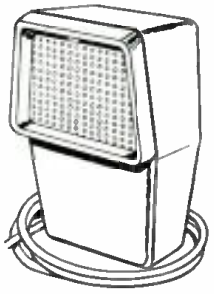
WHIP ANTENNA
Bumper mount whip antenna for mobile use.
$15.80



YAGI ANTENNA
3 element, for point-to-point communications. Provides additional transmitter and receiver gain.
$29.95



GROUND PLANE ANTENNA
For base station use. Mounts on 1¼" IPS pipe. Less connecting cable.
$44.95



CRYSTAL MICROPHONE
$3.95

YOU'LL FIND MANY USES FOR YOUR 2-WAY RADIO

FOR BUSINESS—Ideal communication between office and service trucks operating in a restricted area. Also practical for office and factory liaison.
FOR THE FARM—The solution to fast communication from the farm home to the field. Wonderful in an emergency.
FOR SPORTS—From ship to shore or from base camp to the scene of the hunt, an enjoyable accessory in the field of sports.
FOR THE HOME—From the kitchen to the den or workshop or from the sick room to the living room 2-way communication will save many steps.

Dept. EW
International Crystal Mfg. Co., Inc.
18 N. Lee, Oklahoma City, Oklahoma
Gentlemen: Please place my order for the following:

ITEM	NO. OF UNITS	PRICE EACH*	TOTAL
Unit A—RF Converter		$14.00	
Unit B—IF Unit		16.00	
Unit C—Audio Unit		13.50	
Unit D—Transmitter Unit		14.50	
Unit E—Power Supply, 115 VAC		12.00	
Unit F—Power Supply, 3-way		20.00	
Unit G—Cabinet		20.00	
Whip Antenna for mobile use		15.80	
Yagi Antenna		29.95	
Graund Plane Antenna		44.95	
Crystal Microphone		3.95	

☐ Check ☐ Money Order Amount $ _____ ☐ Information on time payment plan

Available at your local dealer at slightly higher prices.

NAME _____

ADDRESS _____

CITY _____ STATE _____

HOW TO ORDER: Please supply sufficient information with order to facilitate accurate processing. Shipments are made on open account F.O.B. Oklahoma City when credit has been approved. On orders of $25.00 or over, ⅓ down payment with order is required

Please include in check or money order sufficient postage and insurance for your Parcel Post Zone. Shipments exceeding 20 lbs. will be made via express, C.O.D.

Highway Communications System

Can operate signal lights, buzzers in a car or transmit voice signals into it over a 1000-foot length of road.

A UNIQUE system of highway-to-car communications, known as "Hy-Com," has been developed and demonstrated recently by *Delco Radio*. This system makes it possible to actuate signal lights or buzzers in a car or to transmit verbal information to a special receiver in the car from an automatic or manual roadside transmitter. The range of the transmitter is strictly limited so that the car can pick up the signals for only about 1000 feet of road. What is more only those cars traveling in one direction would respond to the radiated signals. Since drivers react quickly to the spoken word, audio communications would be useful on toll roads and expressways to aid in promoting a steady flow of traffic at reasonably high speeds.

The new system uses a carrier frequency that is in the upper audio range, from 10 to 15 kc. This carrier, with its restricted bandwidth audio information, is applied through single-sideband circuitry to elongated loops of wire that are located alongside the road. A receiver in the car is able to pick up the signal radiated by means of induction. The magnetic field surrounding the wire loop is such as to produce a radiated field strength of 1 to 100 milliamperes-per-meter. No FCC license is required for this type of operation under present regulations.

In addition to the voice transmitter and its loop, a trigger transmitter with a much smaller loop (about 50 feet) is employed. This transmitter sends out a continuous signal which is received just ahead of the voice signals. In operation, the receiver in the car is inoperative until the car enters the trigger zone. When the trigger transmitter is picked up, the receiver is sensitized for listening to the voice zone. As long as the voice is picked up, the receiver is held on, but after the car passes beyond the range of the voice loop, the receiver reverts to its insensitive condition and no further operation will occur until the car again passes through a triggering zone.

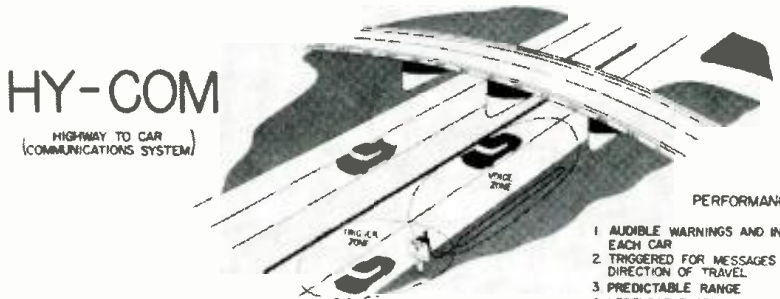
The triggering function is desirable for two reasons. First, it prevents reception of the voice signal in the opposite lane. The curve of field strength

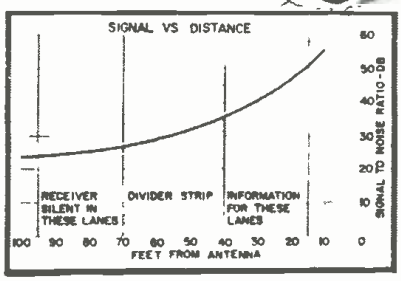
Roadside equipment in waterproof housing.

in the lower left-hand side of the chart below shows appreciable signal even in this lane. However, cars moving in the opposite direction, if they receive sufficient triggering signal at all, receive it geographically too late. Second, weak random voice radiation can conceivably be encountered under some conditions where power lines pick up the transmission and re-radiate it at some undesired spot. The trigger transmitter will prevent reception of the signal at such spurious locations.

All the equipment employed in the system is fully transistorized and battery operated. —30—

Operation, performance, and design of the highway-to-car communications system.





PERFORMANCE

1. AUDIBLE WARNINGS AND INFORMATION IN EACH CAR
2. TRIGGERED FOR MESSAGES ONLY IN DIRECTION OF TRAVEL
3. PREDICTABLE RANGE
4. DEPENDABLE SERVICE

DESIGN

1. SINGLE SIDE-BAND SUPPRESSED CARRIER TRANSMISSION.
2. LONG LOOP INFORMATION ANTENNA AND CIRCULAR LOOP TRIGGER ANTENNA
3. INFORMATION TRANSMITTER AND TRIGGER TRANSMITTER
4. LOW COST RECEIVER MOUNTED ADJACENT TO THE DRIVER.
5. ALL TRANSISTOR SYSTEM (DELCO TRANSISTORS)

build this great new knight-kit® A PRODUCT OF ALLIED RADIO stereo hi-fi amplifier... save up to 50%

COMPARABLE IN EVERY WAY TO WIRED AMPLIFIERS COSTING TWICE AS MUCH

tremendous value at only

$44.50

only $4.45 down

never before such performance... such quality... such styling at so low a price...

knight-kit 20-watt stereo hi-fi amplifier

Newest complete Stereo high-fidelity amplifier at an amazing low $44.50. Incomparable value: Includes two built-in preamps for magnetic cartridges. Single switch selects stereo phono, tuner or auxiliary inputs, plus stereo reverse on each; also switches monophonic inputs to both amplifier channels. Bass and treble controls boost and attenuate. Special clutch-type concentric volume control permits individual channel balancing, plus overall volume control. Total output is 20 watts (10 watts per channel at less than 1½% distortion). Response, 20-20,000 cps, ± 1.5 db. Hum and noise better than 85 db below full output. Has four pairs of stereo inputs: magnetic cartridge, ceramic cartridge, tuner, auxiliary. RIAA equalized for stereo discs. Expertly designed push-pull output circuitry. Beautiful custom-styled case, 4¼ x 13¼ x 9". With case, tubes, all parts, wire, solder and instructions. Shpg. wt., 27 lbs.

Model Y-773. Knight-Kit Stereo Amplifier, F.O.B. Chicago..... **$44.50**

EXCLUSIVE **knight-kit**
MONEY-BACK GUARANTEE

Every KNIGHT-KIT meets or exceeds published specifications, or we refund your money. Buy any KNIGHT-KIT! Build it! It must perform exactly as claimed—or your money is refunded.

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Model CT-1

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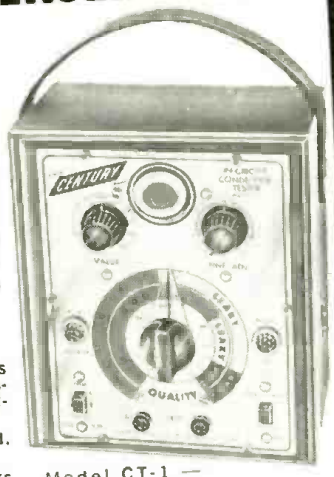
Here is an in-circuit condenser tester that does the whole job. The CT-1 actually steps in and takes over where all other in-circuit condenser testers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation. . . .



in-circuit checks:

- ✓ Quality of over 80% of all condensers even with circuit shunt resistance present . . . (leakage, shorts, opens, intermittents)
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- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ Transformer, socket and wiring leakage capacity

Model CT-1 — housed in sturdy hammertone finish steel case complete with test leads **$34.50** Net

SIZE: W–6" H–7" D–3¼"

out-of-circuit checks:

- ✓ Quality of 100% of all condensers . . . (leakage, shorts, opens and intermittents)
- ✓ Value of all condensers from 50 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ High resistance leakage up to 300 megohms
- ✓ New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

SPECIFICATIONS

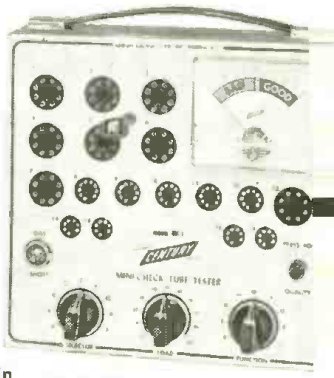
• Ultra-sensitive 2 tube drift-free circuitry • Multi-color direct scale precision readings for both quality and value . . . (in-circuit or out of circuit) • Simultaneous readings of circuit capacity and circuit resistance • Built-in hi-leakage indicator sensitive to over 300 megohms • Cannot damage circuit components • Electronic eye balance indicator for even greater accuracy • Isolated power line

MINI-CHECK TUBE TESTE

Model MC-1

A Real *ECONOMY* MULTIPLE SOCKET TUBE TESTER without sacrifice in *ACCURACY, SPEED* or *VERSATILITY*

Here is a multiple socket tube tester designed to meet limited budgets. Although low in price it boasts a unique circuitry that enables you to check over 600 tube types — and has a range of operation that far exceeds others in its price class.



Model MC-1 — housed in sturdy wrinkle finish steel case **$39.50** Net

SIZE: W–9" H–8½" D–2¾"

SPECIFICATIONS

• Checks emission, inter-element shorts and leakage of over 600 tube t This covers OZ4s, series-string TV tubes, gas regulators, auto 12 plate hi-fi and foreign tubes • 3 settings enable a test of any tube in less 10 seconds • Employs dynamic cathode emission test principles • D'Arsonval type meter — most accurate type available . . . its greater s tivity means more accuracy . . . its jewel bearing means longer life • 17 lasting phosphor bronze tube sockets • Combination gas and short j indicator • 9 filament positions • Handy tube chart contained in special compartment • New tube listings furnished periodically at no cost • tachable line cord

plus these BONUS FEATURES . . . found in no other low price tube tester

✓ Checks for cathode to heater shorts ✓ Checks for gas con
✓ Checks all sections of multiple purpose tubes . . . will pickup tu with one "Bad" section ✓ Line isolated — no shock hazard ✓ able load control enables you to get accurate results on all tu
✓ Positively cannot become obsolete as new tubes are introduc

IN-CIRCUIT RECTIFIER TESTER

Model SRT-1

Checks all power rectifiers in-circuit whether SELENIUM, GERMANIUM, SILICON, etc.

With the growing trend towards compactness, portability and low price, TV manufacturers are resorting more and more to producing series-string TV sets employing selenium, germanium or silicon power rectifiers. Now the need for an in-circuit rectifier tester is greater than ever.

THE SRT-1 CHECKS ALL POWER RECTIFIERS IN-CIRCUIT AND OUT-OF CIRCUIT WITH 100% EFFECTIVENESS FOR:

✓ Quality ✓ Fading ✓ Shorts ✓ Opens ✓ Arcing ✓ Life Expectancy

Model SRT-1—housed in sturdy hammertone finish steel case complete with test leads **$29.50** Net

SIZE: W–6" H–7" D–3¼"

SPECIFICATIONS

- Checks all types of power rectifiers rated from 10 ma. to 500 ma. (selenium, germanium, silicon, etc.) both in-circuit or out-of-circuit.
- Will not blow fuses even when connected to a dead short.
- Large 3" highly accurate multi-color meter . . . sensitive yet rugged.
- Separate meter scales for in-circuit and out-of-circuit tests.
- Cannot damage or over heat rectifier being tested.

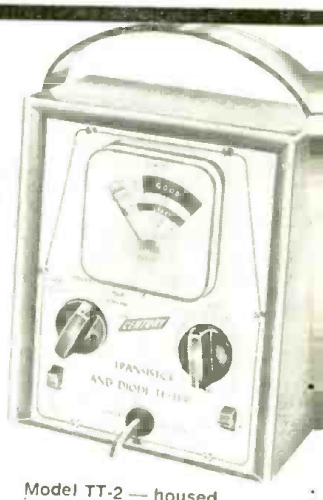
SIMPLE TO OPERATE Just clip SRT-1 test leads across rectifier under test right in the circuit without disconnecting rectifier from circuit. Press test switch and get an instant indication on the easy-to-read three-color meter scales. . . .

TRANSISTOR TESTER

Model TT-2

AN INEXPENSIVE QUALITY INSTRUMENT DESIGNED FOR ACCURATE AND DEPENDABLE TESTS OF ALL TRANSISTORS AND DIODES QUICKLY AND ACCURATELY

Every day more and more manufacturers are using transistors in home portable and car radios . . . in hearing aids, intercoms, amplifiers, industrial devices, etc. Since transistors can develop excessive leakage, poor gain, shorts or opens, the need for TRANSISTOR TESTER is great.



SPECIFICATIONS

• Checks all transistors, including car radio, power output, triode, tetrode and unijunction types for current gain, leakage, opens, shorts, cut-off current • Checks all diodes for forward to reverse current gain • All tests can be made even if manufacturers' rated gain is not available • Less than half a minute required for tests of either transistors or diodes • Large 3" meter is extremely sensiti yet rugged . . . with multi-color scales designed for quick easy readin • Power is supplied by an easy to replace 6-volt battery — current dra so small, service life almost equal to shelf life. Battery cannot be drain due to accidental shorting of test leads • Cannot burn-out its own meter damage transistor or diode under test • Long test leads and insulated te clips enable tests without entirely removing transistor from circuit • Tes leads are identified by E.I.A. color code so that connection to the correc terminal is assured • Comes complete with replaceable transistor set-u chart that fits into a special rear compartment.

Model TT-2 — housed in sturdy hammertone finish steel case complete with test leads **$24.5** N

SIZE: W–6" H–7" D–3¼"

IMPORTANT FEATURE: The TT-2 cannot become obsolete you to check all new type transistors as they are introduced. New listing will be furnished periodically at no cost.

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DR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

EW Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

aturing the sensational new MULTI-PROBE Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

DC Probe ② AC-Ohms Probe ③ Lo-Cap Probe ④ RF Probe

he VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do ll the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you ave to cart around a maize of entangled cables, lose time alternating cables or hunting for a mis-laced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-aving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

SIZE:
W-7⅜"
H-9"
D-4¼"

FUNCTIONS

: VOLTMETER . . . Will measure D.C. down to volts full scale with minimum circuit loading, l give accurate readings of scale divisions as low .025 volts . . . Will measure low AGC and oscillator s voltages from .1 volts or less up to 1500 volts h consistent laboratory accuracy on all ranges . . . o center provided for all balancing measurements h as discriminator, ratio detector alignment and i amplifier balancing.

: VOLTMETER . . . True Peak-to-Peak measure-nts as low as 3 volts of any wave form including sync, deflection voltages, video pulses, distortion i-fi amplifiers, AGC and color TV gating pulses . . . le divisions are easily read down to .1 volts . . . asures RMS at 1/20th the circuit loading of a .M. . . . Unlike most other V.T.V.M.'s there is no s in accuracy on the lowest AC range.

ECTRONIC OHMETER . . . Measures from 0 000 megohms . . . Scale divisions are easily read n to .2 ohms . . . Will measure resistance values n .2 ohms to one billion ohms . . . Will detect h resistance leakage in electrolytic and by-pass densers.

and LO-CAP MEASUREMENTS . . .

h these extra VT-1 functions you can measure ages in extremely high-impedance circuits such sync and AGC pulses, driving saw tooth voltages, r TV gating pulses, mixer output levels, I.F. ge-by-stage gain and detector inputs.

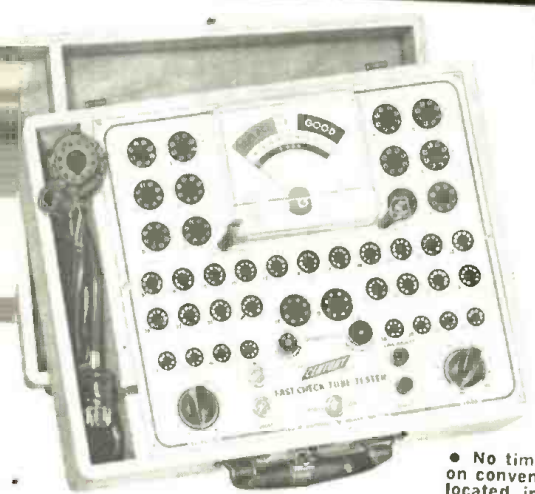
OUTSTANDING FEATURES

• Completely portable — self powered with long life batteries — permits use everywhere • New advanced pentode amplifier circuit assures amazingly low battery drain • Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s • Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC • Simplified multi-color easy-to-read 4-scale meter • No heat operation assures rigid stability and accuracy • Immune to power line fluctuations • Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments • Meter completely isolated — practically burn-out proof • Hand-crafted circuitry eliminates the service headaches of printed circuitry • 1% resistors used for permanent accuracy • Separate RF ground return for low-loss RF measurement • Micro-phone type co-axial connector • Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
- AC Volts (RMS and Peak-to-Peak) — 0 to 3/12/60/300/1200 volts
- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- RF — Peak reading demodulator supplied for use on all DC ranges
- Zero Center — available on all DC volt ranges with zero at mid-scale
- Decibels — from —10 Db to +10/22/36/50/62 based on the Dbm unit: 0Db-1MW in 600 ohms
- Impedance — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- Input Capacity — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model VT-1 — fully wired and calibrated, housed in handsome hammertone finish steel case, complete with MULTI-PROBE and thorough instruction manual covering all the applications in detail. **$58.50** Net



SIZE: W—14⅝" H—11¼" D—4⅜"

odel FC-2 — housed in hand-obed oak carrying case com-ete with CRT adapter **$69.50** Net

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. 0Z4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- Checks for inter-element shorts and leakage.
- Checks for gas content.
- Checks for life-expectancy.

SPECIFICATIONS

• No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers • No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement • Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale • 41 phosphor bronze beryllium tube sockets never need replacement • 7-pin and 9-pin straighteners mounted on panel • Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out • Special scale on meter for low current tubes • Compensation for line voltage variation • 12 filament positions • Separate gas and short jewel indicators • Line isolated — no shock hazards • Long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

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CENTURY ELECTRONICS CO., INC.

111 Roosevelt Avenue, Dept. 207, Mineola, New York

CHECK INSTRUMENTS DESIRED

- ☐ Model CT-1 In-Circuit Condenser Tester $34.50 — $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model MC-1 Mini-Check Tube Tester $39.50 — $9.50 within 10 days. Balance $6 monthly for 5 months.
- ☐ Model SRT-1 In-Circuit Rectifier Tester $29.50 — $4.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model TT-2 Transistor Tester $24.50 — $4.50 within 10 days. Balance $5 monthly for 4 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter $58.50 — $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester $69.50 — $14.50 within 10 days. Balance $11 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

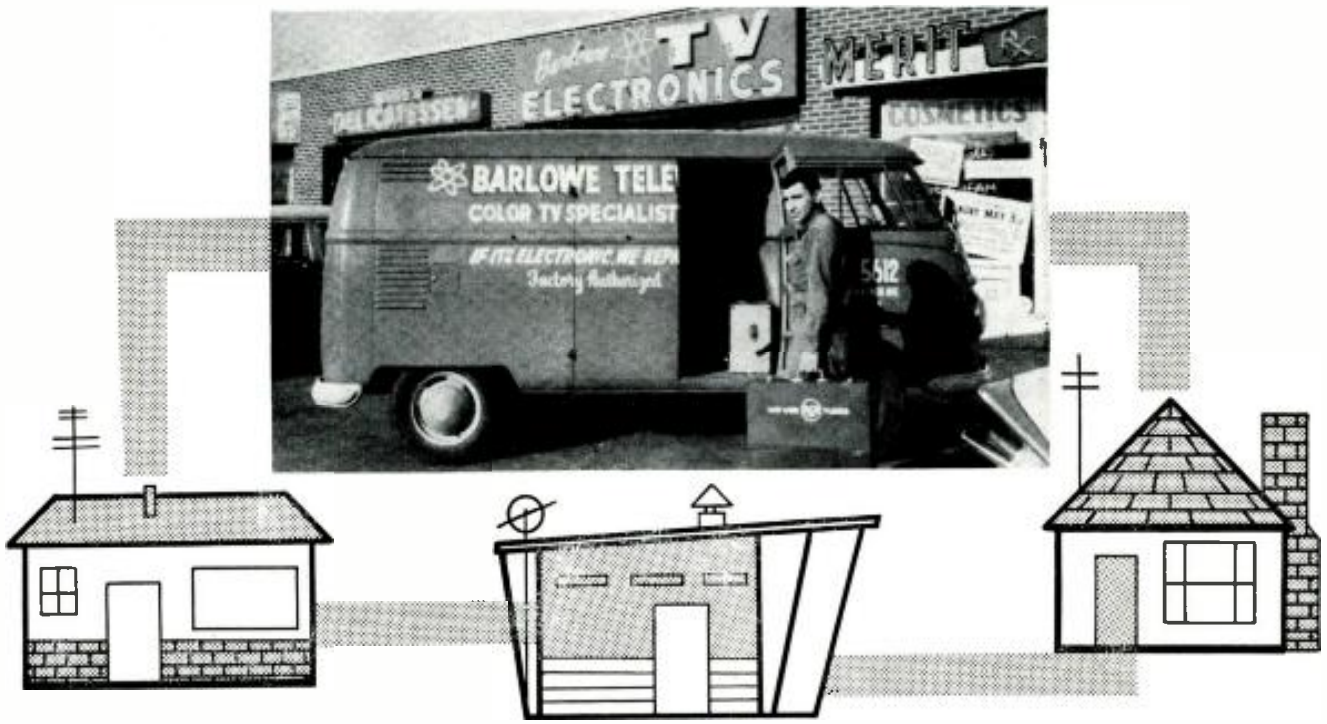
Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name .....

Please print clearly

Address .....

City ..... State .....



The Outside Call: What To Take Along

By **MURRAY BARLOWE**

Equipment for caddy and truck. This successful dealer's solution may work out as well for you.

IN AN industry as highly competitive as service, operation at maximum efficiency is a virtual necessity. Variations of the theme notwithstanding, we have only one commodity to sell in the long run—and that is time. (For example, did someone say, "How about technical skill?" Even this can be reduced to a factor determining how much time a job will take.) We have a limited number of hours for sale each day. The difference between success and failure can be related to what we receive for the time we have had to invest. It therefore behooves us to use this valuable commodity as efficiently as possible.

That part of the service shop's operation where this truth becomes most apparent is in the handling of outside service calls. The more *completed* calls per day, the better the profit picture looks. The greatest drains on the income of the average shop are the incomplete calls and repeat calls. The problem of the repeat call—a complex one involving proper work procedures, technical ability, and customer relations—is not our concern here. Just as wasteful of time, the incomplete calls are more readily resolved.

A check of calls marked "incomplete" shows one outstanding reason: a needed tube, part, tool, or item of test equipment was not on hand. This means either returning to the shop to pick up what was lacking and rescheduling the call for a later date (which leaves the unhappy customer in the same fix he was in before you arrived) or pulling the set to the shop for a repair that could have been completed in the home more profitably.

By this last statement, we do not imply that *all* repairs should be completed in the home. We believe that one of the most important skills of the outside man is his ability to draw the line between a home repair and a shop repair. While many factors influence this decision, profit is the guiding one. It is all too possible to complete a repair in the home at a greater cost to the service shop than to the customer!

On the other hand, how often does it happen that a call is not completed because the outside man was shy a particular tube, a fuse of a certain value, or another common component? How often, after the primary fault has been corrected, has the sale of an additional, marginal tube or two been lost just because they weren't around at the right time? These things happen more often than we care to think about.

Although we have dismissed the repeat call from full consideration, many of these—on which most service shops tend to foot the bill—are incompleted calls in disguise. How often does a set come back to the shop for a minor repair because the technician was not properly equipped to "nail it" while in the customer's home?

For maximum efficiency, the outside man, his tube-tool caddy or caddies, and his vehicle should be equipped to handle adequately as many of the predictable problems that arise. The key question now becomes, "Of the quantity of material available in the shop, what should be taken along and what should be left behind?" Our answer, in arbitrary form, appears in Table 1 (contents of the caddy or caddies) and Table 2 ("back-up" material in the vehicle). While these are tested recommendations, reflecting years of experience, we know that such lists can vary depending on the character of the individual service operation. They hinge most of all on where the shop owner draws the line between the bench repair and the home repair. Since there is room for variation, the list will be most useful as a starting point for the greatest number of people if the reasons for some choices are evaluated.

To begin with, the lists of Tables 1 and 2 include what we consider the irreducible minimum of equipment for an outside technician in a reasonably typical suburban operation. Special conditions are therefore likely to call for additions rather than subtractions. Concerning the tube complement, it should be really complete—possibly *more* complete than that in the shop. After all, the bench man can work on another set while waiting for a tube or part, whereas such a lack for the outside man means an "incomplete" call. For a guide to recommended tubes, see the "Tube Inventory for Service Shops, 1959" in the April issue, page 57. Carry at least one of each and 2, 3, or more of the popular ones, as indicated. A caddy for tubes only is one way, although we prefer a large, combination

tube-tool case. If necessary, less popular numbers can be carried in a second caddy or carton in the service truck—but don't leave any behind altogether because of space limitations.

A filament continuity checker will save time (still the key factor!) in finding open filaments in series-string receivers. You may prefer the type that uses a.c. power instead of batteries. If there's anything less helpful than a filament checker with dead batteries, it's a flashlight with dead batteries! Speaking of flashlights—a good one, or an a.c.-operated light instead, is a "must." If the battery-operated checker and light are preferred, make sure that reserve batteries and a reserve bulb, in the case of the flashlight, are always in the truck.

As important as a complete set of tubes is a complete set of hand tools. This includes a good set of nutdrivers and a complete selection of screwdrivers in different sizes and for *Phillips* heads, diagonal cutters, longnose pliers, gas pliers, and long fiber or plastic screwdrivers for setting oscillator adjustments on front ends.

Concerning the latter, we have an unwritten law that adjustment of the oscillator slugs on a front end should constitute the extent of alignment to be performed in the home. We are convinced that most receivers leave the factory properly aligned. Furthermore, we are convinced that most r.f. and i.f. adjustments are sufficiently stable so that they should not require re-adjustment for the life of the receiver!

This does not mean that we never find it necessary to do an alignment job. On the contrary, dust seldom gets a chance to settle on our full set-up, involving an investment of about $1300 in sweep, marker, scope, and auxiliary equipment of top quality. Nevertheless, we have found that the bulk of our alignment work is the direct result of activity on the part of screwdriver-happy customers and technicians!

Because alignment techniques can be rather tricky, they receive considerable emphasis in most TV training schools. This indoctrination often leaves the otherwise well-trained but not yet fully experienced technician with a distorted perspective. Knowing the host of troubles that *might* be due to misalignment, he may start turning screws if routine checks have failed to disclose a fault. A relatively matter-of-fact call is thus often converted to a time-consuming repair and re-alignment job. For these reasons, alignment instruments beyond the single device mentioned have been left *out* of the caddy.

Getting back to what should go *into* the caddy, take whatever "special" tools you can that have proven themselves as time savers. Such special gimmicks, if well chosen, can earn their cost many times over. One example is the slug-retrieving screwdriver, for recovering, in *Standard Coil* tuners, the oscillator slugs that have been pushed too far out. Since this occurrence is not too uncommon, being able to recapture the slugs without taking the set out of the cabinet is very worthwhile. Another example of the "special" tool is the pump-type device used for forcing a lubricant or solvent into a "noisy" control from the front of the cabinet without removing the chassis. Mention of these fluids brings up another listing for outside calls: A complete supply of chemicals, including solvents, lubricants, cleaners, corona "dope," and others, should not be overlooked.

A complete set of "L"-shaped key-type wrenches with hex and spline

All items in Table 1 and several in Table 2 appear in this compact grouping.

heads is important. Many technicians will recognize these more readily when they are identified as *Allen* and *Bristol* wrenches. Whatever you call them, the set screws on many knobs cannot be handled without one of these. A complete set of such wrenches takes up so little space that carrying them is easier than having to pull a set *cabinet* because one knob couldn't be removed!

The presence or absence of color TV receivers in a given area will, of course, determine the inclusion of some items on the two lists that are too obvious to require further comment. We doubt that there are many places where a shop can afford to ignore color altogether at this date. By "miscellaneous hardware," we admit that we are using an easy out for a difficult item. We believe it is well-nigh impossible to particularize the collection of screws, washers, bolts, and the like that will be included. This is an assortment that can only grow by accretion over the years. Yet its need must be noted.

The cheater cord is also a somewhat loose designation. We may include in this category extension cords and equipment cords that suit the particular operation or the particular operator. For example, some like the type of long extension with a single male plug at one end and a choice of outlets and connectors at the other.

There has been no effort to classify much equipment as optional in the two tables. Some shops have a tendency to take some items along for some calls but leave these items behind on other calls. However a reliable decision as to what should go along can seldom be made on the basis of an untrained customer's telephone report.

This would apply particularly to all antenna-related equipment listed, where some might wish to leave such gear behind unless an installation is scheduled or antenna trouble is anticipated. Besides, many a sale of a new antenna develops as a result of a call that may involve another defect, where the failure to have the replacement antenna available at the psychological moment may mean complete loss of the sale.

As stated, we consider that these lists represent a minimum complement. How do they compare with what you are carrying now? If you take less with you, you may be paying for the extra equipment in time lost. Whether you agree with everything we say or not, the comparison itself can be valuable. It will make you stop to evaluate your own selections. If you are in the process of organizing a list of this kind yourself, the ones given here will help even if you develop your own departures. They will at least provide the necessary starting point. —30—

Table 1. These items, in one or two caddies, go into the home on every call.

Tubes*	Fusible resistor assortment kit
Filament continuity checker*	Multimeter
Flashlight or service lamp*	Knob-spring kit
Nutdrivers, assortment	Miscellaneous hardware kit*
Screwdrivers, assortment	High-voltage tape
Diagonal cutters	Cheater cords*
Long-nose pliers	CRT boosters (series and parallel)
Gas pliers	Bill book and shop tags
Alignment tool (plastic or fiber, long)*	"Not-at-home" cards
"Special" tools*	Color TV interlock cheater
Chemicals*	Pilot lamp assortment
Key-type hex and spline wrenches*	Mirror
Solder gun and solder	Paper towels (cleaning CRT & safety glass)
Fuse assortment kit	

* See text for further discussion of these items.

Table 2. Back-up equipment for truck.

Tube checker
Test speaker
Test audio output transformer (universal type)
CRT checker-rejuvenator
Resistor and capacitor assortment
De-gaussing coil (color TV)
Color and dot or bar generator (linearity adjustments and color TV)
Rabbit-ears antenna (checking antenna troubles)*
Antenna equipment (ladder, wire, masts, mounts, assorted antenna hardware, and local antenna types)*
Auxiliary tools, including: electric drill, hammer, hacksaw, ratchet wrench

* See text for further discussion of these items.

Build an Accurate Pulse Timer

By **DAVID STONE**

Single-tube unit used to trigger solenoids, puts timing marks on recorders and "count-down" pulses on p.a. system.

IF YOU need a timing unit which will continuously and accurately produce voltage pulses for timing or controling, this uncomplicated timer will fill the bill. It can be used to trigger solenoids on single-frame cameras for time-lapse photography, it will put accurate timing marks on recorders, and it can be used to produce a "count-down" over a p.a. system. The constructor will doubtless find other uses for this useful "pulser."

The circuit is a blocking oscillator type which operates when a negative charge on the 4-μfd. grid capacitor, C_3, decreases sufficiently to allow tube conduction. Plate current rises sharply and activates the relay. It also induces a sharp negative pulse back into the grid circuit to cut off the tube and recharge the capacitor. The variable "timing" resistance "leaks" the negative charge off at a rate determined by the *RC* discharge time until the conduction-cut-off cycle repeats. The charging voltage to the capacitor is fairly constant so the "pulser" is relatively insensitive to power supply or line fluctuations. Refer to the schematic diagram shown in Fig. 1.

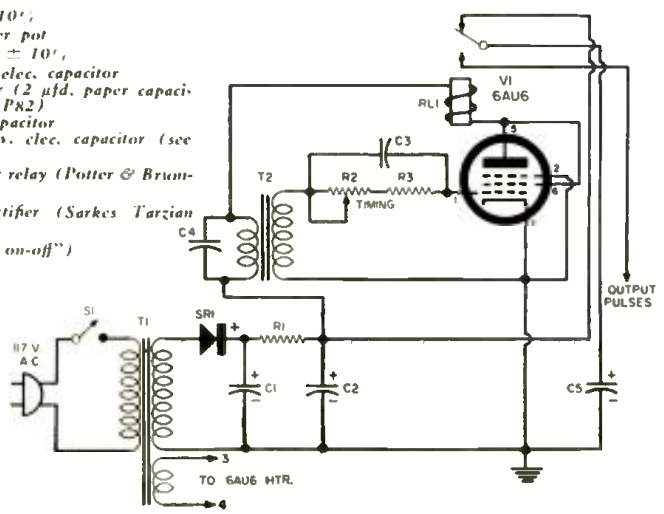
Relay action is very rapid and contacts close only briefly. If it is to be used as a switch, the equipment it drives must be capable of being switched on rapidly. The best way to take advantage of the "pulser" is to insert a 50- to 100-μfd. switching capacitor across the "B-plus" and relay contacts as shown in the diagram. The capacitor discharge will drive a camera solenoid or practically any other relay coil or solenoid. Relays rated at 6-, 12-, 24-, and 117-volts a.c. or d.c. are successfully activated by a 50-μfd., 150-volt electrolytic. These driven relays or solenoids should have a filter capacitor across their coils to minimize arcing of the timer's relay contacts. Enough capacity can be added across the coils to delay the opening of the driven relay for slower switching.

The contacts of the "pulser" can be disconnected from "B+" and inserted in series with a speaker connected to an audio oscillator for "count-down" pulses. The audio tone will be periodically interrupted and the output will sound just like the timing sequences on WWV. Similarly, timing pulses can be injected into recorders if the switching capacitor's voltage output is decreased with suitable resistance.

Construction is straightforward, noncritical, and easy. It can be built in about two hours or so. Calibrate the "timing" potentiometer in 1 or 5 second steps with an accurate stopwatch. The combination of 4-μfd. and 10 megohms produces about 50 seconds delay. More delay can be obtained by adding resistance in series with the "timing" potentiometer at the rate of 5 seconds for every megohm. A step switch with fixed resistances can be substituted for the "timing" potentiometer, if desired. Remember, the accuracy of the "pulser" is dependent, to a great extent, upon the accuracy of calibration. —30—

Fig. 1. Complete schematic diagram and parts list for the pulse timer unit.

R1—3300 ohm, 1 w., res., ± 10%
R2—10 megohm linear taper pot
R3—100,000 ohm, 1 w., res., ± 10%
C1-C2—20/20 μfd., 150 v., elec. capacitor
C3—4 μfd., 200 v. capacitor (2 μfd. paper capacitors in parallel, Acrovox P82)
C4—1 μfd., 200 v. paper capacitor
C5—50 or 100 μfd., 150 v. elec. capacitor (see text)
RL1—5000 ohm, 6 ma. plate relay (Potter & Brumfield LB-5)
SR1—50 ma. selenium rectifier (Sarkes Tarzian Model 50)
S1—S.p.s.t. switch ("Power on-off")
T1—Power trans. 117 v., pri.; 125 v. sec. @ 15 ma.; 6.3 v. @ .6 amp. (Stancor PS-8415 or equiv.)
T2—Audio interstage trans., 15,000 ohm pri.; 60,000 ohm sec. (UTC O-4 or equiv.)
V1—6AU6 tube



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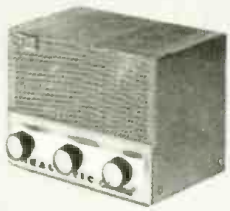

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Service Notes

ADMIRAL: CONTRAST ERRATIC

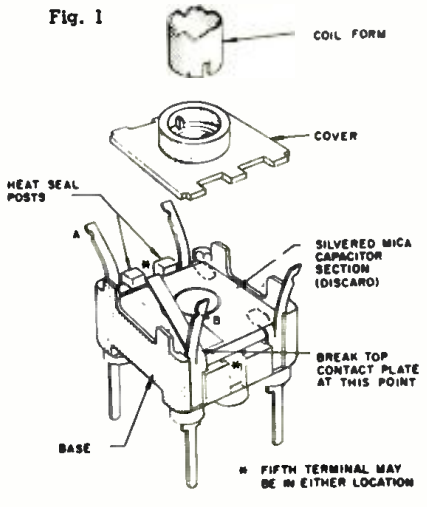
When contrast and/or brightness vary with adjustment of the volume control in receivers using chassis 18XP-4BZ or 18SX4BZ, molded upright capacitor C_{212} (.01 μfd., 400 volts) may have broken down. If this is the case, guard against recurrence by using a ceramic unit, rated at 450 volts, as the replacement.

G-E: RATIO-DETECTOR REPAIR

Some ratio-detector transformers used in receivers over recent years exhibit a tendency to develop leakage. The defect actually arises in the capacitor mounted in the base of the transformer. The transformer types involved (RTD-024, RTD025, and RTD026) were used in receivers in the U, MM, and Q2 lines, among others. Common practice, in case of failure, has been replacement of the entire unit. However repair, which is often quicker and easier to perform as well as less likely to damage associated circuits, is definitely possible. The procedure (refer to Fig. 1) follows:

1. Remove the shield can from the assembly. 2. Unsolder a sufficient number of coil leads (1 or 2) to enable removal of the coil from the plastic base. Identify the leads to insure later replacement to the proper terminals. 3. Break the heat seal posts (Fig. 1) and remove the plastic cover. 4. Remove the top contact plate by bending. It will break loose near the terminal

Fig. 1



and open the capacitor. 5. Remove and discard the silvered-mica capacitor section.

Remaining steps describe the reassembly of the transformer, including replacement of the capacitor section:

6. Replace the cover by softening the plastic base with heat or cement this cover to the base with Glyptal. 7. Install a 120-μμfd. capacitor across the terminals of the secondary on the plastic base. These are terminals *A* and *B* in Fig. 1. 8. Replace the coil and reconnect the coil leads. Make sure that the leads go to the proper terminals, which have been identified earlier. 9. Replace the shield can, making certain that the added capacitor and the terminals do not short to the can. 10. Re-alignment will probably be necessary.

Although the procedure just outlined may appear to be time-consuming, it actually saves time in the long run by eliminating replacement part delays.

RCA COLOR TV TUNER DRIVE

A bead chain assembly is used to rotate the tuning dial drum on the 800M series color receivers. If the drum is turned by hand improperly or if it binds against the cabinet, excessive strain and breakage may occur. A

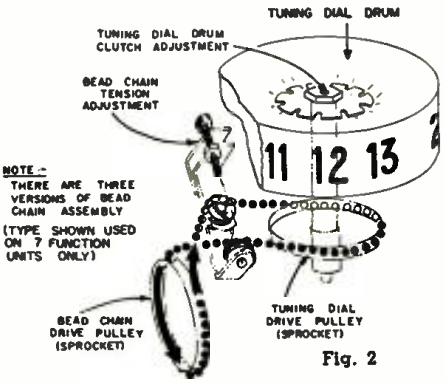


Fig. 2

clutch mechanism normally relieves such strain, but this unit itself may be too tightly adjusted.

The clutch may be re-adjusted by holding the dial drum pulley in position and tightening or loosening the hex nut located in the center of the drum (Fig. 2) as required to obtain proper action. When properly set, the clutch is tight enough to insure positive action during rotation of the station selector yet loose enough to slip if the drum is jammed or purposely turned by hand to center the channel number in the indicating window. It's wise to hold the pulley secure whenever the dial drum is turned by hand. Also, be certain the pulley does not turn while the clutch is being adjusted or the drum is being positioned.

Excessive tension can also be harmful to the bead chain, which has a tension adjustment on some tuners and is spring loaded on others. Tension should be no more than enough to provide positive action. Binding on the cabinet occurs when the chassis is positioned too far forward. To remedy, loosen the chassis bolts, pull the chassis as far back as possible, and again secure the bolts. Observe this same precaution whenever re-installing a serviced chassis.

The bead chain may also be weakened by the action of greasy lubricants and solvents. Make certain that these compounds do not come into contact with the chain. -30-

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FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter, built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8 kc bandwidth and frequency response 20-5000 cps ± 3 db.

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Replacement Problems

(*Continued from page 50*)

from the set manufacturer direct, but such instances are rare. Linearity coils are usually not very critical in value and standard replacement parts can be obtained. It is important to know the inductance range of the width or linearity coil but, if this is not known, one can get the right replacement by looking up the set's flyback transformer in the catalogue to see what width coil or linearity coil is recommended for use with the transformer.

In replacing defective yokes and width and linearity coils, careful soldering is important. Make sure that there is no chance for arc-over and that the coil wires do not get damaged. Polarity of the yoke connections is quite important since otherwise a picture may be backwards or upside down. Be sure to check which are the horizontal and which the vertical coils and whether the damping resistors and the capacitor in the horizontal section are soldered neatly into the correct terminals at the deflection yoke.

Focus coil replacements are rare, but standard coils are available from most parts distributors. To make certain of getting the right replacement, the picture tube type number can be checked in a tube handbook, where the focusing power and coil type is given. Most TV sets use EIA standard focus coils, like the one shown in Fig. 8.

Vertical Transformers

In the vertical sweep section of many TV sets, there may be two transformers. The smaller one is the vertical blocking-oscillator transformer and the larger one is the vertical-output transformer. These parts, intended for 60-cps operation, are both rugged and reliable: they will fail only in very rare cases. A typical unit of open-frame construction is shown in Fig. 3. When the blocking-oscillator transformer becomes defective, it can almost invariably be replaced by a standard part, although physical appearance may vary.

The vertical-output transformer is a different problem. Although certain widely used standard types are available from stock, a few set manufacturers use special units. To find out whether a particular output transformer serves as a correct replacement, check the schematic of another set to see what type of output tube is used with the transformer and what the deflection-yoke inductance should be. Do not replace a two-winding transformer with an autotransformer or *vice versa* nor can the same unit normally be used with a triode (such as the 6S4) that works with a pentode (such as the 6V6). Physical dimensions are also important since the chassis space is usually limited and the leads to the vertical-output transformer can cause audio buzz, poor interlace, and even poor vertical hold, if they run too close

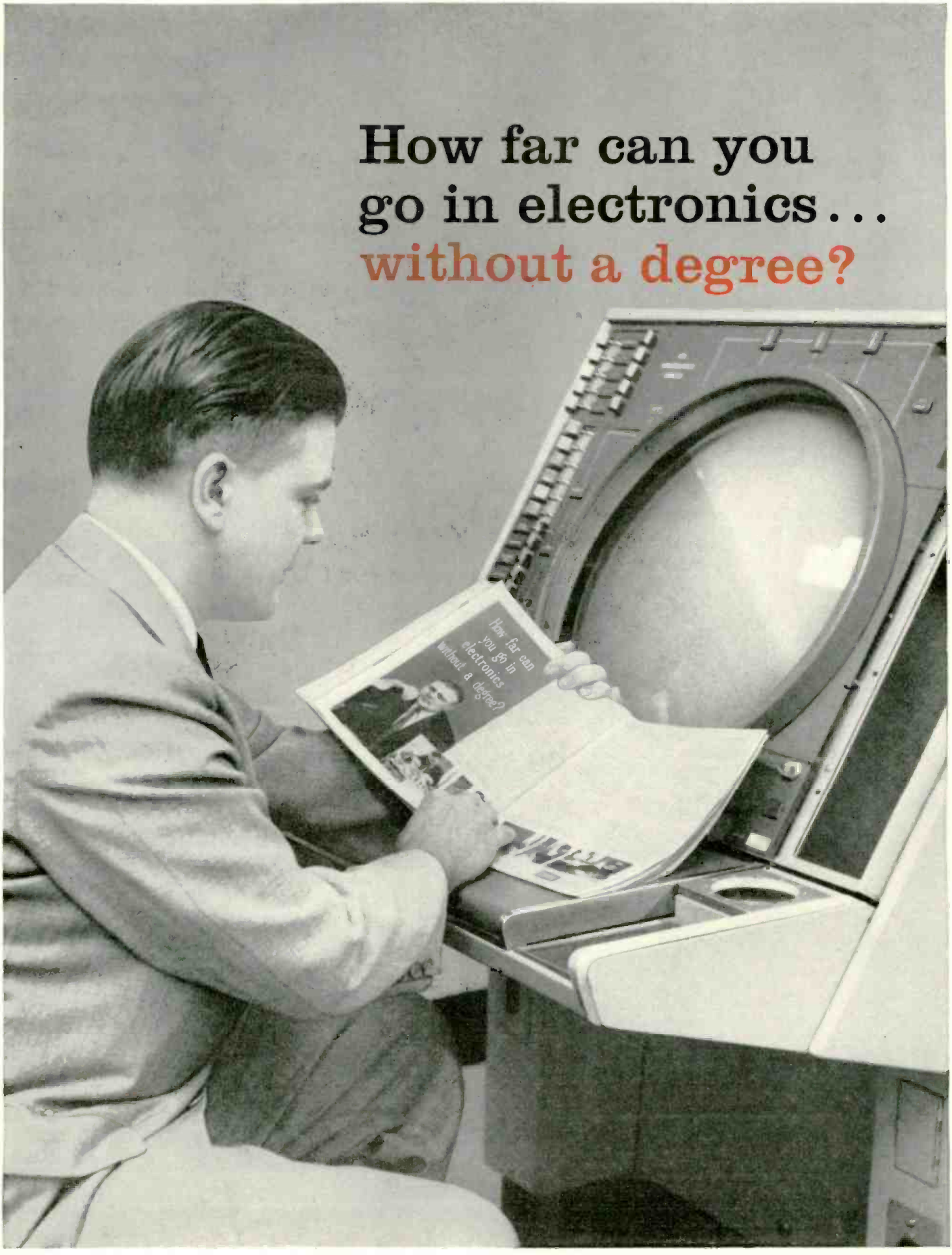
to certain other sections of the set.

Other Transformers

The replacement of audio transformers in TV receivers is the same as in AM, FM, and hi-fi equipment. Since most TV receivers use low-priced audio components, standard replacement parts are almost always available. Audio transformers are such widely used items that they are catalogued by their characteristics rather than by the model of a TV set in which they are used. The important characteristics are the plate impedance, the speaker impedance, and the d.c. they will carry. It is a safe general rule to assume about 4000 ohms for 6V6 tubes and about twice that for 6K6's. Loudspeakers in TV sets most frequently have 3 or 4 ohms impedance and the d.c. will depend on the tube type. If either the tube or speaker impedance is in doubt, a "universal" transformer can be used. These transformers have a number of taps to provide several combinations.

Power transformers for TV receivers come in a great variety of voltage and current combinations, physical dimensions, and mounting arrangements. Many of these are not available from jobbers' stocks. It is often possible to get a "universal" transformer that has characteristics similar enough to the defective one, but unless one is prepared to invest additional time and parts in modifying the set, it is best to stick to an exact replacement. A typical example of this is where all voltages and currents are the same, except that the replacement transformer has an extra filament winding for a 5V4 and 220-volt taps on the main secondary. If these windings are not used and the power drawn in the other windings is as the specifications state, the actual "B+" and filament voltages will, nevertheless, be higher since the loading of the extra windings is missing. The effects of higher "B+" voltage may include early breakdown of some components. The correct remedy would be to shunt a suitable power resistor across the unused windings. This not only entails the selection and cost of the resistor, but the extra heat generated will hardly contribute to the receiver's reliability. It is true that many TV sets use power transformers which are either identical or practically so with replacement parts available from parts distributors. In such an instance it would be wise to check with the local jobber first before sending off an order to the manufacturer.

Filter chokes become defective only rarely and, in practically all instances, they can be replaced by parts from jobbers' stocks. If the exact inductance and d.c. rating are not available, a slightly higher value can be used, even if this means drilling new mounting holes. The one parameter which should not be varied by more than 10% is the choke's d.c. resistance because this would either lower or raise the "B+" in the set. In general, there is no problem in obtaining a filter choke with adequate characteristics. —30—



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The advertisements point out the dangers and complications of do-it-yourself TV repairs. Lively sketches and provocative headings—"TV Tinker-Aches," "He Didn't Know The Set Was Loaded," "Sufferin' TV Sets," and "Don't Shoot That Tired TV"—all serve to attract the attention of TV owners and drive the point home.

The service technician merely adds his name, address, and phone number at the bottom and the advertisements, 1 column by 5 inches in size, are ready to run.

SMALL BUSINESS HANDBOOK

Dun & Bradstreet, Inc., Business Publications Div., 99 Church St., New York 8, N. Y., has prepared a handbook entitled, "How to Control Accounts Receivable for Greater Profits," at a cost of $1.00 per copy.

Of great interest to small business owners, the booklet covers such topics as "Credit Risk Categories," "Setting Up an Effective Accounts-Receivable File," "Computation Tables," "What Collection Action Should Be Taken," "How Long Should the Average Collection Period Be?," and "Sources of Model Collection Letters," among many other informative chapters.

The handbook also includes tables for determining the average collection period for 58 different lines of business.

RECEIVING TUBES

General Electric Company, Receiving Tube Dept., Owensboro, Kentucky, has issued a revised edition of the booklet (ETR-1541) describing the concept and manufacturing techniques of "Service-Designed" receiving tubes.

The new booklet includes detailed descriptions of construction changes in the 1J3, 6/19AU4-GTA, 6AX4-GTB, and 17AX4-GT. Write to the company at the above address for further details.

"TIPS FOR THE SERVICEMAN"

Chicago Standard Transformer Corporation now has available the first issue of "Tips for the Serviceman," to be published periodically for the radio and television service industry. The publication is available without charge from the company's distributors. The first issue covers "Simplifying Flyback Transformer Servicing," and gives detailed pointers on the horizontal output circuit.

The publication, prepared by the firm's engineering department with Milton S. Kiver, will be issued about four times a year. The standing title of the publication is "Stan Cor's Corner" and is designed to simplify the service technician's problems with regard to transformers. It is fully illustrated with photos and diagrams.

SECO LINE

Seco Manufacturing Company, 5015 Penn Avenue South, Minneapolis, Minnesota, is offering a compact folder which describes the firm's complete line of test equipment and service aids. Free copies are available by writing to the firm.

The brochure provides information on a grid-circuit tube tester, in-circuit current checker, vacuum-tube voltmeter, battery eliminator, flyback circuit and inductance analyzer, and a portable tube tester.

ULTRASONICS PUBLICATION

Acoustica Associates, Inc., 26 Windsor Avenue, Mineola, Long Island, N. Y., is offering a new magazine entitled "Ultrasoundings." It is published quarterly and is available free by writing to the company.

The publication contains information of general interest in the ultrasonics field as well as data about applications of ultrasonics by industry, service organizations, medical establishments, and the military.

NEW CATALOGUE SHEET

International Resistance Company, 401 North Broad Street, Philadelphia 8, Penna., has a new catalogue sheet describing the firm's "Handy-Pak" line and various package deals.

Known as Catalogue DC7, the leaflet also describes the company's "Resist-O-Caddy," "Resist-O-Pedia," and "Resist-O-Chest," and carries the dealer's net price on the various assortments.

RCA RECEIVING TUBE MANUAL

RCA Electron Tube Division, Commercial Engineering, Harrison, N. J., has made available its new revised edition of the *"RCA* Receiving Tube Manual." This new manual (RC-19) can be obtained from the firm's tube distributors or direct from the company at the above address. The price from the company is 75 cents.

Some of the highlights of the book's contents include: technical data for more than 625 receiving tubes, covering types for black-and-white and color

TV and series-string applications and more than 95 TV picture tubes, including color types; an easy-to-understand section on basic tube theory and application; and an expanded section on electron tube applications with a description of tone control circuits for hi-fi audio amplifiers and high-voltage regulator circuits for TV horizontal deflections systems. Other portions of the Manual contain information on generic tube types, interpretation of tube data, and electron-tube installation.

Charts for receiving tube classifications and picture tube characteristics have been revised to include the latest data and the circuits section at the rear of the book shows diagrams for an intercom, hi-fi audio amplifiers, an audio control unit, and two complete hi-fi amplifiers having outputs of ten and thirty-five watts.

NEW EIA BOOKLET

EIA Marketing Data Department, 1721 DeSales St., N. W., Washington 6, D. C., is offering a booklet called Buying Index of Distributors—abbreviated BID. The booklet is available to manufacturers from William F. E. Long, Manager of the Marketing Data Dept. at the above-mentioned address. It is emphasized that companies need not be members of the Association in order to obtain copies.

The brochure furnishes a semi-annual barometer, by county, showing over-all sales indices, sales indices by product, and marketing indices by class of business.

The Association has established a new market research service for manufacturers who sell through electronic parts and sound distributors. The service is contained in this new booklet.

1959 SUPREME SUPPLEMENT

Supreme Publications, 1760 Balsam Road, Highland Park, Illinois, has published the 1959 Supplement to its Master Index. It is priced at five cents, postpaid. The 48-page 1958 Master Index is priced at twenty-five cents.

This six-page supplement brings the existing Index up-to-date to include the listings of all available radio and television manuals.

The manuals are also available at all leading parts jobbers.

TRANSISTOR GUIDE

Sylvania Electric Products Inc., 1100 Main St., Buffalo, N. Y., has announced publication of the second edition of its "Transistor Characteristics and Interchangeability Guide." Copies may be obtained directly from the company.

The new booklet lists the characteristics and ratings of a wide variety of transistors and, in addition, contains a substitution chart and guide to manufacturers for close to 700 popular types. The 20-page brochure includes a glossary of transistor parameter symbols as well as definitions and mechanical specifications and connections for the company's complete line of junction transistors. —30—

New Color TV Design Makes Its Debut

Single-gun "Andromeda" CRT and associated design may pave way to reliable operation at lower cost.

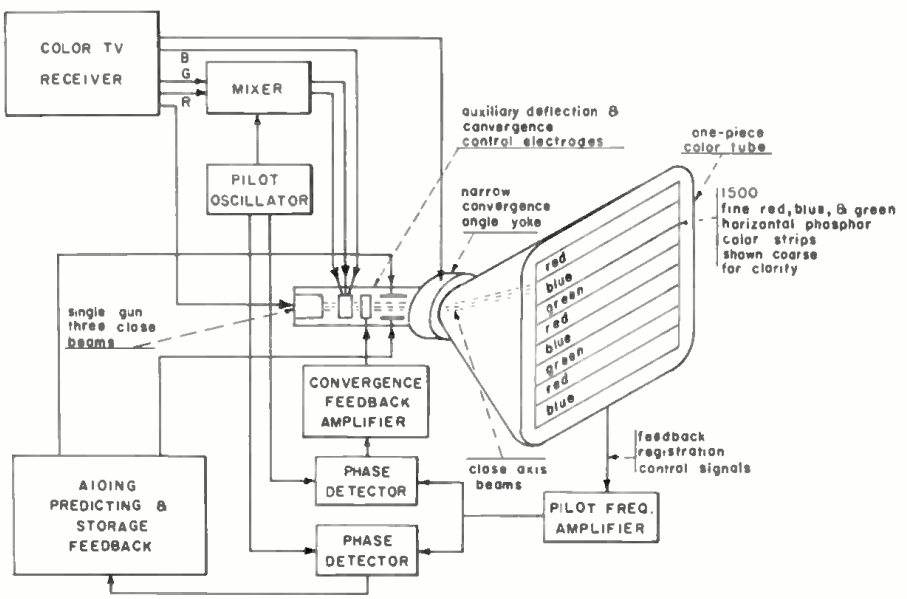
WITH PATENTS already issued and assigned to it, *Andromeda, Inc.* of Kensington, Md. has its engineers busily working toward an early public demonstration of a new color CRT and its associated receiver. As with previously proposed systems, the proponents feel that this one may provide the break-through to mass puhlic acceptance of color television. Advantages claimed include full compatibility with standard, presently transmitted color signals, improved reception quality and receiver reliability, reduced service requirements, and a sizable reduction ("at least 30 per-cent") in the cost of the set. If these claims can be realized, color TV for $350 or less should be the result.

Heart of the system is a one-piece color CRT with a single electron gun. However, the gun will simultaneously emit three electron beams so closely spaced as to minimize convergence and registration problems. Color phosphors are deposited on the back of the CRT screen in the form of 1500 fine horizontal strips: red, blue, and, green. Between the gun and the faceplate there is no intervening physical element for beam control, such as a shadow mask or wire-grid element. Positioning and coordination of the three beams is obtained electronically with circuits that operate auxiliary convergence and control electrodes in the CRT. This technique is said to provide improved resolution and brightness output together with high reliability.

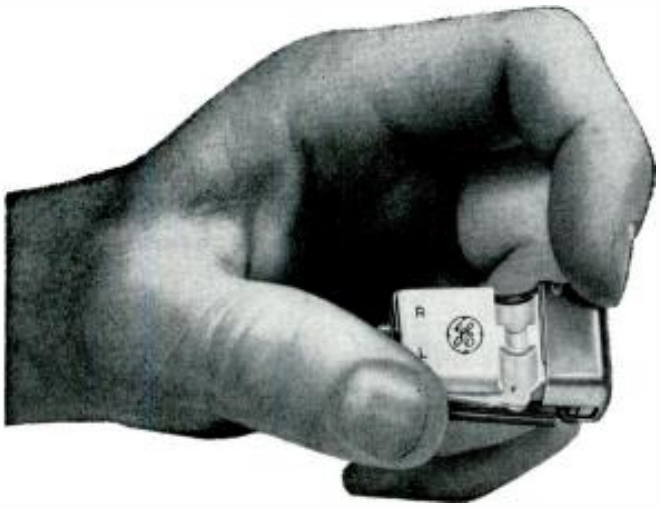
The one-piece, non-critical CRT can be made economically, the designers state, as can the deflection yoke, which should be similar to its monochrome counterpart. Green and red beams are modulated by a weak, 10-mc. pilot carrier, used in a non-critical manner. This signal is applied to each beam in a different phase. Pilot-frequency output is reported to be so low that no interference prohlems occur. Errors in registration are monitored and detected by a feedback network said to be similar to such circuits used in radar design. Resultant correction signals are used to maintain beam alignment within close tolerances through the entire raster area. Standard, low-cost components may be used in the supplementary corrective circuitry required by this system. Whatever additional cost this requirement entails, proponents feel, is more than offset by the elimination of the more elaborate circuit needs of other systems, by cost reductions possible in the use of a relatively simple, one-piece, non-critical CRT, and by less stringent requirements for associated circuits and components, many of which will be no more elaborate than those generally found in black-and-white TV receivers. The absence of beam-obstructing devices permits good brightness output.

A final, specific design for the entire circuit of the supporting receiver does not appear to have been selected yet. However, *Andromeda* president, Arnold Lesti, reports tests have proved the basic principles to be sound. The functional block diagram illustrated here will apply in any case. Until now, experimentation has been conducted with a few specially built tubes. The CRT is not in mass production. It is hoped that a completed, operative color receiver incorporating this tube and system will be ready for demonstration in a few months. —30—

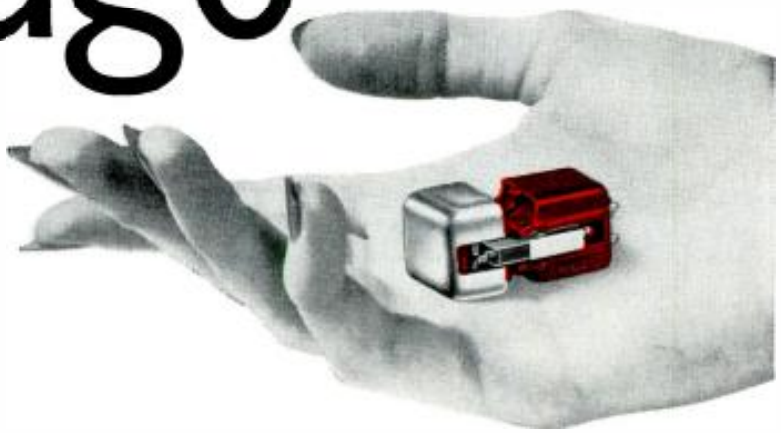
This block diagram of the receiver emphasizes distinctive operating features.



the all-new VR-22 stereo cartridge



VR-225 .5 mil diamond stylus. For professional-type tone arms, **$27.95.**



VR-227 .7 mil diamond stylus. For record changer or turntable, **$24.95.**

Now, outstanding in all four critical areas of stereo cartridge performance—**Compliance**—Tracks precisely, not a trace of stiffness. **Channel Separation**—Up to 30 db for maximum stereo effect. Nothing higher on the market! **Response**—Smooth and flat for superior sound from 20 to 20,000 cycles (VR-225), 20 to 17,000 cycles (VR-227). **Virtually hum-free**—triple shielded against stray currents. **This is our masterpiece. We urge you to hear it.**

GENERAL ELECTRIC

Audio Components Section, Auburn, N. Y.

Is the Name Right?

(Continued from page 45)

names would be necessary to identify each of these shops individually. Every city has its full share of general names such as AA Aba Daba TV (angling for the top spot in the television service classified listings), Advanced, Quality, Alert, Guaranteed, Fidelity, Reliable, Bonded, etc. Occasionally one will run across a simple, forceful listing such as "John Jones—Radio-TV Service Engineer"—and, in following it up, find a very successful service business. Normally, everything about such a business reflects forceful individuality. The business front is strikingly efficient in appearance; stationery, service orders, bill heads, and advertising material all leave the impression of competence and trustworthiness. The entire atmosphere of the business inspires confidence but, at the same time, leaves the impression that the business does not sell its service and facilities cheap.

As an industry, independent electronic service shops face the stupendous task of weaving a foundation for better customer relations from the ground up among a majority of the shops now honestly engaged in the business. The word "stupendous" was purposely selected in the previous sentence to indicate that, in addition to its being an economic obligation, this task also presents an amazing opportunity to the men who are interested in building a strong, independent industry in service.

One of the first steps that must be taken to capture public respect and confidence for service as an industry, is to adopt some figure or slogan as a means of identifying competent, trustworthy service shops. The second thing that must be accomplished is the development of an "appearance personality" for electronic service businesses.

One of the most interesting developments in our industry during recent years was the adoption of the name, Better Electronic Service Technicians, for the electronic service association of Arizona. With affiliated groups in most Arizona cities, the promotion of the name BEST by the individual member shops is doing much to put a solid foundation under independent service in the Sunset State.

While past efforts to interest service dealers in adopting a simple name and distinctive character were not successful, it is quite possible that a maturing service industry will eventually subscribe to one or more of such services aimed at identifying competent, reliable service shops. To be successful, such identifying symbols must be both striking and easy to remember. They must say to the public mind, "I will take the responsibility for giving you good electronic service at fair prices." That is all the average customer wants to know when he must spend money for service. —30—

Sound on Tape

By BERT WHYTE

AFTER last month's "big news," there isn't very much to report in the tape world. We are sort of in an interim period awaiting official pronouncements on the adoption of a 7.5-ips, 4-channel stereo tape proposal. But while officialdom mulls things over, there is no lack of activity. Those few companies who have 4-channel duplication systems are having them modified to the proper equalization curve and otherwise put into shape.

Several friends of mine, whose critical capacities I know to be good, have heard some of the very first samples of the 7.5-ips, 4-channel tapes. Reactions? All favorable! They reported that, in terms of frequency response, dynamic range, and low distortion, the new tapes compare favorably with the best of the old standard. Signal-to-noise ratio is reported as about the same, with even a possible improvement in the offing when the equalization is optimum for a given tape emulsion. Among tape *afficionados* I have talked to about the proposed new standards I have had nothing but expressions of satisfaction coupled with an almost feverish desire to have the tapes appear commercially. So, friends, the wheels are moving . . . we will just have to be patient a little while longer.

I want to steer some folks right who have been writing to me about the note I had in my April column regarding a Japanese condenser mike. The story I was given was that this mike would give *Telefunken*-like specs at a price of "under $90." Unfortunately, for those who would have snapped at such an item, the story was a bit garbled. The mike turned out to be the *Sony* which is comparable to *Telefunken* all right—and why not—since the asking price is $365 (gasp!).

Since, evidently, a number of the readers of this column are very much interested in obtaining for use with their tape recorders a high-quality microphone at a price of around the ninety-dollar figure, I have some suggestions that may prove to be of some assistance.

There are several suitable microphones, some imported and some manufactured in this country, that should certainly do a good job. Some of these are ribbon types and others are dynamics with flat recording curves as well as high gain. One thing I can assure any home recordist . . . you may own a modest tape recorder of non-professional specifications, but you would be surprised just how fine a sound can be recorded on these units providing you utilize a really good microphone.

DAVE MACKAY PLAYS PROGRESSIVE

Dave Mackay, piano; Cliff Gunn, bass; Don Mackay, drums. SterOcraft TN104. Price $8.95.

Since we are getting into those hot summer days, you might want to hear some real "cool" music. Well, man, this is for you—maybe! This Mackay boy is out . . . way, way out and caresses the piano in the approved progressive manner. You know the kind of stuff I mean . . . he plays a number like "It Don't Mean a Thing" . . . and, if you are real lucky through all the runs and embellishments, you just might get to hear the melodic line.

For those as likes, this boy has talent and applies himself lustily to half a dozen other numbers. Very directional stereo, recorded quite close —but clean and good of its type.

TOCCATAS FOR ORGAN

Robert Owen playing the organ of Christ Church in Bronxville. Sonotape stereo SWB8004. Price $9.95.

Inasmuch as vacation time is here and many of you will be taking advantage of this hiatus to put together a new sound system or revamp your old one, here is a tape which can tell you better, quicker, and more pleasantly how good your bass response is. This is, without question, some of the most shuddery, grandiose bass to be found on stereo tape. The tape is quite old, but don't let that stop you.

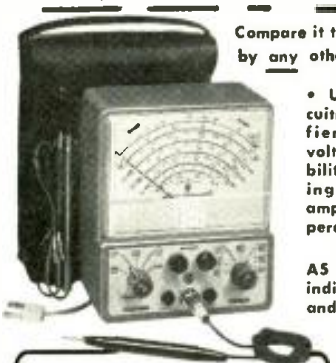
Owen does a fine job of coping with such florid numbers as Widor's "Toccata" from his Fifth Symphony, the famous Mulet "Toccata," and the Boellman "Suite Gothique." There is everything on this tape from 100 cycles down to solid 20- and 30-cycle stuff of tremendous power. If your Monster is really big, there is enough pedal here to rock the house on its foundations.

That cleans up my backlog of review tapes but I hope that by the time next month rolls around the late summer-early fall releases will have started to trickle in and that I will have plenty of goodies to offer. —30—

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER



Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

• Uses new improved SICO printed circuitry. • Employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability • Meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS value if sine wave, and peak-to-peak value if complex wove. Pedestal voltages that determine the "black" level in TV receivers are easily read.

Model 77—Vacuum Tube Voltmeter
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SPECIFICATIONS

• **DC VOLTS** — 0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)** — 0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)** — 0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER** — 0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS** —10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER** — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Complete with operating instructions, probe, leads, and case. 110-120 volt 60 cycle. Only $42.50

SUPERIOR'S NEW MODEL TV-50A

GENOMETER

7 Signal Generators in One!

- R.F. Signal Generator for A.M.
- R.F. Signal Generator for F.M.
- Audio Frequency Generator
- Marker Generator
- Bar Generator
- Color Dot Pattern Generator
- Cross Hatch Generator

This Versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

- A.M. RADIO • BLACK AND WHITE TV
- F.M. RADIO • COLOR TV
- AMPLIFIERS

Model TV-50A—Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: 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.)

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

The Model TV-50A comes complete with shielded leads and operating instructions. Only $47.50

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE ONLY 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES ALL THE FOLLOWING FEATURES:

- 6 INCH FULL-VIEW METER provides large easy-to-read calibrations. No squinting or guessing. when you use Model 80.
- MIRRORED SCALE permits fine accurate measurements where fractional readings are important.
- CAPACITY RANGES permit you to accurately measure all condensers from .0025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges.
- HANDSOME SADDLE-STITCHED CARRYING CASE included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

Model 80—Allmeter
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SPECIFICATIONS:

7 D.C. VOLTAGE RANGES
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.
6 A.C. VOLTAGE RANGES:
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts.
3 RESISTANCE RANGES:
0 to 2,000/200,000 Ohms. 0-20 Megohms.
2 CAPACITY RANGES:
.00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES:
— 6 db to + 18 db, + 14 db to + 38 db
+ 34 db to + 58 db

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

FEATURES:

• A built-in Isolation Transformer automatically isolates the Model 80 from the power line when capacity service is in use.

• Selected, 1% zero temperature coefficient metalized resistors are used as multipliers to assure unchanging accurate readings on all ranges.

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only $42.50

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL-VIEW METER

A Combination
VOLT-OHM MILLIAMMETER
Plus
CAPACITY, REACTANCE, INDUCTANCE, AND DECIBEL MEASUREMENTS
Also Tests
SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES.

Model 79—Super Meter
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SPECIFICATIONS:

• **D.C. VOLTS:** 0 to 7.5/15/75/150/750/1.500. • **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 • **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes • **RESISTANCE:** 0 to 1,000/100,000 Ohms, 0 to 10 Megohms. • **CAPACITY:** .001 to 1 Mfd., 1 to 50 Mfd. • **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. • **INDUCTANCE:** .15 to 7 Henries, 7 to 7,000 Henries. • **DECIBELS:** —6 to +18, +14 to +38, +34 to +58.

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.
All Selenium Rectifiers.
All Silicon Rectifiers.
All Germanium Diodes.
All Silicon Diodes.

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

Model 79 comes complete with operating instructions, test leads, and steamlined carrying case. Use it on the bench—use it on calls. Only .. $38.50

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

SUPERIOR'S NEW MODEL TW-11

STANDARD PROFESSIONAL TUBE TESTER

Model TW-11—Tube Tester
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

★ Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, 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 TW-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TW-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. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES: Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover. **$47.50**

SUPERIOR'S NEW MODEL 82A

Multi-Socket Type TUBE TESTER

Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

TEST ANY TUBE IN 10 SECONDS FLAT!

1. Turn the filament selector switch to position specified.
2. Insert tube into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

THAT'S ALL! ***Read emission quality direct on bad-good meter scale.***

SPECIFICATIONS

- Tests over 600 tube types
- Tests OZ4 and other gas-filled tubes
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence
- Dual Scale meter permits testing of low current tubes
- 7 and 9 pin straighteners mounted on panel
- All sections of multi-element tubes tested simultaneously
  Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more — and as proof, we offer to ship it on our examine before you buy policy.

To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch — THAT'S ALL!. Read quality on meter. Inter-element leakage if any indicates automatically.

Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only **$36.50**

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

TESTS AND REJUVENATES ALL PICTURE TUBES

Model 83—C.R.T. Tube Tester
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

ALL BLACK AND WHITE TUBES
From 50 degree to 110 degree types —from 8" to 30" types.

- Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
- Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.
- Model 83 employs a 4" air-damped meter with quality and calibrated scales.
- Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

ALL COLOR TUBES
Test ALL picture tubes—in the carton—out of the carton—in the set!

- Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
- Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

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The "Ins" and "Outs" of Resistor Pads

By BOB ELDRIDGE

These ever-present matching and attenuating networks are often taken too much for granted in service and other electronic work.

A PAD is a network of resistors. It's as simple as that. The neat little device at the end of the output cable of your signal generator or other item of test equipment is quite likely to be a pad, perhaps with the addition of a coupling capacitor.

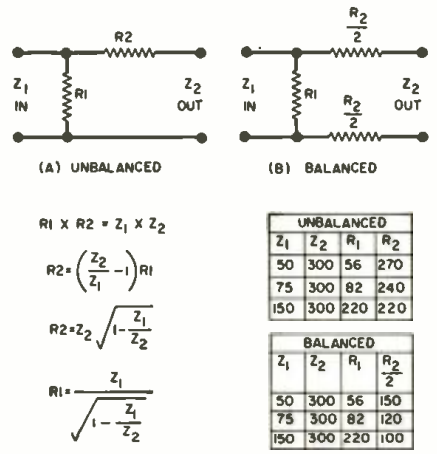
Little information on these devices appears nowadays, perhaps because they are taken for granted. As a result, this means that a number of people do not know as much about pads as they should. Learning the why's and wherefore's of these handy devices not only enables the technician to service and work with his own equipment in which they are used, but also to make up useful pads for many special purposes.

There are two main uses for resistive pads. They can be used to cut down a signal that is too strong for the circuit to which it will be applied (attenuator pads) or for the purpose of connecting together two circuits that present different impedances to each other (matching pads). Sometimes, both uses are desired at the same time.

Where a pad is used to provide impedance match, there is always some incidental loss of power, with the extent of this loss increasing as the difference between the two impedances to be matched increases. For this reason, some device other than the pad will be used to obtain matching in situations where the loss cannot be tolerated. Take the case where a 75-ohm transmission line must be matched to the 300-ohm input of a TV receiver in a weak-signal location. Here some sort of matching transformer, which is more efficient, will be used. Where available signal is more than adequate, of course, the simpler and cheaper resistive network can do the job.

The "L" Pad

The networks and formulas shown in Fig. 1, used primarily for impedance-matching problems, are known in telephone work as "minimum-loss" pads, since they are used to connect circuits of different impedances while introducing the least loss of signal that can be achieved without transformers. As with most pads, we have two versions: the unbalanced and balanced types. The former is used where one conductor is grounded, as where coaxial cable is involved. The balanced type comes in where both terminals of the circuit are equally disposed with respect to ground potential, as is the case with the antenna inputs of most modern TV receivers, for example.



UNBALANCED			
Z_1	Z_2	R_1	R_2
50	300	56	270
75	300	82	240
150	300	220	220

BALANCED			
Z_1	Z_2	R_1	$\frac{R_2}{2}$
50	300	56	150
75	300	82	120
150	300	220	100

Fig. 1. Matching "L" pads, with formulas used for obtaining resistances.

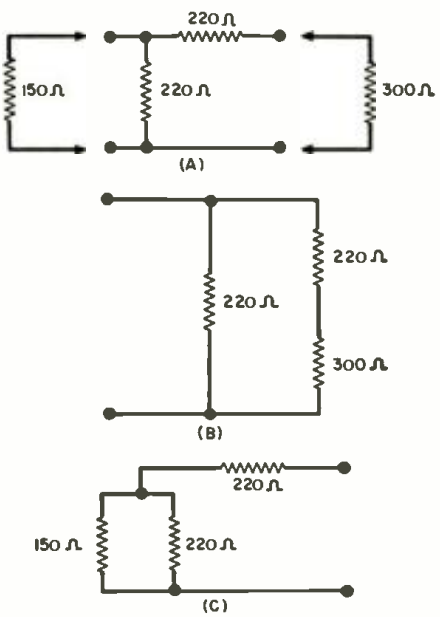
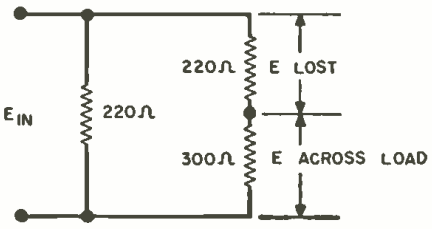


Fig. 2. (A) "L" pad with loads to be matched. (B, C) What each end of pad sees looking at opposite, loaded end.

Fig. 3. Although used for matching, the resistor pad must introduce loss.



You will note that, in the balanced version of the "L" pad (Fig. 1B), the series resistors have been designated as $R_2/2$. This has been done to emphasize the fact that they are equal in value and that each is just half of the single series resistor used in the corresponding unbalanced pad. Thus the same set of formulas can be used for working out problems involving either version of this pad. The balanced version of the "L" pad is sometimes called a "U" pad.

With the four formulas shown, it is possible to determine the values of resistors for transforming from any impedance to any other. The accompanying tables in Fig. 1 have been worked out to show actual examples when transforming from three different commonly encountered impedances to the ever-present 300 ohms. Resistance values given are of the nearest standard-value units, rather than of the exact values determined by formula. To start with, one of the last two formulas shown would have to be used to determine the value of either R_1 or R_2.

Looking into "L" Pads

Straight mathematical formulas are unwelcome to many technicians. It is perhaps of greater meaning to study the "L" pad as a network of series and parallel paths to see what happens to it. In Fig. 2A, we see a specific pad designed to match 150 ohms to 300 ohms. First we "look into" the pad from the 150-ohm side to take note of what this source impedance "sees." As shown in Fig. 2B, it sees a 220-ohm resistor in parallel with 520 ohms. The latter is made up of a 220-ohm resistor plus the connected 300-ohm load in series with it. A quick calculation (or an ohmmeter measurement, if you don't like math) shows that this network comes to 155 ohms connected across the 150-ohm source. The insignificant discrepancy of 5 ohms is due to the fact that we have used standard-value resistors instead of the theoretically calculated values.

Now we look into the pad from the other end, taking note of what the 300-ohm end sees (Fig. 2C) with the 150-ohm source connected. First, there is the 150-ohm source in parallel with a 220-ohm resistor. This comes to 89 ohms. In series with this value is another 220 ohms, for a total value of

309 ohms—quite close to the theoretically ideal 300 ohms.

In the manner shown, you can redraw any pad in terms of fairly simple series and parallel networks. Always remember to include in the network the impedance of the load at the end opposite from the one you are looking into.

As to the matter of efficiency, the "L" pad has been drawn in yet another way in Fig. 3. While this resembles the version shown in Fig. 2B, voltage distribution has been indicated to show why loss is inevitable. The load is part of a voltage divider. Thus the resistor in series with it will always absorb some part of the energy applied through the pad.

Note that, whatever the direction in which the transfer of energy through the pad is to be, the lower impedance is always considered Z_1 and the higher Z_2 for the purpose of the formula.

Some Uses of the "L" Pad

One of the most familiar applications of the "L" pad in TV service, already noted, is as the terminating device for the output cable of a signal or sweep generator. The coaxial output cable is usually matched to a 50- or 75-ohm output which, if connected directly to the 300-ohm input of a TV set or FM tuner, can produce standing waves often serious enough to distort the response curve so badly that alignment is impossible. Simply gripping the output cable or changing its position under these conditions can alter the shape and amplitude of response on the scope, or other indicating instrument. The simple little device at the end of the cable is a matching "L" pad that eliminates these problems.

Less obvious to the service technician, but also handy, is the use of an "L" pad to match the output of a phonograph cartridge, such as some of the new ceramic cartridges for which the manufacturer recommends a specific load impedance for optimum response, to an existing circuit. In Fig. 4, a cartridge with a recommended load of 110,000 ohms is to be connected to an amplifier stage whose input consists of a 1-megohm volume control. With the two added resistors as shown, the cartridge sees slightly over 110,000 ohms.

The pad is particularly useful in those cases where the output of a piezoelectric cartridge is to be fed into a low-level preamplifier stage intended to accept the output of a magnetic cartridge. To prevent overloading of the preamplifier, or of succeeding stages, output of the higher-output pickup can be cut down to the proper value by increasing the size of the resistor in series with the input of the preamp.

Symmetry vs Balance

All "L" pads are asymmetrical networks. That is to say, the input and output impedances are not equal. There is some tendency to confuse the concept of symmetry with that of balance. Symmetry pertains to impedances, whereas balance pertains only to the relationship of the pad's terminals to ground. Thus, the pad shown in Fig. 1B may be referred to as a *balanced asymmetrical network.*

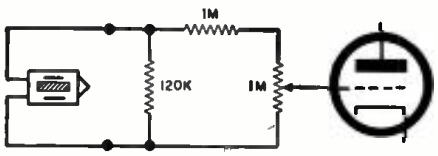


Fig. 4. A pad can provide proper phono cartridge load with an existing input.

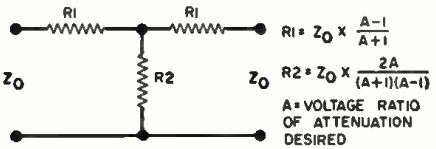


Fig. 5. The "T" pad provides specific attenuation without an impedance change.

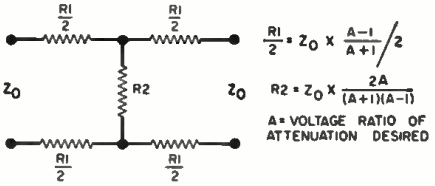


Fig. 6. The "H" pad is the balanced version of the symmetrical "T" pad.

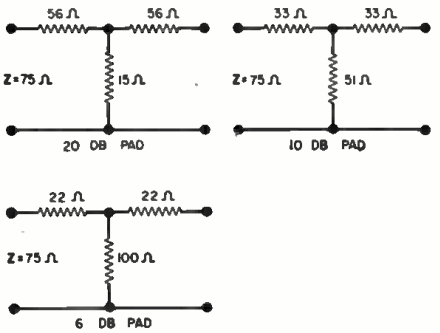


Fig. 7. "T" pads providing 3 steps of attenuation for fixed 75-ohm impedance.

Table 1. Factors for obtaining values for common loss figures, any impedance.

Attenuation in db	Factor for R_1	Factor for R_2
6	.3323	1.3389
10	.5195	.7027
12	.5985	.5362
18	.7764	.2558
20	.8182	.2020
24	.8813	.1267

"T" and "H" Pads

Sometimes we have two circuits with matching impedances, but we wish to attenuate the signal being transferred from one to the other without an impedance transformation. Most commonly used for such a purpose is the "T" pad shown in Fig. 5. This is an unbalanced, symmetrical network. When a balanced line is needed, another version of this type of network, the "H" pad shown in Fig. 6, is used. This is a balanced, symmetrical network. Because of the symmetry, we have only one impedance to deal with here, and we call it the characteristic impedance, Z_o.

To calculate the values of resistors for a pad of this type, we need only two factors: the characteristic impedance already mentioned and the degree of attenuation desired. In the formulas shown, the degree of attenuation is stated as the ratio between the original voltage level and voltage level to which the original is to be reduced. The formulas are the same for Figs. 5 and 6 except, of course, that an adjustment has been made in the case of the balanced pad of Fig. 6 because R_1 will have to be split into two equal parts, one for each leg.

Fig. 7 shows some actual "T" pads that have been worked out for an unbalanced line of 75 ohms impedance. Again, resistors chosen are to the nearest available values, based on the formulas of Fig. 5. 20-db, 10-db, and 6-db pads are shown. These provide, respectively, for voltage reductions of 10 times (that is, 1/10th the original voltage), 3 times (1/3rd voltage), and 2 times (reduction to ½). Using the formulas for Fig. 6, balanced "H" pads for similar voltage reductions have been worked out for 300-ohm networks in Fig. 8.

The fact that attenuation is most often stated in terms of decibels, rather than as a straight ratio between the original and reduced voltage, complicates the matter. There is a formula for computing resistance values directly from db, but it's more cumbersome than most technicians will wish to use. A table showing decibels with

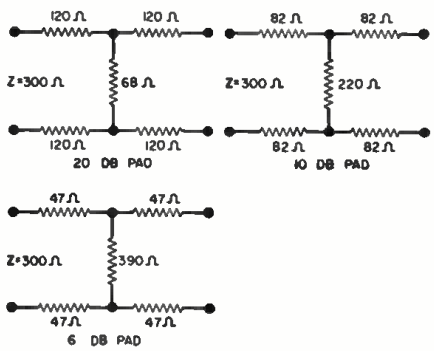
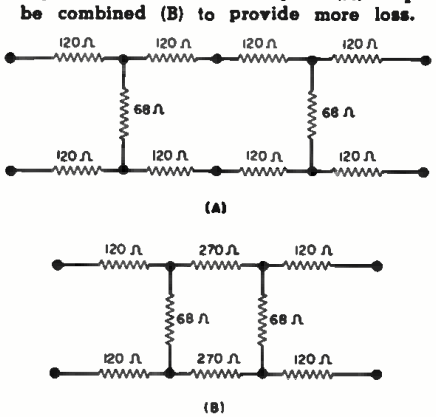


Fig. 8. "H" pads providing 3 steps of attenuation for fixed 300-ohm impedance.

Fig. 9. How 2 attenuator pads (A) may be combined (B) to provide more loss.



corresponding voltage ratios may be used to convert for application of the relatively simple formulas shown. In lieu of this, a table of factors for attenuator networks may be used. Such a table, in abbreviated form, to show the factors for the most commonly used degrees of attenuation (in db) is given here as Table 1.

To use this table, simply determine how much attenuation in db is desired, and what the impedance of the network is. The values of R_1 and R_2 are then determined by multiplying the factors listed in their respective columns by the characteristic impedance. For example, suppose a 20-db pad is needed at 300 ohms impedance. R_1 would then be 300 ohms multiplied by .8182, or 245 ohms. R_2 is 300 ohms multiplied by .202, or 61 ohms. If an "H" pad is involved, R_1 is then broken into two equal resistors for either leg. To the nearest available values, these calculations correspond with the 20-db pad of Fig. 8, which was worked out from the formulas of Fig. 6.

In addition to these common attenuation steps, more complete tables of this kind appear in many technical manuals. Increased attenuation may also be worked out from Table 1.

If attenuation of more than 24 db is required, it becomes convenient to use two or more pads in series. For example, 36 db of loss can be achieved by connecting two 18-db pads in series, as shown in Fig. 9A. What makes this method particularly convenient is that series-leg resistors can be combined. The pad in Fig. 9B, for example, is electrically similar to that of Fig. 9A, with each pair of series 120-ohm resistors combined into a single 270-ohm unit—the nearest standard value.

Measuring Pad Impedance

Sometimes one is faced with the problem of having a "T" or "H" pad on hand but not knowing what the characteristic impedance is. Two quick measurements and a calculation will give the answer. Measurements are taken with an ohmmeter connected to one side of the unterminated pad. The first measurement is taken with the far end of the pad open. This impedance, Z_{oc}, is recorded. Then the far end of the pad is shorted and this new reading, Z_{sc} (impedance with shorted connection), is recorded. These two readings, Z_{oc} and Z_{sc}, are multiplied together. The square root of their product is the characteristic impedance of the pad; or, $Z_o = \sqrt{Z_{oc}Z_{sc}}$. As a matter of interest, this is the same formula used to find the characteristic impedance of a transmission line, readings being taken with an impedance meter.

Uses for "T" and "H" Pads

In service work, symmetrical pads of this type are most often used for reducing signal input to a TV receiver or amplifier, to prevent overloading and cross-modulation effects. When a sensitive receiver is used in a location with one or more very strong local stations and also some weaker distant

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ones, its a.g.c. system may not be able to cope with the stronger signals. An attenuator pad in the lead of the antenna for the local station (or a pad that can be switched in and out if there is just one lead) brings the stronger signal down to a workable level.

In a service shop where only one channel is available to any practical extent for checking out receivers, it is difficult to check on a.g.c. action or sync-circuit operation, or to adjust the sound portions of TV sets with air signal. A series of antenna pads can be very useful in simulating an adequate range of weak and strong signals, with only one good one available. A switched set of pads could be made up, but most often it will be found that two pads, say attenuating at 10 db and 20 db, each with antenna clips at one end and antenna terminals at the other, will provide adequate variety.

Where signal is adequate, pads can be worked out for feeding two or more sets on a single antenna with proper matching and adequate isolation from each other. —30—

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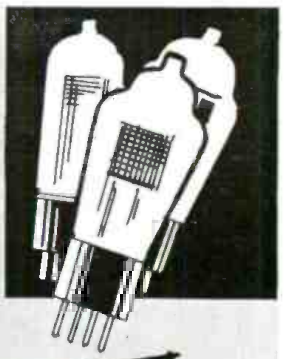

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1C7	3Q4	6AH4GT	6BE6	6CQ8	6SF7	7C4	12AV7	12V6GT	43
1F4	3S4	6AH6	6BF5	6CR6	6SG7	7C5	12AX4GT	12W6GT	45
1F5	3V4	6AK5	6BG6G	6CS6	6SH7	7C6	12AX7	12X4	50A5
1G4	4BQ7A	6AL5	6BH6	6CU5	6SJ7	7C7	12AZ7	14A7/12B7	50B5
1H5GT	4BS8	6AM8	6BJ6	6CU6	6SK7	7E5	12B4	14B6	50C5
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1R5	5AN8	6AQ7	6BN6	6DQ6	6T4	7F8	12BE6	19BG6G	58
1S5	5AT8	6AR5	6BQ6GT	6F5	6U8	7G7	12BF6	19J6	71A
1T4	5AV8	6AS5	6BQ7	6F6	6V6GT	7H7	12BH7	19T8	75
1U4	5AZ4	6AT6	6BR8	6H6	6W6GT	7N7	12BQ6	24A	76
1U5	5BR8	6AU4GT	6BS8	6J4	6X4	7Q7	12BR7	25Z6GT	77
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USED TV CONSOLES

GUARANTEED To Work When You Receive Them

10" & 12"	$29
14" & 16"	$37
17"	$45
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All sets shipped in two cartons to avoid breakage. Sets shipped express to continental U.S.A. and Canada only. F.O.B. Harrison, New Jersey.

FREE BONUS—RABBIT EARS

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Big Discounts Are Yours . . . Call or Write For Our 1000 Tube "Private Label" Special! Attention Branding Dept. MGR.

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Complying with Federal regulations, the following statement appears in all Tru-Vac advertising: Tubes appearing in this ad may be FACTORY SECONDS or USED tubes and are clearly marked.

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Visit Our Huge Testing Dept. In The Heart Of Harrison, N. J.'s Electronics Industry

"THE RADIO AMATEUR'S HANDBOOK" by ARRL Staff. Published by *The American Radio Relay League*, West Hartford. Conn. 584 pages plus tube data and catalogue sections. Price $3.50 in continental U. S., $4.00 in U. S. Possessions and Canada, $4.50 elsewhere. 36th Edition.

This most recent edition of the amateur's "bible" is a new and expanded version of a volume which has been the ham standby since 1926.

The sections on the theory of radio communications have been brought up-to-date and the material on equipment construction features new designs in all categories. Receiver circuits for both beginners and advanced hams are provided along with transmitters for every band and power level open to hams. The sections on sideband and radioteletype have been expanded while the theory and practice of mobile radio equipment receives comprehensive coverage, including the fundamentals of transistor power supplies.

The tube section, which is one of the most useful and comprehensive features of the Handbook, has been completely revised and brought up to date. As usual, the volume carries a large catalogue section featuring commercially built equipment of particular interest to the radio amateur.

* * *

"ELEMENTS OF RADIO" by Abraham Marcus & William Marcus. Published by *Prentice-Hall, Inc.*, Englewood Cliffs, N. J. 653 pages. Price $7.00. Fourth Edition.

Those of us who cut our "electronic teeth" on Marcus are a bit startled to realize that this venerable volume has been around since 1943 and is still going strong. A whole new generation of students and do-it-yourselfers can tackle basic radio theory *via* this up-to-date and attractively presented text.

The authors feel that since the equipment most familiar to the student is the receiver, any discussion of radio theory should start with such gear. After a brief discussion of the history of communications, wave motion, and light, heat, and radio waves, the text launches into an analysis of a simple crystal receiver. The discussion then progresses in orderly fashion to coverage of receiver circuitry and winds up with comprehensive analysis of the superhet and modern radio receivers.

The second part of the text covers electrical theory, transmitters, and more advanced aspects of radio. There is nothing particularly intimidating about this material and if the student has worked through the first section methodically and with comprehension there is no reason why the subject matter of the second part shouldn't be as easily assimilated.

Questions and problems are appended to each chapter and a complete program of classroom demonstrations is outlined at the end of the text. Data which the student will require is grouped together in an appendix for ready reference.

The text material is lavishly illustrated with line drawings, schematics, graphs, photographs, and other aids to understanding. In this reviewer's opinion this volume should be ideal for either classroom use or as a home-study text for the student "going-it-alone."

* * *

"MAN'S WORLD OF SOUND" by John R. Pierce & Edward E. David, Jr. Published by *Doubleday & Company, Inc.*, Garden City, N. Y. 278 pages. Price $5.00.

Serious students of sound and its reproduction will be fascinated by this treatment by two well-known *Bell Telephone Labs* engineers. Besides conveying a great deal of information on a vital subject, this volume could well serve as a model for engineers in writing for the layman. There is no condescension—implied or overt—but the subject comes through "loud and clear." Perhaps the informality of the first-person style contributes to the rapport between writers and reader, but we choose to believe that it is simply a case of the authors knowing how to write about technical subjects.

This is not a "hi-fi" book in the ordinary sense but covers the production and reception of sound—irrespective of source. Both human and mechanical sound sources are discussed, along with the "equipment" involved.

We believe that anyone—professional or lay—who is connected with sound in any way (which would seem to include all mankind) will find this text both instructive and enlightening. If you are looking for a guide to selecting hi-fi components for your home music system—this book is not for you, but if your sense of hearing is sophisticated and a constant source of delight—these two "guides" will prove exciting companions for an exploration of "Man's World of Sound."

* * *

"FUNDAMENTALS OF HIGH FIDELITY" by Herman Burstein. Published by *John F. Rider Publisher, Inc.*, New York. 131 pages. Price $2.95. Soft cover.

Although the author has written this book for the layman without technical knowledge of electronics and audio,

this is not just a glorified "catalogue" of equipment comprising a "hi-fi" system.

While commercial units are well represented in this lavishly illustrated text, the emphasis is on providing the reader with a fundamental understanding of the art. The text is divided into nine chapters which cover the contents of a hi-fi system; the meaning and significance of the decibel; frequency response, distortion, and noise; the original sound and the playback system; program sources and the listener; matching high-fidelity components; loudness compensation; equalization; and impedance.

A careful perusal of the text should enable the reader to purchase, match, and operate components properly and discuss high-fidelity sound reproduction intelligently with other audiophiles, technicians, and audio sales personnel. Most readers of this magazine are thoroughly familiar with the author's style.

The lavish use of schematics, graphs, line drawings, and photographs helps to convey the meaning of the material under discussion.

* * *

"RADIO ENGINEERING HANDBOOK" edited by Keith Henney. Published by *McGraw-Hill Book Co.*, New York. 1800 pages. Price $25. Fifth Edition.

The "Henney Handbook" has always had a well-deserved excellent reputation because of its optimum mixture of theory and practice. This latest edition of the handbook certainly lives up to that reputation and, at the same time, brings the coverage right up-to-date. As evidence of the amount of new material that has been added, this latest edition is fully one and a half times larger than its predecessor volume. In it a staff of experts has provided valuable information on every major branch of radio. Communications, broadcasting, television, navigation aids, facsimile, aircraft radio, and even wire telephony and telegraphy are covered. New chapters have been added on semiconductor diodes, transistors, non-linear circuits, high-frequency measurements, and radio transmitters.

The handbook is designed to meet the needs of advanced students and technicians as well as practicing engineers. In addition to providing a wealth of descriptive information, the book has hundreds of charts, tables, circuit arrangements, and schematic diagrams of practical equipment. Emphasis is on modern working practice, final formulas, dimensions, and usable circuits. Enough fundamental theory is given to aid in applying the practical material. The book is to be highly recommended because of its wide scope and excellent coverage. —30—

ELECTRONICS WORLD LAB TESTED

London-Scott

Stereo Cartridge and Arm

WE HAVE just completed an analysis of the *Scott* 1000 integrated stereo cartridge and arm assembly. This particular unit is a *London* design imported from England by *Scott*. Our tests show that the response of this cartridge is extremely smooth from 100 cps to 10,000 cps. The low end below 100 cps has a rising characteristic, being up about 6.5 db at 30 cps. This is a result of tone-arm resonance which obviously peaks below 30 cps. This might not be a disadvantage if you require some bass boost for the very low frequencies.

Above 10,000 cps the left channel is substantially flat out to 15,000 cps, the limit of our tests. The right channel, however, shows a boost of 10 db at 13,000 cps and then drops off rapidly to zero reference level at 15,000 cps. None of the early cartridges of other manufacturers that we have checked have exhibited this peak. However, we have encountered it in several cartridges that we have checked more recently.

This particular peak occurs only when we use the *Westrex* 1A test record. We have tried the *Scott* cartridge and arm on many other test records and found the response very smooth out to beyond 15,000 cps. We could have just as well reported these results using the other test records, but since the industry as a whole, and we ourselves, have been using the *Westrex* record for test purposes, we felt that it would be unfair to change in mid-stream. Some feel that it is the vinyl material of the record that is causing a resonance. Others feel that the 78 rpm speed at which it is operated is the cause. Further, we found that this peak, which is accompanied by distortion, appears only when measuring the cartridge output directly. We found that when connecting the *Scott* pickup into a *Madison-Fielding* preamplifier and then taking measurements simultaneously at the cartridge and at the output of the audio system, the peak disappears completely. It was obvious that the added capacitive load which the preamplifier presented eliminated the resonance effect. We also found that by adding from 500 to 750 $\mu\mu$f. capacitance when measuring directly at the cartridge provided the same results. Whether adding capacitance is the final answer, we aren't sure. Why would the resonance occur on one channel and not on the other?

We do know this—when the *Scott* cartridge is connected to a hi-fi system for normal operation, the peak and its accompanying distortion are completely eliminated. In checking with *Scott*, we found that many installations of the cartridge include a six-foot shielded cable to the preamplifier in addition to the three- or four-foot cable that is supplied with the arm and cartridge assembly. This is one cartridge where the added capacitance of a long cable proves to be an advantage. This is not necessarily true for cartridges of other brands. A lot of them should not be used with long cables or they will suffer a severe loss of highs.

Stylus pressure is adjusted to 3.5 grams and the cartridge should be terminated in a load resistance of 47,000 ohms. The output is approximately .006 volt (at a recorded velocity of 5 cm./sec.) and the channel separation at 1000 cps is 20 db for the right channel and 23 db for the left.

No doubt almost all ardent devotees of high-fidelity reproduction have read product analyses in other publications that are based solely on listening tests. Under certain conditions the only satisfactory testing method is to judge products in this manner. However, it has been our greatest hope to eliminate personal opinions based solely on such analyses and devote our attention to a more scientific approach to the problem. This, we feel, would eliminate any biased opinions that a reviewer might have and would provide a more accurate analysis which could be more helpful in comparing performances of high-fidelity components. We do not have much of a problem in following this approach when we analyze preamplifiers, power amplifiers, cross-over networks, and similar circuit-type products. However, when it comes to such products as cartridges and speakers, the more scientific testing procedures are quite complex and there is a lack of agreement on methods and standards. In these two particular cases, such listening techniques must play an important part. It is just like the proverbial problem of choosing the prettiest girl—there are so many opinions that one can simply say "every man for himself."

Listening tests proved beyond doubt that this new *Scott* cartridge provided the smooth, clean response that is inherent in top-quality cartridges. We had no problem in tracking loud passages or when playing monophonic records. The cartridge can only be used with the arm supplied by *Scott* and it is sold as an integrated system at a price of $89.95.

Manufacturer's Comments: *Measurement of a wide-range stereo pickup is complicated by the fact that many test records have distortion. In the* London-Scott *pickup the high-frequency resonance is at 26,000 cycles or higher—considerably above the normal range of operation. However, if for any reason the test record has second-harmonic distortion at 13,000 cycles, this will show up on vacuum-tube voltmeter tests as a peak at this lower frequency. If the output of the pickup is analyzed under the circumstances, however, it will be found to consist entirely of distortion components from the record.*

This is proved by the fact that connection of a preamplifier, a cable, or any other device having sufficient capacitance to reduce the output at 26,000 cycles eliminates the 13,000 cycle "peak" while actually not affecting the response at other frequencies as, for instance, 15,000 cycles. It is our belief, therefore, that the effects observed by the reviewer are dependent upon the test record used and do not indicate any actual peaks in the pickup response at that particular frequency—in fact, they prove that the response is considerably wider than customarily found in high-grade phonograph pickups, extending nearly an octave higher. —30—

AIRBORNE RADAR INDICATOR ID-93/APG-13

Frequency range 2780 to 2820 Mc. Input power required: 265 Watts from AC supply 120V at 380 to 1600 cycles. Easily converted for 60 cycles. Controls: Horizontal, Vertical, Intensity, Focus, Slope, Marker Amp, Receiver Gain, Yards Range. Tubes used: 6-6SN7GT, 504G, VR105, 2-6H6GT, 2X2, 5V3GT and 3-inch scope tube type 3BP1. Made by G.E. Supplied complete with all tubes, scope tube, and visor. BRAND NEW. OUR LOW PRICE **$22.50**

MN26Y BENDIX DIRECTION FINDER

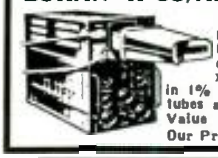
150-325 Kc; 325-695 Kc; 3-4.7 Mc. Complete with tubes, motor. BRAND NEW **$26.95**

BENDIX DIRECTION FINDER

For commercial navigation on boats and planes. 150-1500 Kc. continuous. **$18.95**

MN-26-C Receiver, used, with 12 tubes.. $18.95
MN-26-C With 12 Tubes, BRAND NEW..... $27.50
MN-20-E Rotatable Loop..... 4.25
MN-52 Azimuth Control Box..... 2.95
All necessary accessories for above in stock.

LORAN R-65/APN-9 RECEIVER & INDICATOR



Used in ships and aircraft. Determines position by radio signals from known xmitters. Accurate to within 1% of distance. Complete with tubes and crystal. Exc. used. Value $1200.00. Our Price..... **$79.50**

MOBILE-MARINE DYNAMOTOR

Input 12V DC. Output: 625 V DC @ 225 Ma, for press-to-talk intermittent operation. Shpg. wt. 14 lbs. OUR LOW PRICE **$6.45**

OTHER DYNAMOTOR VALUES: Type	Input	Output	Excellent Used	BRAND NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.75
DM-28	28V	224V .07A	2.75	4.75
DM-32A	28V 1.1A	250V .05A	2.45	4.45
DM-33A	28V 5A	575V .16A 540V .25A	1.95	3.75
DM-34D	12V 2A	220V .080A	4.15	5.25
DM-53A	28V 1.4A	220V .080A	3.75	5.45
PE-73C	28V 20A	1000V .350A	7.95	10.50
PE-86	28V 1.25A	250V .050A	2.75	4.95

DYNAMIC BOOM MIKE M-33/AIC. Low impedance. With mounting bracket for attachment to headsets. A REAL VALUE at $3.95

DYNAMIC HANDMIKE, with "Press-to-talk" Switch on handle, cord and plug—BRAND NEW, only..... $2.95

DYNAMIC HANDMIKE, aircraft, made by Telephonics Corp. Press-to-talk switch on mike. BRAND NEW..... $4.95

Hi-Fi DYNAMIC HEADSET with Cushions

Freq. Range: 40-14000 CPS. No Distortion. BRAND NEW **$7.85**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike	$4.75	$6.95
T-30	Carbon Throat Mike	.34	.74
T-45	Army and Navy Lip Mike		1.25
T-24	Carbon Mike		5.95
TS-9	Handset		3.88
RS-38	Navy Type	2.69	4.75

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.19	$4.65
HS-33	Low Impedance	2.69	4.65
HS-30	Low Imp. (featherwt.)	1.15	1.89
H-16/U	High Imp. (2 units)	3.75	7.95

TELEPHONICS—600 ohm Low Impedance HEADSETS, BRAND NEW, PER PAIR $3.25
CD-307A Cords, with PL55 plug and JK26 Jack ..... .99
Earphone Cushions for above—pair..... .50

REMOTE CONTROL RM-52

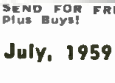
Direct remote control for radio equipment. Uses 4 flashlight batts. Provides bias for Microphone and sidetone to headset. Hi or Lo Imp., Mike and Phone jacks. Makes good phone patch unit. BRAND NEW **$2.49**

MIDGET FAN MOTOR

1¾" square x 2" long, ⅛" shaft extends ½". 10,000 RPM. 24V DC. Input. Complete with fan..... **$2.19**

FL-5 FILTER..... 79c
FL8 Filter $2.45

WILLARD 6-VOLT MIDGET STORAGE BATTERY



3 Amp. Hour. BRAND NEW. 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte.....Only $2.69

2 VOLT BATTERY "PACKAGE"

1—2V. 20 Amp. Hr. Willard Storage Battery $2.79
1—2V. 7 prong Synchronous Plug-in Vibrator 1.49
1—Quart Bottle Electrolyte (for 2 cells).. 1.45
ALL BRAND NEW!
Combination Price **$5.45**

SCHEMATIC DIAGRAMS For any equipment on this page, each.. **65c**

SEND FOR FREE CATALOG, many more Wonderful Surplus Buys!

FM TRANSMITTER-RECEIVER

APN-1. 420 to 460 Mc Aircraft Radio altimeter equipment. Tubes: 4—955, 3—12SJ7, 4—12SH7, 2—12H6, 1—VR150. Complete with all tubes and mount. For 27 V DC. BRAND NEW..... **$8.95**
Original operating manual for above..... $1.00

BC-929 3-INCH SCOPE

Low cost station monitor and/or bench scope. Has Horiz., focus, sweep, intensity controls. Tubes: 2—6SN7, 2—6H6, 1—6X5, 1—6G6, 1—2X2, 3BP1 CR Tube. Voltage req. 115V 400 cy. and 24VDC. Complete with tubes, exc. used **$9.95**
BRAND NEW $12.95
Conversion instructions for 110V 60 cyc AC 65c

SCR-522 2-METER RIG!

Terrific buy! VHF Transmitter-receiver, 100-156 Mc, 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition. SCR-522 Transmitter-Receiver, complete with all 18 tubes, top rack and metal case. COMBINATION.....Special **$32.32**

Receiver only, with all tubes $19.50
Transmitter Only, with all tubes $22.25
Accessories for above available.

BC-733 VHF 10-TUBE AIRCRAFT RECEIVER. 6-channel xtal control. Freq. 108.3 to 110.3 Mc. Dual filter range. Easily converted for tracking Sputniks! **$7.95**
Exc. used .....
BRAND NEW $9.95
Dynamotor for above 12 or 24 V.—New $5.95

AN/ARN-5A AIRCRAFT RECEIVER. 11 tube superhet, 3-crystal control UHF for static-free reception. **$16.95**
Exc. used with tubes.....
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ASB-5 'SCOPE INDICATOR

BRAND NEW, including all tubes, together with 5BP1 'Scope Tube. Originally used in Navy Aircraft RADAR equipment. Easily converted for AC operation. VALUE $250.00! OUR LOW PRICE **$15.95**

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2-meter Superhet. 100 to 156 Mc in 4 crystal channels. Complete with 10 Tubes. BRAND NEW **$24.45**
110V AC Power Sup. Kit for above $9.75

ARC-5/T-23 TRANSMITTER

100-150 Mc Includes 2—832A, 2—1625 Tubes. BRAND NEW..... **$21.50**
SPECIAL Limited quantity ARC-5/T23 xmitters.
OFFER! BRAND NEW, less tubes..... $7.95
Excellent Used, less tubes..... $5.95
MD-7 MODULATOR for T-23, complete with 4 tubes, LIKE NEW..... **$9.95**

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes..... **$16.95**
Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal **$12.45**
MODULATOR for above, new with tubes.....$5.95

LORAN APN-4 FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane. Indicator and receiver complete with all tubes and crystal.
INDICATOR ID-68/APN-4, and RECEIVER R-98/APN-4, complete with tubes. Exc. used **$42.50**
Receiver-Indicator as above. BRAND NEW **$59.50**
Complete Kit of Accessories for Above: PE-206 Inverter, Set of Plugs, Visor for Indicator, Operation Manual, ALL BRAND NEW..... **$49.50**

LORAN APN/4 OSCILLOSCOPE

Easily converted for use on radio-TV service bench.

Completely Assembled

1.IKE NEW! Supplied with 5" Scope, type 5CP1 only **$14.95**
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AC POWER SUPPLY FOR BC603, 683

Interchangeable, replaces dynamotor. Has On-Off Switch. NO RECVR. CHANGE NEEDED. Provides 220VDC @ 80 Ma. 24VAC @ 2 Amps. Complete kit, with easy instructions... **$8.45**
Wired $10.49
Complete 240-page Technical Manual for BC-603, 604 ..... $2.95

BC659 Vibrator Power Supply, exc. used..... $6.95
Brand New $9.95
Please include 25% Deposit with order—Balance C.O.D. 50c Handling Charges on all orders under $5.00. All shipments F.O.B. Our Warehouse, N.Y.C. All Merchandise subject to Prior Sale and Price Change.

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AN/ART-13 100-WATT XMTR

11 CHANNELS
200-1500 Kc
2 to 18.1 Mc

$48.50 Complete with Tubes

Famous Collins Autotune Aircraft Transmitter, AM, CW, MCW. Quick change to any of ten preset channels or manual tuning. Speech amplifier/clipper uses carbon or magnetic mike. Highly stable, highly accurate VFO. Built in Xtal controlled calibrator. PP811a modulate 813 in final up to 90%, class "B." A Real "HOT" Ham buy at our low price! Orig. cost $1800. **$48.50**
Exc. Used.....
0-16 Low Freq. Osc. Coil for ART-13.... 7.95
24V Dynamotor for ART-13..... 11.95

ARB Receiver 4 band 195-9050 Kc, with all Tubes. Like New..... **$17.95**
Brand New, with Tubes and Dynamotor.....$34.50

234-258 MC RECEIVER AN/ARR-2

BRAND NEW 11-tube UHF Tunable Receiver with schematic. Only a few at this low price!
Complete with tubes **$8.88**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Like NEW
BC-453	Receiver 190-550 KC	$14.50	$16.50
BC-454	Receiver 3-6 Mc	9.45	12.45
BC-455	Receiver 6-9 Mc	10.45	12.45
BC-450	3-Receiver Control Box	1.29	1.75

110 Volt AC Power Supply Kit, for all 274-N and ARC-5 Receivers. Complete with metal case, instructions..... **$7.95**
Factory wired, tested, ready to operate $11.50

SPLINED TUNING KNOB for 274-N and ARC-5 RECEIVERS. Fits BC-453, BC-454 and others. Only..... **49c**

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW.. **$7.85**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW **$7.85**
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ARC-5/T-19 TRANSMITTER—3 to 4 Mc. BRAND NEW complete with all tubes & crystal **$8.85**
BC-456 Modulator .....USED 3.45 NEW 5.95
BC-451 Transmitter Control Box.. 1.25 NEW 1.49
POWER SUPPLY KIT, for All Command Transmitters. Provides all needed voltages. A quality kit, only..... **$29.50**

BC-906 FREQ. METER—SPECIAL

Cavity type, 145 to 235 Mc. BRAND NEW, complete with antenna. Manual included.
OUR LOW PRICE..... **$9.88**

STANDARD TUBES

Removed From Brand New Govt Equipment

1S5	.35	6AJ5	.45	6X5	.35	807	.95
3Q4	.35	6AK5	.35	6E5	.35	813	6.95
6AQ5	.35	6C4	.25	6AC7	.35	826	.44
12AT7	.45	6X4	.32	6J6	.32	5670	.75
12X4	.35	6AL5	.33	6BA6	.35	1625	.29
12AX5	.45	6J4	.59	6A56	.55	1629	.29

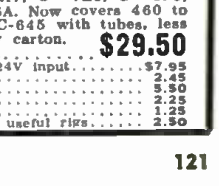
MINIMUM TUBE ORDER: 6 TUBES (6 of a number or 6 assorted).

SYNCHRONOUS SELSYNS

Transformer, AC Synchronous, for 115 V 60 cycles. Wt. 1¾ lbs. Brand New. Each..... **$3.95**

BC-645 XMTR RECEIVER

15 Tubes 435 To 500 MC



BRAND NEW

Can be modified for 2-way communication, voice or code, on ham band 420-450 mc, citizens radio 460-470 mc, fixed and mobile 450-460 mc, television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs..... **$29.50**

PE-101C Dynamotor, 12/24V input..... $7.95
UHF Antenna Assembly..... 2.45
Complete Set of 10 Plugs..... 5.50
Control Box 2.25
Shock Mount 1.25
Conversion Booklet, many useful figs..... 2.50

Lightning Protection

(*Continued from page 59*)

faster than a satellite in orbit. The rapid heating and ionization of air molecules in its path produce thunder.

During what part of the storm is lightning most ferocious? Nature speaks with her most terrifying voice at the beginning of her outburst. The charge has built up to its highest peak and the lower air is driest before the storm breaks. As the ensuing downpour develops, the damper air is a better conductor. Thus the lady vents much of her rage in the first wild shriek; then grumbles, mutters, and finally quiets.

A main bolt may be miles long and about as thick as a man's waist. It is likely to do less damage if it comes later in the storm. Such earthbound objects as trees and houses are less likely to be damaged when struck as they become increasingly wet, since they are better able to pass the charge to ground.

Isn't the likelihood of lightning striking someone or something rather small, actually? You can draw your own conclusions from available statistics. The map of Fig 1, based on data compiled by the U. S. Weather Bureau, shows the number of lightning storms that have occurred in various parts of the country over the last twenty years. Some areas average over a hundred a year, other as low as five or ten. No area is immune. The number of strokes in each storm can only be guessed.

Also consider this: The National Board of Fire Underwriters, in assessing the causes of all fires in rural and suburban areas, indicates that lightning is the villain in close to 40 percent of these! It is responsible for almost as many as the next five leading causes combined. What's more, a lightning-caused conflagration can differ in degree. As in the case of the photo at the beginning of this article, a stricken property can be utterly devastated before the owner has had a chance to recover from the initial shock.

We have mentioned that probing lightning leaders seek out earthbound weak spots to complete the path. It is generally known that anything projecting up from the ground is such a weak spot. It may be a church steeple, a tree, or a flagpole. It may be a TV antenna.

Aware that unprotected antennas may invite lightning, many people take the precaution of insisting on antenna lightning arresters and, if they don't, their conscientious service dealers are likely to urge these devices on them. When properly installed, these arresters will prevent the *antenna* from inviting disaster. However, except in the case of the relatively small home, these legitimate safeguards give some people a false sense of security. The area under the antenna that will be protected is relatively small.

A carefully planned, over-all system is needed. Yet, even with such an installation, many people tend to ask: "How effective are protection systems? We hear of so many cases where lightning has struck in spite of safety devices." For the answer to this one, we go to another agency. *Underwriters' Laboratories, Inc.*, on the basis of its own extensive records, reports that a lightning protection system is 99 percent effective—if it is properly planned, constructed, and installed! A defective system may actually have an effect opposite to the one sought, however, in that it can increase the hazard.

How does one know that a particular installation is properly completed? The *Underwriters' Laboratories* issues individually registered and numbered master labels on satisfactory systems. The inspections on which issuance of these labels are based include the materials used as well as the completed installation itself. For those interested in safeguarding their properties, no over-all system without such a label should be considered. Also, the presence of this label is often a determining factor in insurance savings.

A protection system is not always as simple as is often thought. A single lightning rod, for example, does not necessarily do the job for a single structure, even where the former is located in the best spot and properly grounded. There are too many factors for an inexperienced or untrained amateur to take into account. Structures adjacent to the one to be protected must also be evaluated. For example, an unprotected tree next to a house that has a system may be a weak spot. Later changes in the structure must also be taken into account. Periodic inspections should be made to check on the condition of the system. Clearly a professional hand is needed here.

For the TV service dealer, an exceptional opportunity is open in this field. One insurance company estimates that three quarters of the nation's rural property needs such services. Add to this the rapid rise in private suburban dwellings. Systems manufacturers, simply unable to exploit the potential through existing facilities, are looking for new dealers. At least one such firm, the *Independent Protection Company* of Goshen, Indiana, has been alert enough to see the manner in which this type of work complements that of the TV service dealer. Robert Cripe, *IPC* vice-president, points out that equipment used is very much the same as that required in antenna work. His firm welcomes TV service dealers, whom it will train and assist. With TV service work slowing down in the summer months, when interest in lightning protection is high, there is a built-in balancing factor. In addition, the sale of an antenna is an open door to suggesting lightning protection, or *vice versa*.

For anyone who lives where lightning may strike, the ounce of prevention is available. —30—

Certified Record Revue

by Bert Whyte

A CRY has been raised in the land that the widespread acceptance of the stereo disc is degrading sound quality standards. No doubt there is a certain validity to these arguments. I have seen various types of distortion tolerated which, in the heyday of mono sound, would have caused loud anguish. Let's go a step farther and point out that even stereo standards are deteriorating. What was accepted in the palmy days of stereo tape, is being attacked. Thus we find equipment which reproduces what is supposed to be stereo sound lacking frequency response, poor in signal-to-noise ratio, and the principles of good stereo speaker placement seem to have been forgotten or conveniently repealed. This is, of course, due to the intense commercialization of stereo and the attempt of some manufacturers to ram it down the public's throat. Thus innocent John Q. is being fed a tremendous diet of their propaganda and, having neither the background to understand its complexities nor a kindly and knowledgeable salesman to guide him, the poor sap is easy prey for any kind of sales pitch.

The more sinister aspects of this situation are that the whole basis and foundation of component hi-fi and stereo is under attack. It would be foolish to deny that, to some extent, stereo does lend itself to a certain amount of "packaging." There are certain units on the market which have been intelligently designed with an honest respect for the exigencies of stereo. But these are the exception rather than the rule and the rule seems to be inordinately flexible.

Looking at the problem in a cold, hard light you always come up with one inescapable conclusion . . . "packaged stereo" is neat, self-contained, pre-digested, "simple enough for a child to operate," and is a complete and salable item available in everything from Queen Anne to Paul McCobb. Components, on the other hand, require a certain amount of thinking and reasoning, work and bother, and possible inconvenience. It also requires a love of music with good taste and a discriminating ear.

The rugged individualism of the component's manufacturer has always been something to admire and, in a comformist society, he has been a bulwark against mediocrity. Today he is faced with the desire to maintain his product's integrity in spite of the myriad pressures to relax his standards and embrace the hurdy-gurdy world of cheap stereo. It is sad to relate that some are heeding this siren call. This fall from grace has been defended as "a realistic attitude," that the "times call for a change," etc. It would be far better if these people realized how great the danger to their existence is and did some hard thinking.

The over-all stereo picture isn't likely to change in the next year or so . . . to successfully sell high-quality component stereo in today's market, the manufacturer has two choices as I see it. One is to stand firm by the quality standards which have made the component's manufacturer unique in a world of mass production and automation, the other is to steal a page from the cheap stereo boys. In other words *sell!*

Get behind your trade organizations and build up a war chest that will be used for institutional advertising to tell *your section* of the public what stereo is really all about! The phrase "your section" was emphasized to point out that there is always a very substantial segment of the public that is looking for "something better" or even "the best." These people have the money to indulge in components . . . but they have to be *sold*. The manufacturer must utilize every means possible to reach this public. He must be willing to use some of the "rah-rah" tactics of the opposition and he must even take a reasonable and considered attitude towards possible merchandising modifications of his equipment, especially with a view towards pleasing the ladies. All this and yet he must not compromise the underlying philosophy of high quality. You can't sell everyone with this approach but I'll guarantee one thing . . . there are hundreds of people who buy stereo equipment every day, who don't know what they've bought, don't know how to run the set, and don't even know how to listen to it! These people aren't stupid . . . they're just confused by all the gobbledegook. Now figure out how to get to these people, before or even after their disillusionment, give them an honest demonstration of a quality product, and they will listen themselves right into a sale! In my opinion there is a bigger market than ever for components . . . providing the manufacturer sticks by his guns and continues to plug the doctrine of quality.

As is usual in the summertime . . . most record companies drastically curtail their releases . . . so this month the bag is small but, on the whole, very choice!

MENDELSSOHN
SYMPHONY #4 ("ITALIAN")
HAYDN
SYMPHONY #104 ("LONDON")
New York Philharmonic conducted by Leonard Bernstein. Columbia Mono ML5349. Price $4.98.

Bernstein's reading of the Mendelssohn is full of driving energy, a headlong propulsive sort of thing that makes you want to catch your breath. Yet with all this high-spirited and ebullient handling, he keeps himself on solid ground with the more lyrical sections. A highly individual but nonetheless interesting performance. The Haydn fares less well, with Bernstein having some ideas of tempi quite at variance with Papa Haydn. Over-all sound is quite clean and good, but I would have preferred a more generous bass response.

BIZET
CARMEN SUITE
L'ARLESIENNE SUITE
L'Orchestre de las Suisse Romande conducted by Ernest Ansermet. London Stereo CS6062. Price $5.95.

A curious record this. Ansermet turns in good idiomatic readings of these chestnuts, but nothing catches fire. I really think he was a bit bored with the idea of recording the umpteenth version of these scores, for the usually impeccable Ansermet has permitted some sloppy playing from his orchestra. In the sound department, this is at all times a nice clean recording, with some exceptional high-energy cymbal clashes. However, it is weak in the bass as compared to the splendid solidity of most *London* stereo, and it was also possible to hear some very obvious tape splices. Some judicious juggling with tone controls might correct the bass deficiency depending on the type of system you own.

Well, *London* stereo which is usually reliable as the morning sun, has stubbed its toe a bit, but its batting average is so high it can be forgiven this light fall from grace!

DVORAK
SLAVONIC DANCES (Op. 46, Op. 72)
SMETANA
BARTERED BRIDE (EXCERPTS)
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury Mono OL-2-107. Price $9.96. Two discs.

No doubt this recording will soon be issued in the stereo format with the expected gains typical of stereo. But it's good to know in the meantime that *Mercury* has not lost its touch in issuing mono discs of outstanding quality. This complete edition of the Dvorak "Slavonic Dances" is a case in point. The sound is splendidly realized throughout, with everything bright and clean . . . and this in spite of the thick-textured scoring of much of the Dvorak and a great deal of the Smetana. The percussion still has that wonderful weight and impact you can "feel" and the brass sings out in a sharp clear voice. The woodwinds have exceptional articulation and the strings are uniformly smooth except where zing is demanded.

Dorati turns in a fine reading, emphasizing the rhythmic aspects of the "Dances" more than others. His tempi are justly paced and incisive and his dynamic control very expressive. No doubt there are those who prefer the warmer, more lyrical approach such as Talich favors, but unless given ultra-clean super-detailed recording this "warm" attitude usually results in muddy orchestration.

The Smetana is much along the same lines and the need for clarity here is evident in the scoring. Hi-fi buffs can have a fine time with the huge percussion in the "Polka and Furiant" sections. For those who are still mono only, a very choice item.

PARAY
MASS COMMEMORATING THE 500TH ANNIVERSARY OF THE DEATH OF JOAN OF ARC (1931)
Detroit Symphony Orchestra conducted by Paul Paray with Rackham Symphony Choir, Frances Yeend, soprano; Frances Bible, mezzo; David Lloyd, tenor; Yi-Kwei-Sze, bass. Mercury Stereo SR90128. Price $5.95.

This "Mass" by Paul Paray was a wonderfully moving experience when it appeared in mono format a few years ago. Needless to say, a huge work like this, involving many voices is ever so much more effective in stereo. The stereo opens wide the work and lets us revel further in its newly revealed complexities. Here is sharply limned detail, where in mono it would be veiled. Here is splendid separation of the voices, the indi-

vidual timbres no longer fused and indistinct. The directional effects are quite pronounced here but with the chorus properly positioned simply adds to its realism. Oddly enough, I have thought from the mono version that the voices would sound more "close-up," but this is not the case and in fact this is as "distant" a mike pickup as I have ever heard from *Mercury*. Thus, while the stereo does give a more distinct impression of the scoring, the over-all choral work still sounds very huge and slightly homogenized. The general sound here is clean and there are some formidable dynamic peaks which will put the big systems to test!

The work is very dramatic and compelling and certainly can stand comparison with the best works in this genre. As you might expect, the orchestra and chorus are very responsive to Mr. Paray and the excellent soloists honor his work with fine performances. My only quibble is that there was what seemed to be some overcutting in certain places, or more possible a lack of proper groove "fill," which caused some crackling noises in the right channel. May not be in all copies, as this defect is found in the stampers.

MASSENET
LE CID BALLET
MEYERBEER
LES PATINEURS
Israel Philharmonic Orchestra conducted by Jean Martinon. London Stereo CS6058. Price $5.95.

Deft, spirited performances by Martinon of these two popular ballet suites somewhat negated by a stereo sound that has all the directional virtues but which appears overbright and even "wiry" at times. Will require some tone control work in the very top systems, but will probably sound very good on inexpensive stereo sets.

HINDEMITH
KLEINE KAMMERMUSIK (Op. 24, No. 2)
DANZI
QUINTET (Op. 67, No. 2)
New York Woodwind Quintet. Concert-Disc Stereo CS205. Price $5.95.

The Hindemith is the important piece here, the Danzi being little more than an interesting trifle. This was issued previously as a stereo tape and was of excellent quality. In this transfer the quality has been maintained although a comparison with the tape reveals more separation and a cleaner top end on the tape. The music is difficult to accept if you don't like moderns. Those who do will find it engrossing and especially interesting texturally. Performance is first rate.

SHOSTAKOVICH
PIANO CONCERTO #2
RAVEL
PIANO CONCERTO IN G MAJOR
Leonard Bernstein, pianist, conducting the New York Philharmonic and Columbia Symphony Orchestra. Columbia Mono ML5337. Price $4.98.

This is an outstanding mono recording and a perfect showcase for the talents of the remarkable Mr. Bernstein. The Shostakovich is a first recording and is very typical of his works. The opening allegro quickly becomes a really pell-mell march and it is the sort of racy, jazzy music suited to Bernstein's temperament. After a brief quiet middle section, there is a return to the brisk bubbling vitality of the allegro and there is much interplay between piano and snare drum. Plenty of clean, well-balanced hi-fi sound here, with the piano recorded fairly close-up and showing good detail.

The Ravel "G Major" is one of Bernstein's

favorites and he does an altogether splendid job of performing and conducting. Plenty of meat for the hi-fi man here, too, and there are subtle percussive effects in the first movement, that are apparent for the first time in any recording of this work I have heard. The stereo on this should be a pip!

BRAHMS
SYMPHONY #5

Vienna Philharmonic Orchestra conducted by Rafael Kubelik. London Stereo CS6022. Price $5.95.

If you like your Brahms in the old-fashioned, hugely proportioned manner, full of "gemutlichkeit," then this version of the "3rd Symphony" under Kubelik will please you. This is easy going, warm, and lyrical Brahms, with the Vienna Philharmonic going along nicely with the whole idea. Given this approach, the engineers added to its mellow contours by affording it a noble sound, clean and well balanced, recorded moderately close-up, but with liberal reverb. This may not please the "experts," but few will deny that, with its superb stereo, it falls very easily on the ear!

PUCCINI
MADAMA BUTTERFLY

Renata Tebaldi as Butterfly; Carlo Bergonzi as Pinkerton with Chorus and Orchestra of Accademia di Santa Cecilia, Rome, conducted by Tullio Serafin. London Stereo OSA-1305. Price $23.90. Three discs.

I haven't the slightest doubt that there have been thousands of people all over the world waiting for *London* to issue this recording. It's that sort of thing. Tebaldi as "Butterfly" has become a legend in her own time and her mono recording made for *London* many years ago is treasured as few records ever have been. I dare say this new stereo recording will cause more opera lovers to switch to stereo than for anything else you can imagine.

Is it as good as the old mono? Well, that depends on your point of view . . . if Tebaldi and "Butterfly" are your main interests, you will hear the diva in rare and beautiful voice many times enhanced in the rounded fullness of stereo. I thought Bergonzi did a very creditable job as "Pinkerton" and the rest of the cast was more than competent. However, there may be those who prefer the personnel on the old disc as foil to their beloved Renata.

To me, there can be no doubt or no contest. Tebaldi is still *the* "Butterfly" and when you add all the other blandishments and then afford it some gorgeous stereo recording, it's well nigh irresistible!

As with the other *London* stereo operas, there has been no attempt to keep the stage action static. This movement is well delineated by the stereo sound and, to me, adds immensely to the over-all realism. Nuff said? This record will sell and sell and sell!

WAGNER
GREAT SCENES FOR BASS-BARITONE

George London, bass-baritone with Vienna Philharmonic Orchestra conducted by Hans Knappertsbusch. London Stereo OS25044. Price $5.95.

This recording is merely sensational! Of course I admit I am a big fan of George London, so I may be prejudiced. This is operatic vocalizing of the very highest order and Mr. London has the benefit of some of *London's* most incredibly realistic stereo opera recording. London is heard in scenes from the "Flying Dutchman," "Die Meistersinger," and "Die Walkure." In each his richly resonant voice commands your attention from the first note and, in addition to the con-

siderable beauty of his voice. Mr. London is one of our best actors which adds thrilling realism to his characterizations.

London Records has made something of a specialty of recording stereo opera and in these pieces their mastery of this medium is unquestioned. The singer's voice is always completely articulate and yet he is surrounded by the complexities of the scores which are realized in every shade and nuance and with no compromise in dynamics.

HANDEL-HARTY
WATER MUSIC SUITE
ROYAL FIREWORKS MUSIC
London Symphony Orchestra conducted by Antal Dorati. Mercury Stereo SR-90158. Price $5.95.

This is *Mercury's* genuflection to the Handel festival and although it is one of the great composer's oft-recorded works, this is an exceptionally fine job. Dorati gets a superb sound from the London Symphony, which plays as if they were really enjoying their work. The stereo is just wonderful . . . fine directionality and good instrumental positioning, no trace of a middle "hole" and most felicitous acoustics which allow nice clean detail and yet affords a huge smooth roundness for maximum presence.

STRAVINSKY
CONCERTO FOR PIANO AND WIND INSTRUMENTS
CAPRICCIO FOR PIANO AND ORCHESTRA
Nikita Magaloff, pianist, with L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London Stereo CS-6035. Price $5.95.

This stereo disc appeared early in *London's* releases and has now been issued again after a job of recutting. I thought it was a pretty fair recording the first time around, but this is audibly superior, and the music has gained by it. Neither of the pieces is the most accessible Stravinsky, but if you like "L'Histoire du Soldat," you will like these. The scoring is on the astringent side, but extremely clever and well integrated for all of its atonality. Magaloff has made something of a speciality of these scores and turns in a facile and vigorous reading. Ansermet is sympathetic to this type of music as usual.

MUSIC FOR FIFES AND DRUMS
Eastman Symphonic Wind Ensemble conducted by Frederick Fennel. Mercury Stereo SR90111. Price $5.95.

Just in time for the Fourth of July is this rousing recording of the traditional fife and drum music of the U. S. Army, much of which originated in the "Spirit of '76" days. This was a big hit on stereo tape and it has been transferred to stereo disc with notable success. The transients of the drums are cleanly reproduced with only a slight diminution in dynamics as compared to the tape.

My favorite here is the quite incredible drum solo called "Connecticut Half-Time." This is really a fantastic display of rhythmic dexterity. All drum and fife corps . . . Legion, Boy Scouts, etc. . . . should own and listen to this recording as an example of how the art should be practiced!

TRAVELING ON WITH THE WEAVERS
Vanguard Stereo VSD2022. Price $5.95.

I am frankly not very hep for folk song singing groups, but these Weavers are so outstandingly good and downright entertaining, that it is a pleasure to recommend this recording. For one thing their repertoire isn't the same stale old stuff you always seem to hear. Oh, they have a familiar one here and there to act as a leaven for the rest, but most of the material is fresh and new. —30—

Wireless Baby Sitter

(*Continued from page 63*)

with no tricks or gimmicks. The audio portion uses a 6J7 voltage amplifier into a 6C5 current amplifier which drives a 6L6 modulator. Choke or Heising modulation is used. In the audio portion, because of the high gain, r.f. bypass capacitors are used in critical spots to prevent r.f. feedback. These ceramic bypass capacitors should be wired in as close to the tube socket as possible and with the shortest practical leads.

C_{11}, the plate r.f. bypass for the modulator tube, should be rated at 1000 volts d.c. or more. This capacitor sees high voltage transients occasionally which may puncture a lower rated capacitor.

The 6L6 r.f. tube, V_4, is connected as an electron-coupled oscillator using a conventional Colpitts circuit. The oscillator coil, L_1, is a commercially built 80-meter amateur coil which happened to be available. When using the larger section of a variable capacitor from a broadcast set as C_{15}—C_{13}, C_{14}, C_{15}, and L_1 resonate in the broadcast band. If exact duplicates of L_1 and C_{15} are not available, a little experimenting with components on hand should produce a combination that will resonate in the broadcast band. It is fairly important that C_{13} and C_{14} be kept as they are. They form a voltage divider which feeds back r.f. power to sustain oscillation. If they have to be changed to produce a tuned circuit in the broadcast band, the capacity ratio of 3 to 1 should be maintained.

The r.f. power output of V_4 is coupled through C_{19} and C_{20} into the power lines. C_{19} may be varied to suit the individual locality. Less capacity will couple less r.f. into the lines and cut down any unlawful radiation if it is present. More capacity in C_{19} will increase the power into the lines. C_{19} should not be increased to more than .5 μfd., however.

The power transformer, T_1, was a replacement type unit rated 375-0-375 volts at 150 ma. with 5 and 6.3 volt filament windings. Any transformer of this general type may be substituted and will work satisfactorily in the circuit shown.

Other Uses

Of course, it might be pointed out that the uses of this unit are not limited to baby sitting. It can be used by the children as a workable "broadcast station." Phono inputs could be added and a complete little neighborhood broadcast station made for children who wish to be "on the radio." It must be emphasized, however, that excess radiation is illegal and punishable by fines and, in extreme cases, imprisonment.

A good test for determining whether or not the device is radiating excessively is to walk around the neighborhood with a portable radio. If you can hear the baby sitter more than 50 feet away from the building or power lines, there is too much radiation and C_{19} should be reduced to .001 or .0005 μfd. In most cases the range of the transmitter will be determined by the distribution wiring of the power company. Since the power line transformer is high impedance at radio frequencies, the range of the transmitter will be limited to those houses or apartments fed by the same distribution transformer and from the same side of the power-line feeder cables. —30—

Transistorized TV

(*Continued from page 57*)

supply one of the two voltages that may be selected for best focus. (The other is +12 volts.) Also needed is a means of obtaining the 10,000-volts for the second anode.

Since the peak output that may be realized from the horizontal-output transistor is limited to about 50 volts, the high-voltage winding of the flyback transformer is wound for a step-up ratio of 100 to 1, recovering about 5000 volts. A voltage doubler (Fig. 3) employing two miniature, glass, vacuum-type, high-voltage diodes finishes the job. Other taps and windings on the flyback transformer, connected to suitable rectifiers and filters, as shown, provide the remaining voltage requirements. The 300-volt rectifier is a silicon unit.

Housed in a leather case and with a leather carrying handle, the "Safari" could easily be mistaken for a large camera. Even when its front visor or hood is snapped up for viewing, a camera is still suggested. An adjustable tilt base provides adaptation to the viewer's eye level.

The novel receiver has been subjected to rigorous tests, including a simulated life test. The manufacturer feels that anticipated life will be at least that of a tube-powered TV set, and probably greater. At a public demonstration, performance of the "Safari" made a favorable impression. —30—

EUROPEAN SET OWNERSHIP

By A. V. J. MARTIN

TV PROGRESS is slow but sure in Europe. At the end of June 1958, Sweden had 150,000 TV receivers officially declared. Switzerland has not published current figures but indicated that by the end of 1958 it had 46,000 television receivers in operation.

France has just passed the million mark in set ownership with sales for one year, the summer of 1957 to the summer of 1958, totaling 230,000 TV receivers. At the present time, about 1 home in every 14 has a TV receiver in France. This compares with 10,500,000 radio receivers—nearly one per home.

Sales resistance seems to be based solely on economic factors. It is estimated that the French market will not be "saturated" until at least 8 million TV receivers are marketed. —30—

Hi-Fi with Triodes

(*Continued from page 62*)

power sensitivity is achieved by employing only 12 db of inverse feedback, which is a direct reflection of the combined benefits of the triode output stage.

Total harmonic distortion at 1-, 10-, and 15-watt levels is shown in Table 3 for the range of 40 through 15,000 cps. At 1-watt output the distortion is 1 per-cent or less through 15,000 cps. The particular output transformer employed causes the distortion to rise above 1 per-cent at 15,000 cps at the 10- and 15-watt levels. Although of little consequence, since the power level of program material seldom exceeds a few watts above 12,000 cps, the latter condition can be corrected by selecting a different transformer.

The excellent linearity of the amplifier is also shown by the low percentage of intermodulation distortion present. With frequencies of 400 and 1000 cps, in a 4:1 ratio, the intermodulation distortion is only 1 per-cent at 1.5 watts and .8 per-cent at 15 watts.

The unretouched square-wave oscillograms shown further attest to the capabilities of the amplifier. The 100- and 10,000-cps square waves exhibit slight low- and high-frequency roll-off, while the 1000-cps square wave is reproduced almost perfectly. Although a somewhat more square 10,000-cps wave was obtained with a smaller value capacitor in the feedback loop, the larger value used in the final design assures ring-free performance at the higher power levels. No high-frequency ringing was in evidence with the amplifier reproducing the 10,000-cps square wave even when a .1-μfd. capacitor was shunted across the output transformer secondary—indicating good high-frequency stability.

The amplifier is also extremely stable at low frequencies despite the use of somewhat oversized coupling capacitors. Should low-frequency instability be encountered, due possibly to the use of an output transformer other than the specified model or a power supply without adequate filtering, the value of the coupling capacitor between the plate of the 6SJ7 and the phase inverter, C_3 should be reduced slightly. The exceptional stability of the amplifier is further indicated by the absence of oscillation with the output transformer plate-leads incorrectly phased to provide positive instead of negative feedback. As a result of this characteristic, the builder must determine the output transformer primary connection that provides negative feedback. Of the two connections possible, the correct connection will be characterized by lower amplifier sensitivity.

In conclusion, the performance specs speak for themselves. Here is a high-quality, medium-power amplifier that can be built at low cost and with remarkably few construction problems.

—30—

What's New in Radio

PHOTOFLASH CAPACITORS

Illinois Condenser Co., 1616 N. Throop St., Chicago 22, Ill. has recently added a new series of smaller-case-dimension capacitors to its line of photoflash units.

Guaranteed low leakage at full rated working voltages, the new capacitors

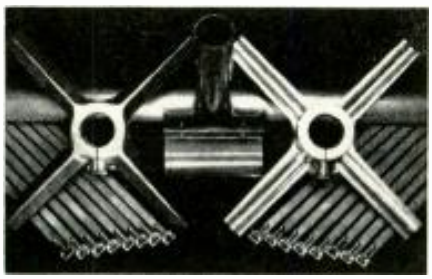
are designed for minimum inductance and greater discharge currents with more useful watt/seconds available. The new units may be stacked for space saving.

Among the new standard items are units measuring 1½" x 2½" rated at 400 μf., 300 volts and 1½" x 3¼" rated at 450 μf., 475 volts. Bulletin Type UMCF, available without charge, gives complete information on the entire line.

"QUAD FOUNDATION KIT"

Cubex Company, 3322 Tonia Ave., Altadena, Calif. is now offering a "Quad Foundation Kit" for experimenters and "do-it-yourself" builders of the cubical quad beam antenna.

The kit consists of two end spiders, boom, boom-to-mast mounting fixture mast stub, and 16 radial arm clamps. The end spiders are of lightweight,



high-strength aluminum alloy castings which mount to a 2" diameter tubular aluminum boom. Clamps are furnished for mounting bamboo, tubular aluminum, or Fiberglas radial arms securely to the casting. The spiders are designed for positive clamp mounting to the 10-foot x 2-inch diameter tubular aluminum boom.

Additional information on this new kit, including price, is available from the manufacturer.

MULTIPLE OUTLET

Tap-A-Line Mfg. Co., 31 S. W. 5th Court, Pompano Beach, Florida has recently introduced a handy multiple outlet unit which is especially valuable for radio and TV service shops.

The device consists of a tough plastic sheath 12 inches long and 1 inch square which carries the parallel conductors in channels ½ inch apart. The channel is fastened to the wall, back of the service bench, etc. and the device plugged into the power line by means of a 4-foot cord. Up to eight units can then be plugged into the "Tap-A-Line."

The device is available in lengths ranging from 6 inches to 10 feet. Depending on the appliances or equipment plugged into the strip, from 3.5 to 7.25 amps can be carried. The strip within the device is equal in capacity to No. 12 wire.

For complete details on sizes and prices, write the manufacturer direct.

NEW V.T.V.M.

Electronic Measurements Corporation, 625 Broadway, New York 12, N. Y.

is currently offering a new vacuum-tube volt-ohm-capacity meter in both kit and factory wired versions.

The Model 107A features a 6" meter with a zero center position for FM discriminator alignment. This multi-function meter cannot burn out, according to the company. The circuit features 1% precision resistors for all voltage, capacity, and resistance measurements. The meter reads peak-to-peak voltages in six ranges from .2 volt to 2800 volts; a.c. (r.m.s.) voltages from .1 to 1000 volts in six ranges; capacity from 50 μμfd. to 5000 μfd. in six ranges; and resistance from .2 ohm to 1000 megohms in six ranges. The unit will also measure inductance from 1.4 to 140,000 henrys in four ranges.

DUAL-HEAT SOLDER GUN

Weller Electric Corporation, 601 Stone's Crossing Road, Easton, Pa. has developed a dual-heat soldering gun which is suitable for a wide variety of applications.

Providing both high and low heat—90 and 125 watts depending on requirements—the device is operated by an instantaneous "Triggermatic" control. The soldering gun is of modern, compact design and is carefully balanced to aid in precision soldering and reduce hand fatigue. A pre-focussed spotlight illuminates the work while the gun is in use.

The gun has a new high-efficiency tip which has been especially developed for this application. The tip utilizes copper for superior heat transfer and soldering efficiency and iron-plating for durability.

Marketed in kit form as the Model 8200K, the package includes the solder-

ing gun, a roll of rosin-core solder, a soldering aid, and a cleaning brush.

Write the manufacturer for full details on this *UL*-approved soldering tool.

SUBMINIATURE TRANSFORMERS

Microtran Company, Inc., 145 East Mineola Ave., Valley Stream, N. Y. has added seven new subminiature transistor transformers to its regular catalogue line.

The new units are being offered in hermetically sealed MIL-AF, round, or epoxy molded cases. Size is slightly less than 1 cubic inch with an approximate weight of 1 ounce. Impedance ranges are designed to meet the requirements of many new transistors.

A new 24-page catalogue which includes full specs on these new transformers, as well as other items in the firm's line, is available on request.

FEDTRO "TRANS-LYTICS"

Federal Electronics Sales, Rockville Centre, N. Y. is now offering a new line of electrolytics which has been

designed specifically for application in transistor radios, test equipment, portable electronic gear, hearing aids, TV cameras, etc.

The subminiature "Trans-Lytics"

feature high stability and low current leakage. The units are metal cased with a protective insulating sleeve of chemical- and abrasive-resistant plastic. An etched plate of highest purity aluminum is used internally. The leads are solder coated to assure trouble-free use in dip-soldering production assemblies.

Standard stock sizes range from 5 to 100 μfd. in voltages from 3 to 10. All leads are of standard two-inch length.

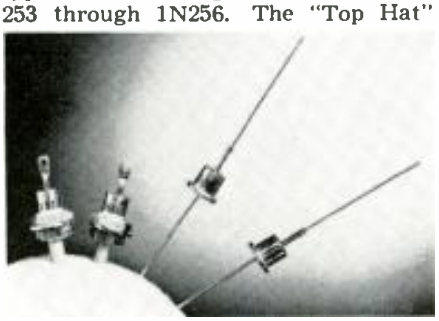
Write the manufacturer for a data sheet and listing of available units.

SILICON RECTIFIER LINE

The Semiconductor Products Division, *Motorola Inc.*, 5005 E. McDowell Road, Phoenix, Ariz. has announced the availability of a wide variety of diffused-junction silicon rectifiers in standard "Top Hat" and "Stud Mounted" welded packages.

All units have very low back currents at high temperatures. Exceptionally high surge current handling capacity and excellent stability are claimed for these rectifiers.

The "Stud Mounted" rectifiers are types 1N115 through 1N1120 and 1N-253 through 1N256. The "Top Hat"



rectifiers come in types 1N536 through 1N540, 1N1095, 1N1096, and 1N547. Small quantities are available from the company's distributors, production quantities from the Division.

MICRO-MODULE COMPONENTS

P. R. Mallory & Co. Inc., 3029 E. Washington St., Indianapolis 6, Ind. has announced the development of two micro-modular components—a solid tantalum capacitor half the thickness of a dime and a tiny mercury battery the size of an aspirin.

The capacitor was developed in two thicknesses, .028" in ratings up to 15 μfd. and .035" in ratings up to 30 μfd. Three different ratings and five terminal arrangements were developed in each thickness. The units have an effective operating temperature range of −65 to 85 degrees C.

The battery, RM 312, was designed for modules requiring a self-contained source of power. The battery measures .305" in diameter by .135" thick.

These new components have been developed and are being produced for the Army Micro-Module Program.

CRT ADAPTER

B & K Manufacturing Co., 3726 N. Southport Ave., Chicago 13, Ill. has announced the availability of a handy new CRT adapter for the testing and rejuvenating of 110-degree picture

tubes having 2.34, 2.68, and 8.4 volt filaments.

The new adapter is designed for use with the firm's Models 400 and 350

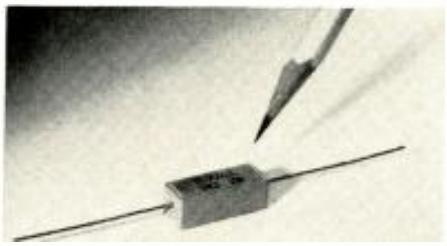
cathode rejuvenator testers. It is merely plugged into the unit and is ready for immediate use.

For complete information on the new Model CR48 adapter, write the manufacturer direct.

NEW WIREWOUND RESISTORS

Hamilton-Hall Resistor Corp., 227 N. Water St., Milwaukee 2, Wis., has recently introduced a new line of 2-watt wirewound resistors which are priced to sell from 5% to 27% below comparable carbon units.

The new units are available in three tolerances: ±5%, ±10%, and ±20%. The resistance range is from .270 ohm



through 4700 ohms. The resistors are made in rectangular shape, 5/16" high x 5/16" wide x 7/8" long, with 1 1/8" tinned copper axial leads.

The resistors are highly resistant to humidity and carry permanent lifelong markings of resistance, tolerance, and wattage.

Complete details and prices on this new line will be supplied upon request to the manufacturer. —30—

PACIFIC HAMS MEET

THE American Radio Relay League Pacific Division Convention will meet at San Jose, California on July 3, 4, and 5.

Mr. Goodwin L. Dosland, president of the League, will be the main speaker at the radio affair, which will include technical talks by leaders in the amateur radio and electronics fields.

The convention will feature entertainment, a ladies program, and a steak barbecue, among other events.

Hotel and motel accommodations are available in the Greater San Jose area, and headquarters at the Hotel St. Claire are in the central downtown area.

The convention is being sponsored by the Associated Radio Clubs of Greater San Jose. Hams and non-hams may receive details by contacting "ARCs," P. O. Box 6, San Jose, Calif. Registration fee is $7.50 and pre-registration deadline is June 20. —30—

The Summer Slump

(*Continued from page 55*)

make available schematics and service data, provide training materials, advise on the requirements for and procurement of FCC licensing for work on the transmitters, and fill in on what additional equipment will be required beyond that already available in the shop.

As for industrial electronics, many local hospitals and non-electronic manufacturing firms use controls and other electronic gear in daily operation. As a rule, service and maintenance by the manufacturer-installer, usually not nearby, is expensive and inconvenient for both parties. Many alert local independents have been able to step into the breach here by soliciting business from the user. Although unfamiliar, these devices are generally far simpler and more straightforward to service than the average TV receiver. After contact with the user and determination of what equipment he has on hand that may need work, direct correspondence with the manufacturer for technical data concerning operation, characteristics, maintenance, and replacement should be undertaken. Some manufacturers are still reluctant to divulge such information. The number who will cooperate because they have been forced to accept the fact that local service is the only feasible solution is growing.

One "natural" not to be overlooked is the installation of lightning-protection systems on homes, farms, churches, and other buildings. Apparently unrelated to electronic service, the equipment and techniques involved are strikingly parallel to those in antenna-installation work. In addition, antenna work can be used as a wedge for selling protection systems, and *vice versa*. Furthermore, interest in this direction is highest during the slow summer months. As though this weren't enough, the service dealer seeking entry into this field will find a welcome mat facing him rather than a "keep-out" sign.

Manufacturers of protection systems face a paradox. On the one hand, there is an impressive number of properties throughout the country still requiring protection. On the other hand, makers have not succeeded in reaching owners of these properties through existing dealerships. This sideline shapes up as a most promising one. For further details, see our article on "Facts about Lightning Protection" on page 59 of this issue.

In conclusion, slumping business, whether it is seasonal or long-term, has its cures, but none of these is in the easy-miracle class. Push your regular type of work harder with promotion. For a summer boost, the newly opening field of lightning protection is a sleeper. For a year-round boost, 2-way mobile communications looks like a good bet, with other diversified electronics fields possible. Good luck! —30—

Stereo Tape System

(Continued from page 68)

teresting possibilities since it has low inherent distortion and low output impedance.

The two 10-watt power amplifiers used in this system consist of two identical amplifiers with circuitry as shown in Fig. 6. This is a direct-coupled amplifier with excellent low-frequency response and also has the advantage of a feedback arrangement for current stabilization of all stages. The feedback system also stabilizes the voltage division across the power output transistors, V_5 and V_6, which operate in a class B push-pull arrangement. V_3 and V_4 also operate class B in the familiar Darlington connection to increase the current gain. Using an *n-p-n* for V_4 gives the required phase inversion for driving V_6 and also has the advantage of push-pull emitter-follower operation. V_5 and V_6 have a small forward bias to minimize crossover distortion. This bias is set by the voltage drop across the 1000-ohm resistors (R_9 and R_{10}) that shunt the input to V_5 and V_6. V_3 and V_4 are biased for the same reason with the voltage drop across the 1N91. A 68-ohm resistor would serve the same function as the 1N91 except there would be no temperature compensation. Thermistors have also been used to compensate for the temperature variation of the emitter-base resistance, but they do not track this variation as well as a germanium junction diode which has temperature characteristics similar to the transistor.

V_2 is a class A driver requiring a very low-impedance drive which is accomplished by an emitter follower, V_1. V_1 needs a current source for low distortion thus R_1 was set at the maximum value which would allow the amplifier to be driven to maximum output with the Standard Reference Level into the preamp.

The bias adjust, R_2, is set for one-half the supply voltage across V_6 and can be trimmed for symmetrical clipping at maximum power output. The .001-μfd. feedback capacitor (C_5) from collector to base of V_2 aids in stabilizing this circuit by reducing the phase shift and high-frequency gain of this stage. The 100-μμfd. capacitor (C_2) shunting the bias network further aids the stabilization with high-frequency negative feedback from output to input. This circuit has approximately 15 db of over-all feedback with the 24,000-ohm resistor (R_4) from load to input. The speaker system is shunted by 22 ohms (R_{11}) in series with .2 μfd. (C_7) to prevent the continued rise of speaker impedance and its accompanying phase shift beyond the audio spectrum.

The over-all result from using direct-coupling, no transformers, and ample degeneration, is an amplifier with output impedance of ½ ohm for good speaker damping and very low total harmonic distortion, as shown in Fig. 8. The frequency response at average listening levels is flat over the audio spectrum and the maximum power response is shown in Fig. 14. The amplifier square-wave response is shown in Fig. 13. All of the data was obtained using an amplifier load of 16 ohms.

Figs. 11 and 12 show the construction and layout of both 10-watt amplifiers on a single aluminum chassis. V_5 and V_6 of Fig. 6 are mounted on a common heat radiator which is insulated from the chassis. See Fig. 11. One of these transistors must be insulated from the common heat radiator. The author placed a thin sheet of mica between transistor V_6 of both amplifiers and the *Delco* automobile radio heat sink. These aluminum heat sinks could have been sawed in half for direct mounting of each of the four power transistors. Another method would be to mount each power transistor directly on a 3" x 3" x 3/32" aluminum plate, with each of the four plates insulated from each other and also insulated from the chassis.

The two 10-watt amplifiers use the common power supply of Fig. 15 which provides excellent isolation for each amplifier. Figs. 16 and 17 show the layout and construction of the power supply used by the author. Mounting hardware and mica washers are furnished with the 1N1115 silicon rectifiers. The aluminum power supply chassis (Fig. 16) is the heat radiator for the bridge rectifier system that is used to deliver the required d.c.

Although the construction described may seem fairly complicated and be relatively expensive, the results obtained have fully justified the author's outlay of time and effort. —30—

COMPACT METER MOUNTING

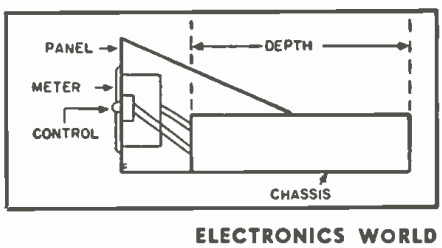
By CHARLES ERWIN COHN

WHEN building equipment designed to go into a relay rack, it is often found desirable to keep the panel height low so that as many chassis as possible can be placed in one relay rack. It often happens, however, that these units must have meters on their front panels.

If the conventional construction ordinarily employed is used, the panel must have a height equal to the sum of the chassis and meter heights. However, if the parts on top of the chassis are not too high, space can be saved by adopting the construction technique shown below. Here the chassis is spaced behind the panel far enough to clear the meters and the panel height need only be sufficient to accommodate the meters.

If equipment constructed this way is to be used in an enclosed rack, the maximum possible chassis depth will be reduced by the amount of the panel clearance needed. —30—

Method described in text.



Tame TV "Dogs"

(*Continued from page 58*)

the voltage drop across all the resistors in the network. Look at this diagram (Fig. 3). You should measure a voltage drop across R_3, R_4, and R_5 only—nothing across R_1, R_6, or R_7. While you're at it, check the delay resistor, R_2, to make certain that there isn't too much delay."

"Boy!" Phil exclaimed. "If I had used that procedure this morning it would have taken only minutes instead of hours to find the trouble!"

"Incidentally, if you do get a voltage reading across R_1, R_6, or R_7, it indicates grid current in the i.f. stages, probably resulting from a leaky coupling capacitor."

"What if the trouble doesn't lie in this section—how do we further isolate the breakdown?"

"With a scope adjusted for maximum gain connected across the video-detector load resistor," Harry replied patiently.

"A scope! What then?"

"Vary the a.g.c. clamp voltage with the control on the bias box and look for a signal waveform on the scope. If you see it, adjust the clamp voltage for the nearest thing to a normal looking signal; then scope-trace the waveform on the grid of the a.g.c. keyer and the plate and grid circuits of the stages between the video detector and picture tube for a distorted signal. When you find a stage with a distorted waveform, use your v.t.v.m. for voltage and resistance measurements to find the defective component."

"What if we don't get a signal at the video detector, or if the signal we do get is already badly distorted?" Phil asked. "What then?"

"In that case the bug is in the tuner or i.f. stages; routine scope or voltage and resistance checks should pinpoint the trouble. The important thing is that we have quickly and systematically cut down a broad trouble area to working size. And that, my friend, is what I mean by standard isolating procedures. Think you can use it?"

"I don't see why I shouldn't try it."

As a matter of fact, Phil didn't think much of the system when he first began using it. Like anything new, it took some getting used to. Then, after a week or so, he just took it for granted and stopped thinking about it.

It wasn't until a few weeks later that he thought about it again. He was in the middle of a relaxed coffee break and didn't interrupt it to dive back to the bench just because the boss happened to walk through. Considering the number of jobs he had already tackled that day, Phil felt entitled to coast for a while. Evidently the boss felt the same way, because he just smiled, nodded, and passed along. It occurred to Phil that neither he nor the boss would have taken that attitude a few weeks before.

—30—

Service Industry News

THE TWO leading service industry conventions that are held annually during the month of August will be of more than usual interest to service dealers this year. The first of these annual affairs, by two weeks, will be the widely acclaimed Clinic and Fair sponsored by the Texas Electronic Association. It will be held in San Antonio, Texas, on August 7, 8, and 9, with TEA of San Antonio serving as the host organization.

In keeping with the intense competition among Texas cities to better the record of each preceding Clinic and Fair, members of the San Antonio affiliate have set an attendance goal of one-thousand dealers and technicians for their 1959 show. Their well-organized ladies auxiliary is arranging a full schedule of events for the wives who accompany their husbands to the fair. Information about the Texas Electronic Association annual convention may be obtained from Clarence Schertz, Clinic Chairman, TEA of San Antonio, 810 East Commerce Street, San Antonio, Texas.

The other highlight on the service industry horizon is the annual NATESA convention. It is scheduled for August 21 to 24 at the Congress Hotel in Chicago. In addition to the large number of smaller associations that have joined the national alliance since its last convention, it is reported that two of the largest service associations in the industry are in the process of affiliating with NATESA. (See "For the Record," June 1959.) There is a strong trend in the direction of alleviating intra-industry friction to enable the service industry to present a united front in its drive to accomplish the needed objectives. Information about the NATESA convention may be obtained from Frank J. Moch, Executive Director, NATESA, 5908 South Troy Street, Chicago 29, Ill.

Delaware Valley Officers

The Television Service Association of Delaware Valley recently installed the officers who will head the organization during the coming year. Samuel Brenner of *Samuel Brenner TV Service,* took over the post of president. Other new officers include Tony D'Annibale, of *Alert TV,* vice-president; Louis J. Smith of *Louis J. Smith Service Co.,* re-elected corresponding secretary; Raymond Fink, of *Fink's TV Service,* recording secretary; and Ralph Newby, of *Newby's TV Service,* treasurer.

The TSA directorate includes Ray H. Cherrill, Samuel Brenner, Ralph Newby, Raymond Fink, Louis J. Smith, John McCloy, Dave Krantz, Tony D'Annibale, Herman Shore, and Henry Whelan.

Successful Ohio Convention

The successful spring convention of the Television Electronic Service Association of Ohio, held in Toledo, aptly epitomizes the rapid spread of interest in association activities that develops when a strong state-wide service organization is created. TESA of Ohio is comprised of local associations from more than twenty communities in the Buckeye State.

Russell Harmon, past president of NATESA and member of TESA-Cincinnati, is president of TESA-Ohio. Other officers serving with Mr. Harmon include Don Sisk, past president of ARTSD of Columbus, 1st vice-president; V. H. Bailey, past president of TESA of Dayton, 2nd vice-president; Vern La Plante, past chairman of ETAT of Toledo, 3rd vice-president; John Graham, president of ARTSD of Columbus, secretary; and Marvin Miller, vice-president of TESA of Springfield, treasurer. The address of TESA-Ohio is: John Graham, secretary, 2552 North High Street, Columbus, Ohio.

The state organization is making an aggressive drive to get a service licensing bill passed during the current session of the Ohio State Legislature. The organization is soliciting funds from service dealers and technicians to help finance its campaign to get action on favorable legislation. The association's legislative committee address is: TV Educational and Welfare Fund, P.O. Box 851, Springfield, Ohio.

Printed-Circuit Survey

Results of the poll conducted by NATESA to take the guesswork out of the nature of service complaints concerning TV sets using printed boards (see "Service Industry News," June 1959) are being evaluated. Many conclusions, as valuable to the industry as they are interesting, are already clear. For example, far more problems are being attributed to secondary considerations (the manner in which the boards are used) than to the direct fact that boards are involved. Most of the former can be solved.

Inaccessibility of the boards was a strong complaint, as were difficulties in tracing circuits and pinpointing failures. Problems involving conductor lifting and board breakage were also cited, but these appeared to be on the downgrade. Of all service calls made, about one-half of one per-cent involved printed boards. Slightly more than

half the technicians surveyed felt that sets using the boards required more service than hand-wired receivers, with most of the remainder feeling that there was no significant difference.

Inconvenient mounting of components on both sides of a board and the absence of component and circuit coding were considered great handicaps, especially since color coding of wiring is not feasible. Poor mounting of tube sockets, controls, and other components were other impediments.

Coding on the boards themselves, the use of several smaller boards as against fewer larger boards to facilitate localization, and panels with components mounted on one side only were judged to be significant in relieving problems. Many manufacturers have already begun to adopt such measures and others are promising to do so. With manufacturer cooperation, the boards may eventually come to be regarded as blessings by service, as the poll also revealed some advantages. One of these is that set owners, evidently awed by the boards, are less willing to experiment with repairs themselves!

Winning Back Tube Sales

A successful campaign against tube sales in non-service outlets has been developed by distributor Milt Bursma of *Bursma Radio Supply Co.*, Grand Rapids, Mich. Key factor is a series of newspaper ads embodying a program worked out with the cooperation and consent of local service shops after many conferences. Key points hammered home by the ads include: the inadequacy of many drug-store testers in evaluating tubes, the frequently poor operating condition of these testers, and the importance of technically qualified personnel in evaluating the readings of any tester properly. Ads also emphasize that only guaranteed, first-quality, name-brand tubes will be sold by service shops. Cooperating dealers, who are listed in the advertisements, agree to test tubes free. Each of them—there are more than 70—gets a large banner tying in with the program for shop use.

G-E Service Lectures

Using a dynamic demonstrator to simulate receiver troubles with switching circuits and inviting attending technicians to diagnose the troubles, the *General Electric* Training Staff has been conducting a series of "Serviceability" lecture-demonstrations of its latest "Designer" chassis line in the New York-New Jersey area. The audience-participation feature was being received favorably. Emphasis was placed on techniques for servicing the somewhat unusual chassis layout which, it is claimed, permits trouble-shooting and replacement of 90 percent of the components without removing the set from its cabinet. Following each demonstration, a question-and-answer period is conducted by Ed Tilin, TV Product Service Specialist. More such programs will be scheduled in the fall.

Individual Service Bonds

Long associated with a program for bonding service dealers, *Raytheon Co.* will now provide cooperating dealers with individual 90-day warranty bonds to be filled in by the dealer and presented to the customer on the completion of repairs. The bond itself and the cooperating dealers who will issue them are to be publicized by *Raytheon* in magazines, through radio, and in other media. —30—

Expanded-Range A.C. Meter

(Continued from page 69)

diode remains constant but voltages across the resistors in the bridge change. This unbalances the bridge, with current flow through the meter indicating the degree of imbalance.

If the d.c. voltage applied to the bridge is made proportional to the a.c. voltage we wish to measure, we then have an expanded-scale a.c. meter, with the voltage at which the bridge is balanced (no meter deflection) representing the bottom of the scale rather than zero. In this design, a small selenium half-wave rectifier and an electrolytic capacitor produce a d.c. voltage proportional to the peak of the a.c. line voltage.

The zener diode, type 1N1320, is a *Hoffman* silicon rectifier whose breakdown (constant) voltage will fall in the range between 30 and 40 volts. For the particular one used, this happened to be 36 volts. The resistor in series with the meter, R_4, serves a dual purpose. It tends to limit current through the diode during maximum imbalance to a safe value. It also limits current through the meter to that required to produce full-scale reading for the highest voltage to be measured. Actually a 2-milliampere meter could have been used in this configuration without exceeding the diode's ratings, but the 1-milliampere meter is more likely to be available.

To adjust the circuit a variable a.c. source, such as a variable-voltage transformer, is necessary. For optimum accuracy, a reliable voltage standard is also necessary. An auxiliary, precision a.c. voltmeter may be borrowed. Assume that a range of 95 to 135 volts is desired, as was the case with the author. With 95 volts a.c. applied, the value of R_3 is adjusted until the meter indicates no deflection. This was done by starting with a 10,000-ohm resistor shunted by a 50,000-ohm potentiometer, with the latter adjusted until the bridge was balanced. The final value of the combination was then measured with an ohmmeter and fixed resistors making up the value were substituted.

Next the applied a.c. voltage was increased up toward 135 volts. If the meter tends to be driven off-scale before the top voltage desired is reached, the meter movement can be shunted with a variable resistor. The latter is then adjusted to produce full-scale deflection at 135 volts a.c., and a fixed resistor of the proper value may then be substituted across the meter permanently. No such resistor is shown here because, for the range desired, none was needed.

If deflection is *insufficient* at 135 volts, shunt R_4 with a variable resistor and adjust for a full-scale reading at the desired point. Some detail has been given to variations in the adjustment procedure because the particular expanded range worked out here is not

the only one possible. If another range is desired, manipulation of circuit values as described is used.

In this case, the auxiliary a.c. voltmeter used for calibration was a precision, moving-vane device. This type reads true r.m.s. values, whereas the expanded-range indicator described is a peak-reading instrument. Since the calibrating voltage used was slightly distorted, showing some peaking, the finished instrument reads slightly low on pure sine waves. However, this distortion is quite common in power lines, so the accuracy of the expanded-range meter is entirely adequate.

The final meter scale was drawn with India ink on a piece of white paper, which was fixed to the back of the meter's face plate. If the completed instrument is going to be mounted in a steel panel, incidentally, adjustment and calibration should be done while the meter is so mounted. —30—

Mac's Service Shop

(*Continued from page* 64)

geon would probably want to do a little studying before attempting to deliver a baby!

"How about the ham's returning the transmitter to the manufacturer? There they should have the required knowledge, testing facilities, and replacement parts."

"That's a good last resort, but it has some drawbacks," Barney answered. "For one thing, trying to crate a heavy, delicate transmitter so it can be shipped without damage is about as easy as trying to wrap up a scythe in a newspaper. Even after the transmitter has been repaired it still has to make the rough trip home and it's quite likely to develop some new troubles as a result of this shaking up. Moreover, factory service is notoriously slow; and the average ham can't bear to be without his rig a day longer than necessary."

"OK, then; what's your answer to the problem?"

"I'm old-fashioned enough to think the best answer is still for the ham to educate himself to repair his own rig. Acquiring the knowledge of what's going on inside the equipment is a very large part of the fun of hamming. The guy who only operates misses all this. And really it is not too hard. Even the most complicated transmitter is simple, circuit-wise, when compared to a TV receiver."

"That's right. If the new ham would sit down as soon as he buys his transmitter and puzzle out the function of every part shown on the diagram, he'd be off to a running start. Once he knew what every part was supposed to do, he could consider the symptoms and make a shrewd guess as to which one had fallen down on the job."

"Check! Another thing he can do is keep a notebook of the comments he hears about his rig on the air. Every time he hears a fellow ham talking

about trouble, its cause, and the cure with that particular transmitter, he should write it down. Each model transmitter has certain weak points that fail in unit after unit, just as is the case with TV receivers. That notebook can be a real help when trouble comes."

"Of course," Mac added, "he'll need some test equipment—at least a good v.o.m."

"Sure, and he should use it to do his darndest to find the difficulty himself. However, when he can't do it, he should next hunt up another ham with lots of experience and know-how. Many of these old-timers or just plain sharp boys are scattered around over the country. They are invariably willing to help a fellow ham who is really stumped, but they don't like having the problem just dumped in their laps without the owner's trying to help himself. These outstanding hams are almost sure to have good test equipment and access to substitute parts; but far more important they have a command of theory and a wealth of experience to help them. The new ham who can make a friend of one of these has a great treasure, and he will be wise not to abuse the friendship by asking for help with things he can do for himself."

"Amen!" Mac agreed heartily. —30—

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59	Independent Protection Co., Inc.
60, 61, 62	Sylvania Electric Products
90	Delco Division
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HAM CLUB DOINGS

THE Tenth Annual Gabfest of the Uniontown Amateur Radio Club will be held on Saturday, July 11th at the Club House on Old Pittsburgh Road, Uniontown, Pa.

Hams from Pennsylvania, West Virginia, Ohio, and Maryland are invited to join the locals—along with those who may be visiting in the area.

The committee has planned an interesting and exciting program. For full details on the event call W3PIE, the Club Station, P. O. Box 849, Uniontown, Pa.

* * *

THE Sheridan Radio Amateur League whose Annual Wyoming Hamfest was announced in last month's issue has had to reschedule its meet since fire has destroyed some of the previously announced facilities.

The event will now be held in the Caribou Recreational Area of Big Horn National Forest, 28 miles west of Buffalo, Wyo. The dates, July 25-26, remain unchanged. Cabins and camp sites will be available. All other details are as stated on page 120 of the June issue of this magazine.

* * *

THE 1959 ARRL New England Division Convention will be hosted by the Hartford County Amateur Radio Assn. on Labor Day weekend, September 5-6, at the Statler-Hilton Hotel in Hartford, Conn.

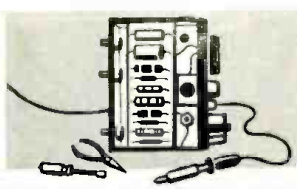
Some 1500 amateurs are expected to attend the affair which will feature a full program of technical sessions as well as social doings of interest to all.

For information on registration and a complete program, contact the host club, P. O. Box 242, West Hartford 7, Connecticut. —30—

AWARD WINNERS

Victor H. Pomper, vice-president of H. H. Scott, Inc., has been chosen as one of the ten outstanding young men of the year by the Boston Junior Chamber of Commerce. He was honored for his contributions to the field of electrical engineering.

William H. Thomas, president of James B. Lansing Sound, Inc., was named "Business Man of the Year" and his company was titled the "Most Outstanding and Successful Business" by the Los Angeles Chapter of the National Association of Accountants. Mr. Thomas (right) is being presented the award by Mr. H. Kamph, who is past president of the chapter.



ELECTRONICS MARKET PLACE

RATE: 50c per word. Minimum 10 words. September 1959 issue closes July 10th. Send order and remittance to ELECTRONICS WORLD. One Park Ave., N. Y. C. 16, N. Y.

RADIO ENGINEERING

ELECTRONICS! Associate degree—29 months. Technicians, field engineers, specialists in communications, missiles, computers, radar, automation. Start September, February, Valparaiso Technical Institute. Dept. N, Valparaiso, Indiana.

FOR SALE

MARINE receivers for fishermen, ARC-5 Complete unused $9.95, Also 6-12-24VDC Converted, Hoey and Co., Hayward Airport, Hayward, California.

4000V 6UFD, new divided, $5.56, JRJRCO, 201 Fernwood, Evansville, Ind.

NEW AMPEX 350-2P $1560; 350-2U $1485; A 122 $466. Grove. Roslyn, Pa. TUrner 7-4277.

WALKIE-TALKIES Hand sized two-way radios. Any citizen may operate. Several miles range. $49.95. Kit $34.95. Free information. Dixon Electronics, 13444 West McNichols, Detroit 35, Michigan.

MOTORS airway 2400—275 volt D.C. Blower assembly. Suitable circulator for transmitter, small fan, toys and experimental use $1.89 while they last. Motors, Box 416, Edna, Texas.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

TELEVISION Sets $9.95 plus shipping. Jones TV, Sanatoga, Pa.

RADIO & TV Tubes at manufacturers prices. Guaranteed—Send for free price list. Edison Electronic Tube Co., Menlo Park, N. J.

TELEVISION & Radio Tubes, Parts and Supplies Guaranteed. Hi-Quality Tube Co., Inc., 284 Lafayette St., Rahway, New Jersey.

TUBES—Radio—Television, Guaranteed big discount. Atom Tube Co., Inc., 1709 Lawrence Street, Rahway, New Jersey. Distributorship openings at present.

GOVERNMENT Sells—Surplus Electronics; Walkie-Talkies; Transceivers; Test Equipment; Oscilloscopes; Radar; Voltmeters; Misc—Fraction of Army costs—Buy direct now from U. S. Government—"Depot List & Procedure" $1.00—Brody, Box 8-RT, Sunnyside 4, N.Y.

GOVERNMENT Surplus Snooperscopes, parabolic reflectors, Receivers, Transmitters. Picture list 10¢, Meshna, 580 N. Lynn, Malden 48, Mass.

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.

GIZMOS & Such of Still River, Mass., offer a limited number of BC779 Hammerlund super pros guaranteed to please at $74.50 each.

FOREIGN Auto Radio Distributor, FM-AM and AM, trade discount. Square Electronics, 150-60 Northern Blvd., Flushing, N. Y.

RADIO & TV Tubes at Manufacturers Prices! 100% Guaranteed! Brand New! No re-brands or pulls! United Radio, Box 1000, Newark, N. J.

CRYSTALS Guaranteed: 2 to 80 meters FT-243. Holders, 3 for $1.00. SSB crystals FT-241A. 10¢ each. Lists available. Quaker Electronics, 1040 West Main Street, Plymouth, Penna.

FREE Fluorescent Lighting Bargain Catalog—Easily assembled kits; repair parts; fixtures. Shoplite, 650 N. Franklin, Nutley 10, New Jersey.

ANODIZED Aluminum Nameplates, Labels, also printed circuits, all types. Describe problem for price quotation. Mahler Research, Box 1159, New York 1, N. Y.

PRINTED Circuits serviced easily. $1.00 postpaid. Address, "Snooper" P. O. Box 934, Dunedin, Florida.

FT-234A Single Mounting Rack for BC-457, BC-458, etc., Command Transmitters, brand new postpaid $1.50. Bauer Industrial Supply Co., 17170 Redford, Detroit 19, Mich.

INDIVIDUAL screen printed panels, preformed chassis, Printed Circuit Boards custom made. Kits and projects assembled. Send specifications or magazine layout. Electronic Aids, Box 137, Stamford, Conn.

NEW: Citizens Band Class "D" Communications Transceivers. Meet FCC requirements, adjacent channel selectivity. Model CB-27910 Includes crystals for one channel, mic, and antenna $89.50. Brochure on request. Ray J. Wood Jr., P. O. Box 10417, St. Petersburg, Fla.

TUBES—Radio & Television. Also Picture Tubes. one year Guarantee. Rad-R Tube Co., P. O. Box 27, Rahway, New Jersey.

WANTED

CYLINDER and old disc phonographs. Edison, Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Classified Box 50 % Electronics World, 1 Park Ave., N. Y. C. 16, N. Y.

CASH Paid! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, klystrons, broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone. Barry, 512 Broadway, New York 12, N. Y. WAlker 5-7000.

LABORATORY Quality Equipment and Military Surplus Electronics bought, sold. Engineering Associates, 432 Patterson Road, Dayton 9, Ohio.

TUBES Wanted: Receiving, transmitting, special purpose, any type, make, quantity. Must be clean. Highest prices paid. Write, wire, or phone J.S.H. Electronics Co., 1108 Venice Blvd., Los Angeles 15, Calif. RIchmond 9-7644.

1940 SCOTT Radios Phantom Deluxe 20 tube, Paul Moses, Taylor Street, Lexington, Va.

MOVING?

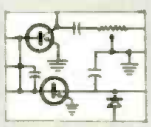
Make sure you notify our subscription department about any change of address. Be sure to include your postal zone number as well as both old and new addresses. Please allow four weeks' time for processing.

ELECTRONICS WORLD
434 South Wabash Avenue
Chicago 5, Illinois

REPAIRS and SERVICING

ALL Makes High Fidelity Speakers Repaired. Amprite, 70 Vesey St., N. Y. 7, N. Y. BA 7-2580.

INSTRUCTION



CAMERA Repairmen greatly needed! You can learn manufacturers' service methods at home, in your spare time! Free, big illustrated book tells how! Write today, National Camera Repair School, Dept. ZR1. Englewood, Colorado.

1959 INDUSTRY Training. Home-Study Drafting, Design, Electronics. Aero Tech, 2162-ZD Sunset Blvd., Los Angeles 26, Calif.

USED Correspondence Courses and Books sold and rented. Money back guarantee. Catalog Free. (Courses Bought.) Lee Mountain, Pisgah, Alabama.

ENGINEERING and Art Degrees earned through home study. Electronics, Electrical, Mechanical, Civil, Physics, Business Administration, Liberal Arts. When writing, specify course desired. Pacific International College of Arts & Sciences. primarily a correspondence school. Resident classes also carried. 5719-C Santa Monica Boulevard, Hollywood 38, California.

CALCULUS or Algebra, Easy Practical Lessons, Four for $1, Mathco, 4256-3 Minmor, Cincinnati 17, Ohio.

IF you have a background in electronics, but are having trouble passing FCC phone exams, my 12 years experience as chief instructor of electronics school can help you over the hump. Not a course. Write me personally for free information. Wallace Cook 1614 Morson Road, Jackson 9, Miss.

TAPE & RECORDERS

TAPE Recorders, Hi-Fi Components. Sleep Learning Kits, Tapes. Unusual Values. Free Catalog. Dressner, 69-02R 174 St., Flushing 65, N. Y.

UNUSUAL values. Hi Fi components, tapes and tape recorders. Send for package quotations. Stereo Center, 18 W. 37 St., N. Y. C.

WE will not be undersold! We meet any competition. Send us any competitor's advertising, showing a lower price for a tape recorder and will not only Meet this lower price, but will include, with your purchase a 1200 foot tape of your choice, Free! (73 models in stock). Commissioned Electronics, 1776 Columbia Road, Washington, D. C.

AMPEX, Concertone, Crown, Ferrograph, Presto, Tandberg, Pentron, Bell, Sherwood, Rek-O-Kut, Dynakit, Others. Trades. Boynton Studio, 10RT Pennsylvania, Yonkers, N. Y.

HIGH-FIDELITY

RECORDERS. Hi-Fi. Free Wholesale Catalogue. Carston, 215-R East 88, N. Y. C. 28.

PRICES? The Best! Factory-sealed Hi-Fi Components? Yes! Send for free catalog. Audion. 25T Oxford Road, Massapequa, N. Y.

DISGUSTED with "Hi" Hi-Fi Prices? Unusual Discounts On Your High Fidelity Requirements. Write. Key Electronics, 120 Liberty St., New York 6, N. Y. EVergreen 4-6071.

BUSINESS OPPORTUNITIES

RADIO parts stores and Hi-Fi salons! Someone "borrowing" your personal copy of Electronics World each month? You ought to be taking advantage of Electronics World convenient re-sale plan. Sell copies in your store . . . perform a good service for your customers . . . with no risk involved. For details, write: Direct Sales Department, Electronics World, One Park Avenue, New York 16, New York.

TV Picture Tube rebuilding plant and training program still available for many territories. Investment $8,000-$11,000. Annual volume $25,000 to $100,000. Windsor Co., 999 N. Main St., Glen Ellyn, Ill.

JOBS Overseas! Write Janecek Development Co., 109 Hub Station, New York 55, N. Y.

EARN Extra money selling advertising book matches. Free Samples furnished. Matchcorp, Dept. MD-79, Chicago 32, Ill.

MAKE $25-$50 Week, clipping newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. National, 81-DG, Knickerbocker Station, New York.

FOR Sale. Prosperous, well established marine electronics business at peak of operation. Must sell all or part due to illness. James Electronics, 308 W. 6th Street, Panama City, Florida.

SOUND business for sale. Equipment, trucks, all contracts—no competition. Distributor for major lines. Owner retiring. Quality Sound Service, 1217 N. Wilson Way, Stockton, Calif.

SELF Service Tube Testers. Now you can trade-in your obsolete testers at Calex Manufacturing Company for latest model, 123 socket console model 603. We allow $65 trade-in value for every unit—any make, any model. Calex Manufacturing Inc., Amityville, N. Y.

MISCELLANEOUS

DECALS—Trademarks, Service, Sales, etc., Write Allied Decals, Inc., 8378 Hough, Cleveland, Ohio.

REBUILT Reconditioned Typewriters, Printing, duplicating machines $25.00 Up. Dixie, King, N. C.

KIT and custom building of any equipment, Kwikit, P.O.B. 111, Brooklyn 19, N. Y.

SHOPPING GUIDE *Classified*

A HANDY GUIDE TO PRODUCTS, NOT NECESSARILY ELECTRONIC, BUT OF WIDE GENERAL INTEREST.

PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

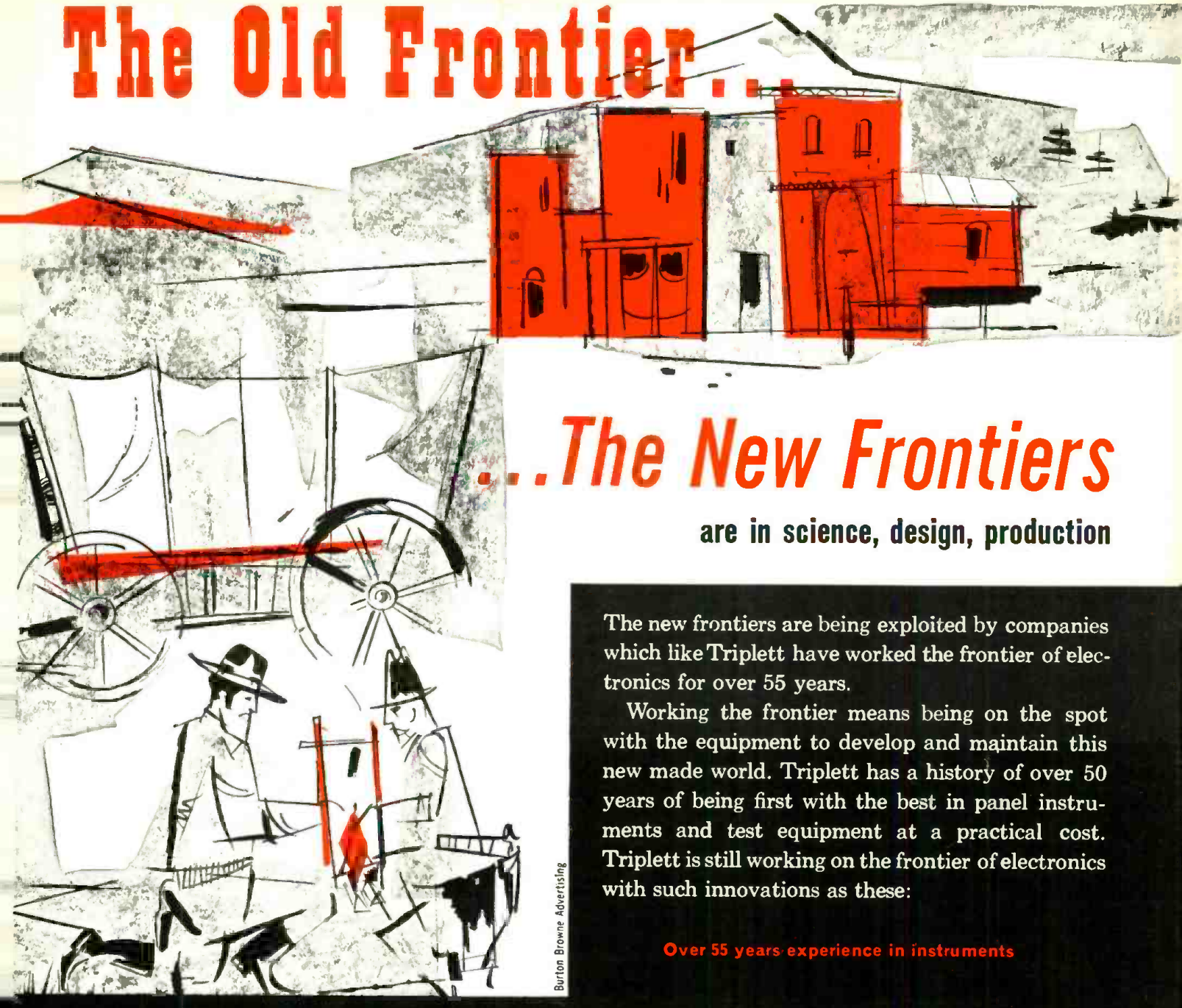
STAMPS & COINS

MISCELLANEOUS

INDEX OF *Advertisers*

JULY 1959

The Old Frontier...



...The New Frontiers

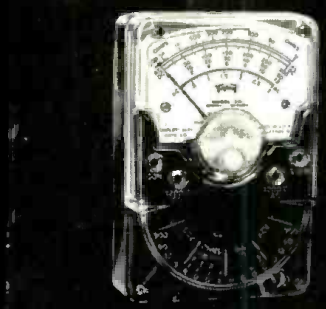
are in science, design, production

The new frontiers are being exploited by companies which like Triplett have worked the frontier of electronics for over 55 years.

Working the frontier means being on the spot with the equipment to develop and maintain this new made world. Triplett has a history of over 50 years of being first with the best in panel instruments and test equipment at a practical cost. Triplett is still working on the frontier of electronics with such innovations as these:

Over 55 years experience in instruments

Burton Browne Advertising



Model 310 a complete miniature V-O-M with single switch selection and the ranges and accuracy of units several times its size. Used with Model 10 clamp-on ammeter plugged in it becomes one of the world's most versatile pieces of test equipment—even measuring current flow without stripping wires.

Model 630-PL V-O-M with such advanced features as an unbreakable clear plastic front for wide range, shadowless, instant vision, polarity reversing switch, single king size knob for selecting both range and circuit, continuous resistance readings from 0.1 ohm to 100 megohms.

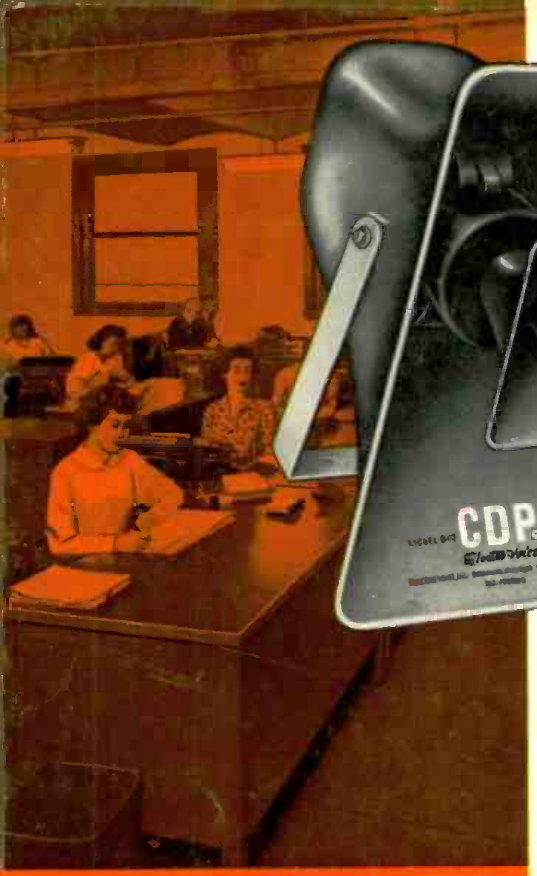
Model 690-A, a new Transistor Tester with more Triplett "plus" in accuracy and simplicity, for testing leakage and gain of all low and medium power PNP and NPN transistors. Small, rugged, battery-operated, it measures DC Beta from 5 to infinity. Affords exact tests for shorts, checks forward & reverse leakage of diodes. Features single switch selection of transistor types, positive "off" to prevent accidental battery drain, separate "calibrate" and "gain" buttons eliminate errors, transistor socket and external leads for any basing arrangement.

New Unimeters—a great step forward in increasing meter inventory flexibility while cutting inventory cost. These Select-Your-Range unimeters consist of only two basic meter movements, which can be combined with any one of a number of separate dial-component units for a wide variety of meter ranges. Movements quickly and simply slide onto dial-components and lock together—no soldering, no wiring. Exclusive Triplett Bar-Ring construction for self-shielding, greater accuracy and sensitivity.

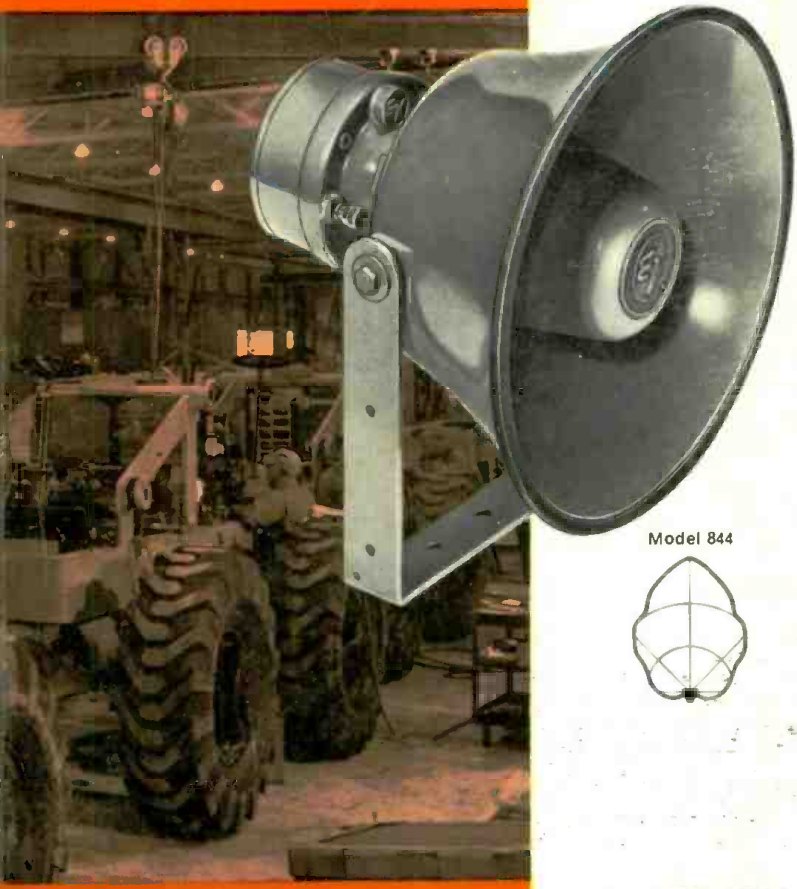
TRIPLETT

Triplett Electrical Instrument Company
Bluffton, Ohio

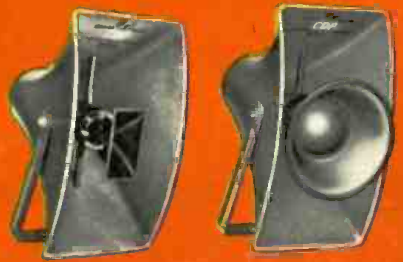
Throughout the world Triplett first . . . to last



Model 847



Model 844



848 CDP

848LT CDP

Musicaster

HEAR PAGING Clearer...Easier

SAVE MONEY, TOO!

advanced engineering assures
CLEARER COVERAGE with FEWER SPEAKERS
...improves efficiency...reduces listener fatigue

Every installation further proves the efficiency, utility, and economy of E-V sound projectors. Messages become easier to understand without listener fatigue. At the same time, you save cost by using fewer speakers for proper coverage of the listening area. Wherever paging is required, get the benefit of natural voice reproduction.

Choose the Type Designed to Meet Your Paging Needs

WIDEST DISPERSION. Exclusive CDP dual-diffraction design* gives uniform, wide angle coverage at all frequencies . . . no dead spots, no hot spots. Exclusive E-V compound horn reduces compression distortion to as low as 2% at full power—thus assuring minimum listener fatigue at any sound level. High efficiency performance cuts the need for costly high power amplifiers.

CONCENTRATED COVERAGE. E-V newly designed reentrant projector provides highest intelligibility at lowest cost where sound must be concentrated. Handles twice the power of conventional speakers, for greater penetration.

Model **847** 25-watt CDP. Has two coaxially-mounted horns working from opposite sides of a single diaphragm. Special edgewise-wound voice coil provides 18% greater efficiency. Wide-range response: 250-10,000 cps. Sound pressure level: 114 db. Dispersion: 60° x 120°. Imp.: 16 ohms. Indestructible fiberglass horn. Size: 11¾" x 7¾" x 10¼" deep. Net wt. 6½ lbs.
List Price, $46.33

Model **847-45** CDP with 45-ohm voice coil for intercom applications.
List Price, $47.83

Model **844** 30-watt Reentrant. Diecast aluminum horn, with removable driver, and universal mounting bracket. Designed for easy servicing with field-replaceable voice coil. Wide-range response: 250-10,000 cps. Dispersion: 90°. Sound pressure level: 120 db. Imp.: 8 ohms. Size: 9⅛" diam. x 8¼" deep. Net wt. 5 lbs. 10 oz. List Price, $34.50

Model **844-45** Reentrant with 45-ohm voice coil for intercom use.
List Price, $36.00

(Sound pressure level measured at 4 ft. on axis from 500 to 1500 cps with full rated input.)

E-V sound projectors are extra-rugged for long-life service indoors or outdoors. They are weatherproof, blastproof, splashproof. Actual comparison on the job proves their superiority.

*Design Patent 169,904

Write for Bulletin 258A to Dept. 79-N

No Finer Choice than **Electro-Voice®**

Other Popular Models in the Complete E-V Line

For large area sound reinforcement: Model 848 30-watt CDP or Model 848LT 30-watt Long-Throw CDP, at $75.00 list. For high-fidelity voice and music: the E-V Musicaster at $80.00 list. Remember too, you get even better sound when you choose an E-V high-fidelity professional microphone from today's most complete line.

ELECTRO-VOICE, INC. • BUCHANAN, MICHIGAN