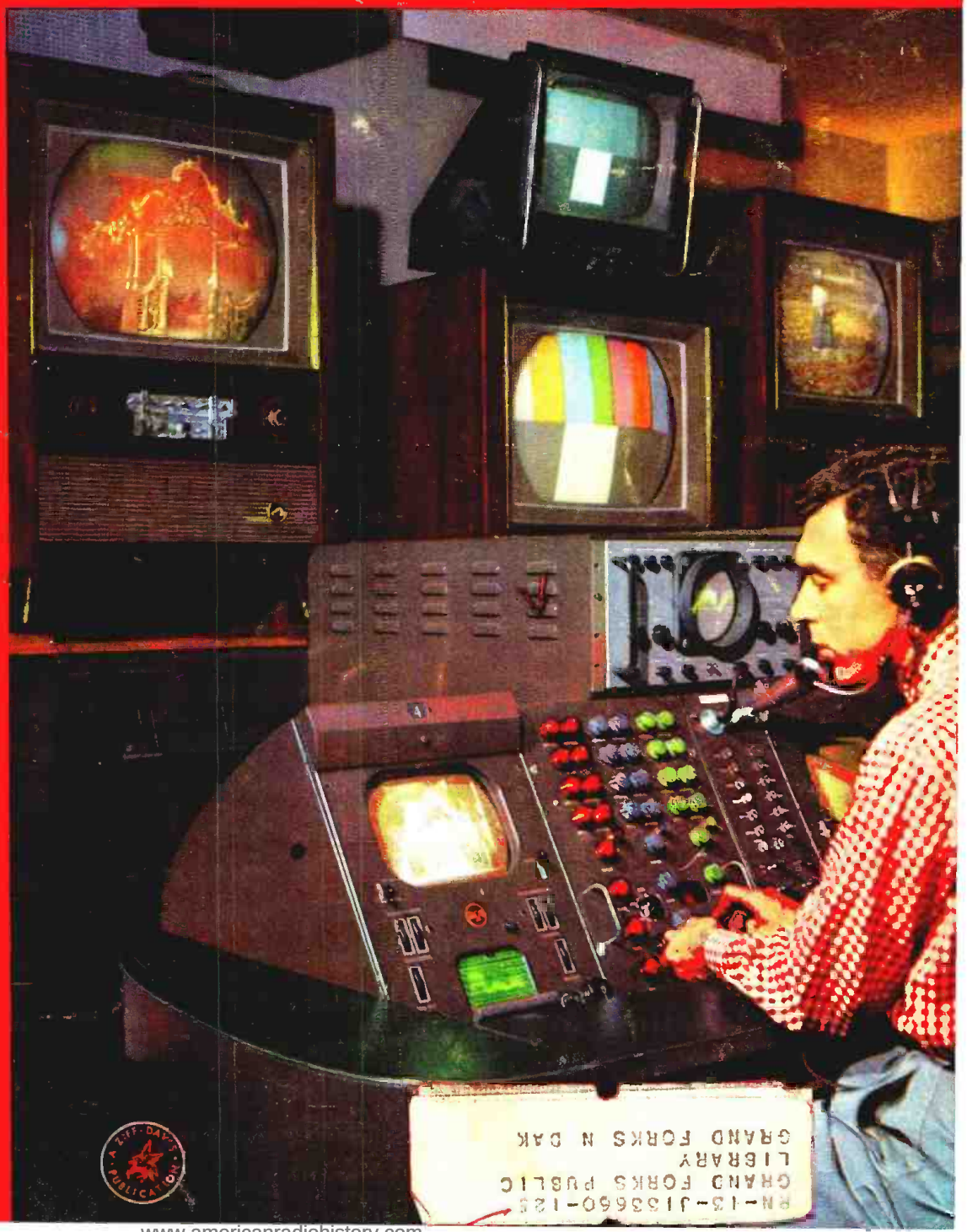
TAPE RECORDING—COMPONENTS AND THEIR FUNCTIONS

RADIO & TELEVISION NEWS

SEPTEMBER
1955
35 CENTS
In U. S. and Canada

World's Leading Electronics Magazine

IN THIS ISSUE



MR. SERVICE DEALER: you're ridin' high, wide an' handsome

in this RAYTHEON **LIFE** ad

September 12th

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In only a few short years, America has created a new guild of skilled craftsmen . . . the electronic technicians who service the nation's 36 million television receivers. It's a big job—one that calls for a high order of technical know-how and a substantial investment in training and equipment.

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4. *Test customers' tubes as accurately as possible.*
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116 pages — over 50 practical applications — complete how-to-do-it instructions. Available from your Raytheon Tube Distributor or send 50¢ to Department P7, Raytheon Manufacturing Company, Newton 58, Massachusetts.

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Your Raytheon Tube Distributor will be happy to help you plan a tie-in campaign that will prove most effective. Call him today.

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COVER PHOTO: One of the color monitors at NBC's new Burbank, California studio. The studio is designed to allow for the growth of colorcasting in the U. S. in the future. (Ektachrome by Peter J. Samerjan)

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WILLIAM B. ZIFF (1898-1953) FOUNDER
Editorial and Executive Offices
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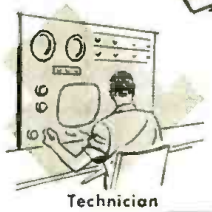
Radio Shop

Set Design



Technician

Repairman

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LET D.T.I. HELP YOU GET STARTED!

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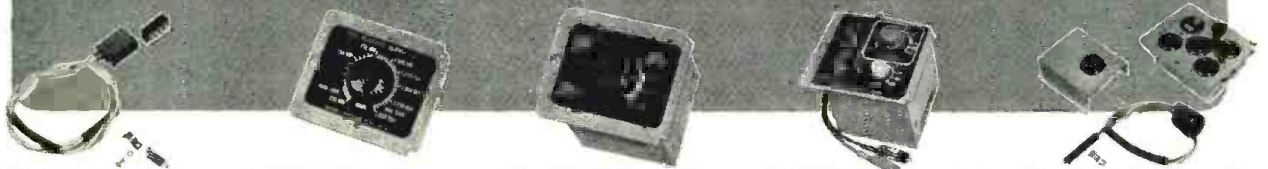

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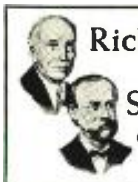

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For the RECORD

BY THE EDITOR

THE $50,000.00 S.O.S. HOAX

THE Eastern seaboard was electrified several weeks ago by distress signals reporting that a fishing boat was afire and in immediate danger of sinking. It followed with a report that a "foreign submarine" in the area had spotted the fire and had rescued several members of the crew, etc.

The U.S. Coast Guard and many other emergency services combed the designated area for many hours and conducted an exhaustive and costly search for signs of wreckage, survivors, or at least an oil slick which might provide some clue as to the fate of the vessel and its crew.

After many hours of fruitless search, reporters in the dailies suggested the possibility that no such vessel had been in distress and that "some ham station" operator probably was guilty of sending out the fake message for kicks. This conjecture on the part of the daily press, based strictly on a very remote possibility, caused a great deal of harm to the radio amateur and his prestige in the eyes of the public. What is even more shocking is that later, after the clandestine operators had been caught and had confessed, these same news reporters did not even have the courage or decency to apologize or retract their inference that a radio amateur operator was *probably* the cause of the hoax.

Actually, the two young men who were responsible for the fake S.O.S. didn't even know the front end of a screwdriver, let alone have any knowledge of communications or the operation of a transmitter. These individuals had, according to the final story, been on a beer binge and in seeking a hideout to serve as sleeping quarters for the night had trespassed aboard a fishing boat which was at its mooring and on which one of them had previously worked.

The two of them were said to have first discussed distress signals and had let their curiosity lead them to the controls of the transmitter. After "fiddling" with these controls, one of them after capture insisted that they had no idea that the transmitter had been turned on. This, of course, was ridiculous, as was later shown.

These violators of the airways were then held in high bail for action by a Federal grand jury. They were charged with operating a radio station without a license and with sending false messages.

It was estimated that this S.O.S. hoax cost the taxpayers over $50,000.00. That's bad enough, but insofar as the radio amateur or ham is concerned, it would be almost impossible to estimate the amount of ill will, seeded in the public mind, created as a result of sheer stupidity and conjecture on the part of the press.

It is an old, old story that amateur radio has received much more than its share of blame for improper operations of many sorts. In the early days of television, as we all well know, hams were immediately damned by the TV viewer for every interruption or disfigurement of TV pictures. Here, again, the daily press did not take the trouble to learn all of the facts before putting the blame on the ham in their columns.

To have this latest distortion of ham radio, we think, is a great injustice to the rank and file amateur who, without question, has in practically every case completely removed spurious radiations, etc. from his equipment so as not to cause interference to TV receivers. Occasionally, there are bonafide instances where such interferences still remain. But, according to every conceivable source of reliable information, including the FCC, such interference is now almost a thing of the past.

We think it's about time that the newspapers exercised a bit of common sense when dealing with copy involving technical things like communications. At least, we feel they should wait for the facts before damning the network of noncommercial radio that has done so much through the years to justify its existence and the respect of the public. Perhaps our newspapers will some day recognize amateur radio at its true value and quit blaming the "ham" whenever the necessity arises for "sensationalism."

Phonorama

The early history and development of the phonograph will be featured at our display in room 514 at the Hotel New Yorker, New York City during the four day "Audiorama" beginning on Thursday, October 13. Our readers are urged to visit this display and demonstration of cylinder and disc phonographs from out of the historical past. These forerunners of the high-fidelity phonograph pay tribute to the audio pioneers of yesteryear. The genius of Edison, Berliner, Johnson, Tainter, and Bell is reflected in this exhibit. We will be pleased to have you drop in. . . . . O.R.

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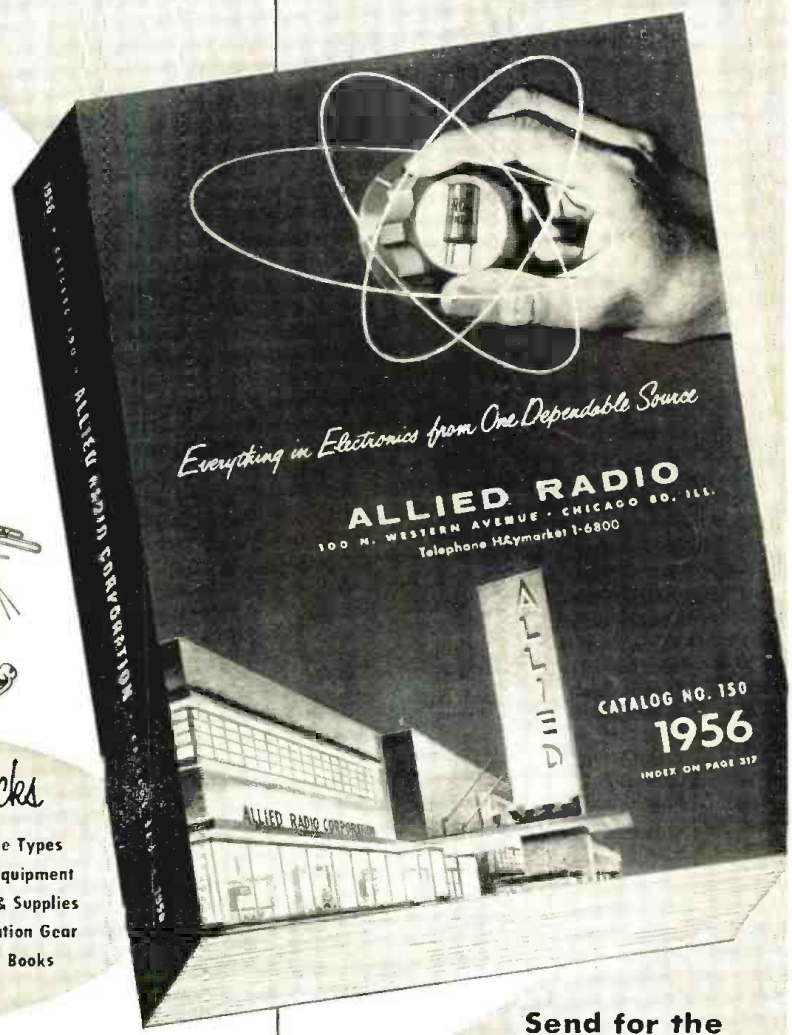

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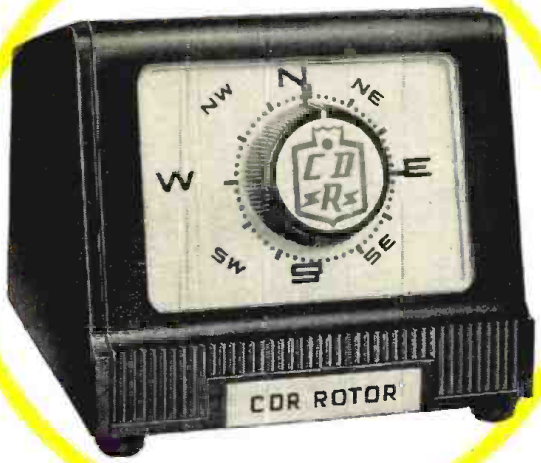

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MODEL KR-3
MODEL KR-3U
MODEL KR-4-12
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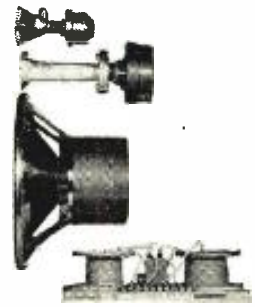

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THE Rebel 4 SPEAKERS

THE Rebel 5 SPEAKERS

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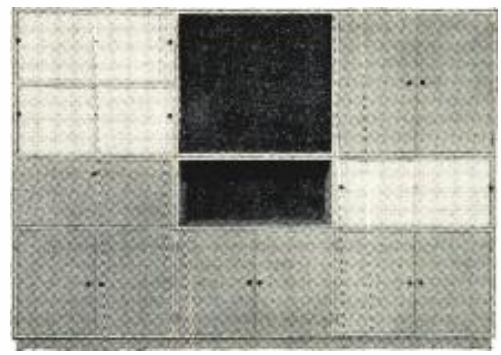
KIT 27K ●
KIT 28K ●
KIT 80
KIT 8112
KIT 8115
KIT K-3 ●
KIT K-4-12
KIT K-4-15
KIT KST-1 ●
KIT KST-2 ●
KIT KST-3 ●
KIT KST-4 ●
KIT KST-5 ●
KIT KST-6 ●
KIT KST-7 ●
KIT KST-8 ●
KIT KST-9 ●

MODEL 27K
MODEL 28K

• TWELVE NEW HI-FI KITS



. . . EVEN A HI-FI STORAGEWALL

ACC-1
ACC-2
ACC-2U
ACC-3
ACC-4
ACC-5
ACC-6
ACC-7
ACC-7A

TURNTABLE BASE WITH LEVEL AND LEVELING DEVICES

RECORD CABINETS . . . 3 SIZES

and NINE HI-FI ACCESSORIES FOR THE SOUND ENTHUSIASTS.

Factory and Offices: B'klyn, N. Y.

Each CABINART design is an engineer's answer to an individual hi-fi equipment storage problem. Each cabinet, properly used, is a designer's expression of the elements of good furniture design.

If your hi-fi dealer does not stock Cabinart, write for the name of our nearest Cabinart dealer or mail order house.

WRITE

CABINART '56 CATALOGS:

1. EQUIPMENT STORAGE
2. EQUIPMENT/ENCLOSURE KITS
3. REBEL HORNS & SPEAKERS
4. THE CABINART STORAGEWALL
5. HI FI ACCESSORIES

cabinart

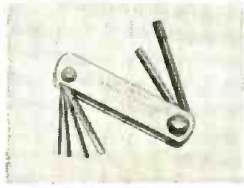
***The* pioneers in high fidelity radio furniture**

Cabinart is a division of G & H Wood Products Co., Inc. ● *99 N. 11th St.* ● *Brooklyn 11, N. Y.*

G-C CRT DUO-DECAL TEST SOCKET ADAPTER
For top-of-chassis tests.
No. 9251 NET $1.95

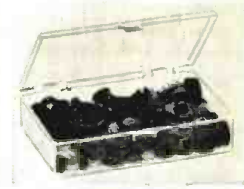
G-C GRILLE CLOTH ASSORTMENT
Various sizes and patterns.
No. 9114 NET $0.99

G-C HIGH-VOLT TEST LEADS
Heavy duty TV leads; phone tips.
No. 9100 NET $3.00

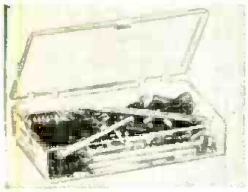


G-C POCKET HEX KEY WRENCH SET
Seven sizes .050" to 3/16"; case.
No. 9124 NET $1.65

G-C PRINT-KOTE SILICONE RESIN
Protects printed circuit repairs.
No. 14-2 NET $1.17

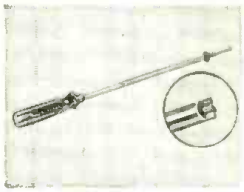


G-C "99" RUBBER GROMMET ASSORTMENT
Many types & sizes; plastic box.
No. 9121 NET $0.99



G-C "99" SPRING ASSORTMENT
Styles and sizes for all repairs.
No. 9118 NET $0.99

G-C "99" WASHER ASSORTMENT
Metal & liber washers, all types.
No. 9119 NET $0.99



G-C SCREW-STARTER SCREW DRIVER
Starts screws in tight spots.
No. 9148 NET $2.10

G-C SPRAY-KOTE TUBE-KOTE
Touch up scratched picture tubes.
No. 49-12 NET $2.17

G-C K-27 PRINT-KOTE
Pressure-spray silicone resin.
No. 14-6 NET $2.17

G-C SPRAY-KOTE HAMMER-KOTE
Brown hammer finish, air dries.
No. 83-12 NET $1.83

G-C DUAL SPEAKER SWITCH ASSEMBLY KIT
Wired, ready to use.
No. 9188 NET $1.17

GENERAL

G-C

CEMENT

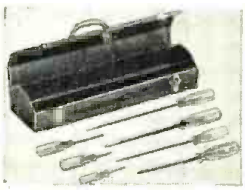
Ask For These

RADIO-TV SERVICE AIDS

...at Your Jobber

G-C SPRAY-KOTE APPLIANCE WHITE
Snow white finish for ranges, etc.
No. 9113 NET $1.30

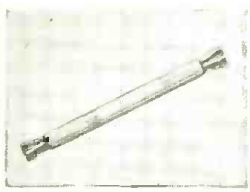
G-C PHONE DUPLEX JACK AND PLUG
For hi-fi and audio, ready-wired.
No. 9226 NET $0.90



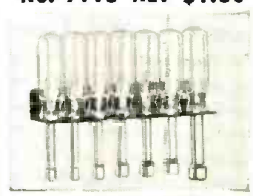
G-C ALL-STEEL SERVICEMAN'S KIT
Large, roomy kit with 7 tools.
No. 9052 NET $8.10

G-C KLEEN-TEX CLEANER
Safe, slow-burning, inexpensive.
No. 11-G NET $2.10

G-C HORIZONTAL BAR GENERATOR
Simple, accurate TV alignment.
No. 9149 NET $1.95



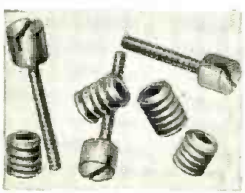
G-C NUT & HEXHEAD SCREW STARTER
For 1/4" & 5/16" hex nuts, screws.
No. 9147 NET $1.50



G-C 7-PIECE NUT DRIVER SET
Sizes 3/16" to 1/2", wall rack
No. 9208 NET $3.60

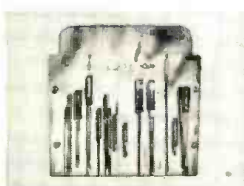
G-C TV PICTURE TUBE BOOSTER
5-wire type, half-moon socket.
No. 9136 NET $1.50

G-C PRINT-KOTE SOLVENT
Solvent for silicone resin.
No. 13-2 NET $0.33



G-C TV-RADIO IRON CORE KIT
7 types, for 90% replacements.
No. 9141 NET $0.57

G-C STANDARD TUNER SLUGS
Envelope of 3 replacements.
No. 9095-E NET $0.30



G-C DELUXE TV ALIGNMENT TOOL KIT
Roll-type case with 16 tools.
No. 8280 NET $7.74

G-C 7-PIN MIN. TEST SOCKET ADAPTER
Saves time on chassis tests.
No. 9247 NET $1.65

G-C 9-PIN MIN. TEST SOCKET ADAPTER
Use with alligator clips or prods.
No. 9249 NET $1.85

G-C MOTOROLA TV DIAL BELT
Genuine replacement for tuners.
No. 196 NET $0.30

G-C

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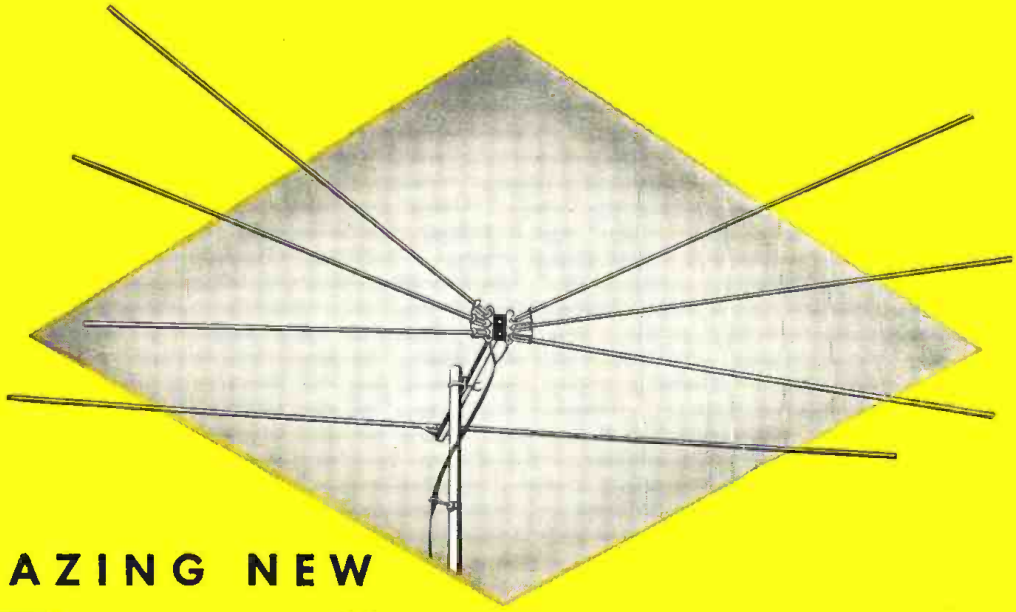
Complete, illustrated G-C Catalog. New service aids. Send postcard today.

GENERAL CEMENT MFG. CO.

904 TAYLOR AVENUE • ROCKFORD, ILLINOIS

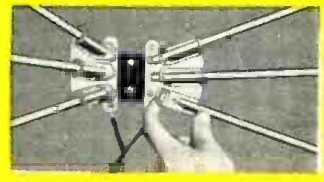
25th Anniversary

PHILCO® Announces

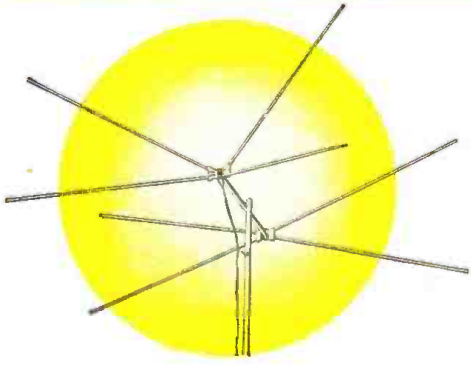


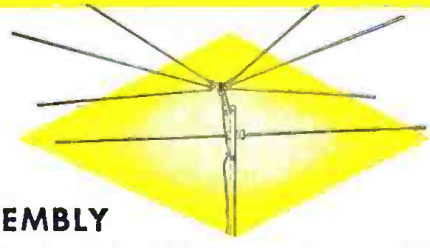
AMAZING NEW

FAST LOCK ANTENNA



Insert elements in clip mounting on cross arm . . . release pressure . . . presto! That's it! No screws to loosen or lose. Dowelled aluminum elements are held firmly for a life time of super performance. Part No. 426-0009. Stacked array Part No. 426-0009-2.





2-WAY ASSEMBLY

A versatile, sensitive, low-priced kit that may be assembled as a 6 x 2 or 4 x 4 unit. Enables you to give your customers super performance in unusual locations. Dowelled aluminum elements. Part No. 426-0008. Stacked array Part No. 426-0008-2.

PHILCO TUBES IMPROVE THE PERFORMANCE OF ANY TV OR RADIO RECEIVER

PHILCO CORPORATION

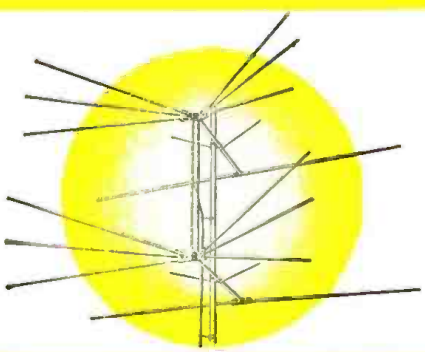
PHILADELPHIA 34,

a Complete New Line of

SUPER CONICAL TV ANTENNAS

Laboratory Designs are fully Field Tested
Ideal for Replacements or New Installation

New scientific design plus exhausting field tests in winds of hurricane velocity, salt spray and widely varying temperatures prove that new Philco Super Conical TV Antennas can "take it"! Here's the antenna that out performs any equivalent type . . . meets all reception requirements for *both* color or black and white . . . regardless of location. Give your customers complete satisfaction. Recommend a Philco Super Conical! See them . . . order them today, at your Philco Distributor.



NEW! PRE-ASSEMBLED QUICK RIG

A 6 x 2 stacked antenna package with auxiliary "V" element for vastly improved reception on high channels. Easy to erect and durable. Top fringe area performance. Solid aluminum elements—factory assembled for quick on-the-spot rigging. Stacked array package. Part No. 426-0010-2.

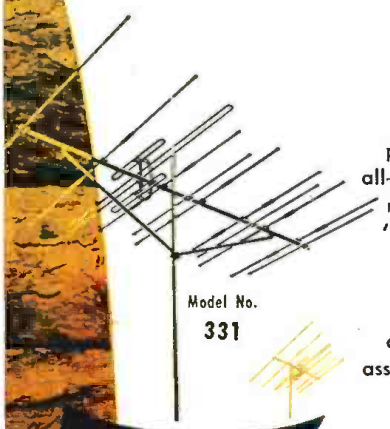
NOW! For the first time . . . YOU EARN YOUR CHOICE OF VALUABLE PREMIUMS THROUGH PHILCO'S DEALER'S CHOICE

Yes, you can't lose in this fabulous new Philco Parts and Accessories opportunity! It's the greatest bonus bonanza ever offered to dealers. You earn your choice of valuable FREE parts and accessory merchandise or top quality prizes for your family or home . . . simply by concentrating your purchases on Philco tubes, batteries, or parts and accessories. Nobody loses . . . everybody wins . . . hands down! See your Philco Distributor for details . . . today!

Accessory Division
PENNSYLVANIA

PHILCO
Famous for
QUALITY
the World Over

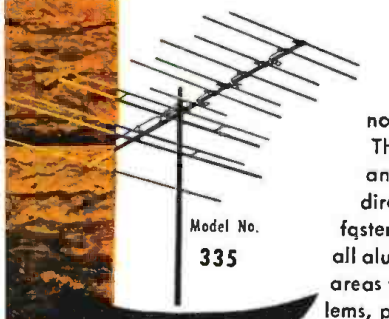
KINGS of the TV FRONTIER!



SUPER RAINBOW

Unmatched for power and performance!

This extraordinary fringe-area powerhouse is still the most sensitive all-channel antenna made today—bar none! The SUPER RAINBOW's many "years-ahead" engineering features include the triple-powered Tri-Pole, separate high and low band operation, 100% aluminum construction, and "Snap-Lock" pre-assembly. Also in great demand . . . The RAINBOW, Model No. 330.



TRAILBLAZER

Extra elements, extra performance!

There may be antennas that resemble our TRAILBLAZER, but none can top its blazing performance. The TRAILBLAZER features *extra* High and Low Band directors, and *full-wave* directors on the High Band. It installs faster than any similar antenna, and—it's all aluminum! Especially recommended for areas with front-to-back interference problems, particularly on the Low Band. Count the elements . . . then compare the prices!

SUPER LANCER

Advanced design — and "Super-Sembled"

Look to the LANCERS for Channel Master "extras": extra elements and extra gain — at no extra cost. Completely "Super-Sembled." The SUPER LANCER gives 1½ db more gain on both the Low Band and the High Band than similar types. The LANCER, Model No. 333, has an extra director that provides 1½ db more Low Band gain. Count the elements . . . then compare the prices!

CHANNEL MASTER CORP. ELLENVILLE, N. Y.
The World's Largest Manufacturer of TV Antennas and Accessories

CHANNEL MASTER®

All-Channel Yagis

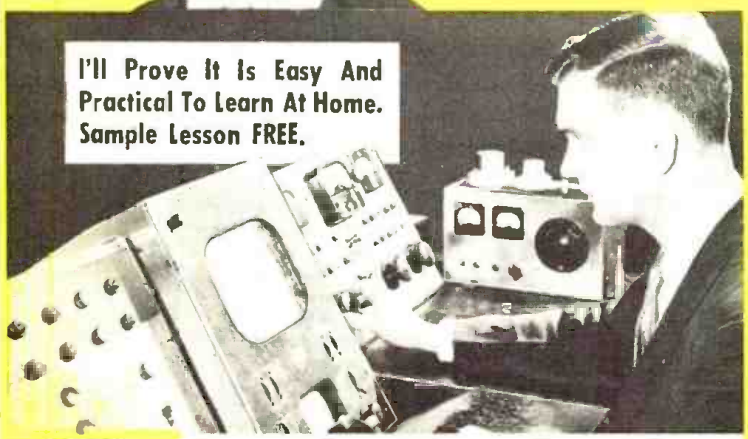
Unrivaled for power, popularity and price!

Servicemen everywhere are discovering an entirely new answer to the problem of multi-channel fringe-area reception: *Channel Master all-channel yagis. These* are the antennas that have what it takes to bring top TV performance to the most distant, isolated locations. And, they're ready for color, too!

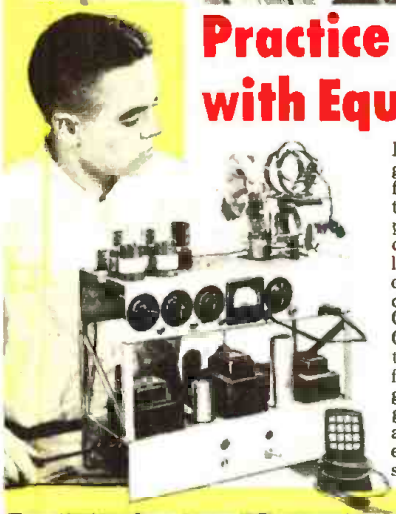
Today's leading all-channel yagis are designed — *and improved* — in the Channel Master Antenna Development Laboratories. Isn't it logical to use Channel Master's famous engineering skill to solve your reception problems?

I Will Train You at Home
for Good Pay Jobs, Success in
RADIO-TELEVISION

J. E. SMITH
President
National Radio Institute
Washington, D.C.
40 years of success training men at home in spare time.



Practice Broadcasting with Equipment I Send



It's practical to train at home for good Radio-TV jobs and a brighter future. As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build. Get FREE sample lesson.

Practice Servicing with Equipment I Send

Self-confidence, security, earning power come from knowing-how and from experience. Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester, use it in conducting experiments, fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build. Judge for yourself whether you can learn at home in your spare time.

Television Is Growing Fast Making New Jobs, Prosperity

More than 30 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets and to operate hundreds of Television stations. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity, get started now learning Radio-Television at home in spare time. Cut out and mail postage-free card. J. E. Smith, President, National Radio Institute, Washington, D. C. Over 40 years' experience training men at home.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs Good Pay **See Other Side**

Get My SAMPLE LESSON and 64-Page Illustrated Book BOTH FREE

Cut out and mail card NOW!

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-page Book, "How to Be a Success in Radio-Television." Mail card now!

NO STAMP NEEDED! WE PAY POSTAGE

Mr. J. E. SMITH, President
National Radio Institute, Washington 9, D. C.

Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

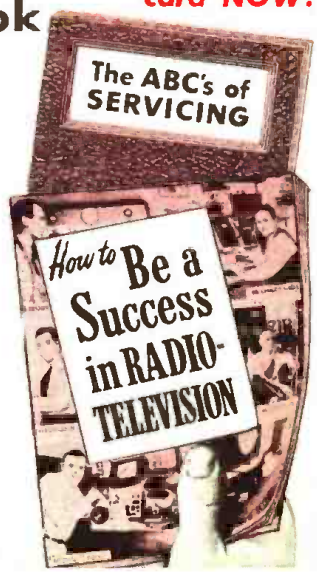
NAME..... AGE.....

ADDRESS.....

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

VETS write in date of discharge.....

K L M O P R S T U W X Z



Train at Home to Jump Your Pay as a RADIO-TV Technician

J. E. Smith, *President*
National Radio Institute

The men whose messages are published below were not born successful. Not so long ago they were doing exactly as you are now . . . reading my ad! They decided they should KNOW MORE . . . so they could EARN MORE . . . so they acted! Mail card below now.

Get a Better Job—Be Ready for a Brighter Future in America's Fast Growing Industry

Training PLUS opportunity is the PERFECT COMBINATION for job security, good pay, advancement. When times are good, the trained man makes the BETTER PAY, GETS PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure more of the better things of life.

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Television Broadcast Stations extend from coast to coast now with over 30 million Television sets already in use. Over 400 Television stations are on the air and there are channels for hundreds more. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc., is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

My Training Is Up-to-Date You Learn by Doing

Get the benefit of our 40 years' experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other side of this page.

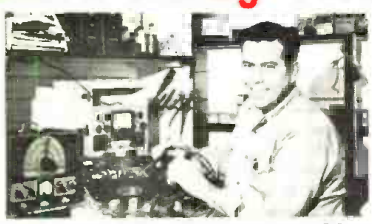
More and more Television information is being added to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About this Tested Way to Better Pay

Read at the right how fellows who acted to get the better things of life are making out now. Read how NRI students earn $10. $15 a week extra fixing Radios in spare time starting soon after enrolling. Read how my graduates start their own businesses. Then take the next step—mail card below.

You take absolutely no risk. I even pay postage. I want to put an Actual Lesson in your hands to prove NRI home training is practical, thorough. I want you to see my 64-page book, "How to Be a Success in Radio-Television," because it tells you about my 40 years of training men and important facts about present and future Radio-Television job opportunities. You can take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mailing postage-free card can be an important step in becoming successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. Training Men for Over 40 years. Approved Member, National Home Study Council.

Start Soon to Make $10 to $15 a Week Extra Fixing Sets



Keep your job while training. Many NRI students make $10, $15 and more a week extra fixing neighbors' Radios in spare time, starting a few months after enrolling. The day you enroll I start sending you special booklets that show you how to fix sets. The multitester you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

I TRAINED THESE MEN

Lots of Spare-Time Jobs

"I do a lot of spare-time Radio and TV servicing. It was fun learning and I don't know how to thank you." B. Goede, Plainview, Minn.

Now TV Trouble Shooter

"I had only gone to 7th grade when I started course. Now have job as TV trouble shooter, also fix sets spare time." M. R. Lindemuth, Fort Wayne, Ind.

Engineer with WHPE

"Thanks to NRI, I operated a successful Radio repair store. Then I got a job with WPAQ and now am an engineer for WHPE." V. W. Workman, High Point, N. C.

NRI Course Can't Be Beat

"Am with WCOC. NRI Course can't be beat. No trouble passing 1st class Radiophone license examination." Jesse W. Parker, Meridian, Mississippi.

Quit Job for Own Business

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

Extra Money in Spare Time

"I am a police captain and also have good spare-time service business. Just opened my new showrooms and shop." C. W. Lewis, Pensacola, Fla.

My Training Leads to Jobs Like These

BROADCASTING: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P.A. Systems, Television Receivers, Electronic Controls, FM Radios. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician, Service Manager, Tester, Serviceman, Research Assistant. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **AVIATION RADIO:** Plane Radio Operator, Transmitter Technician, Receiver Technician, Airport Transmitter Operator. **TELEVISION:** Pick-Up Operator, Voice Transmitter Operator, Television Technician, Remote Control Operator, Service and Maintenance Technician. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman.

SAMPLE LESSON and 64-Page BOOK BOTH FREE

CUT OUT AND MAIL POSTAGE-FREE CARD

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

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE
16th and U Sts., N.W.
Washington 9, D. C.

Have Your Own Business

Many NRI trained men start their own successful Radio-Television sales and service business with capital earned in spare time. Joe Travers, a graduate of mine, in Asbury Park, N. J., writes: "I've come a long way in Radio and Television since graduating. Have my own business on Main Street."

How to hand yourself more business

Whenever you replace a tube, it's smart to hand the lady the CBS carton . . . and yourself more business.

It's smart because CBS tubes are advertised to *women* in Life, Good Housekeeping and on Arthur Godfrey's Talent Scouts.

And it's good business for you because *women* have greater confidence in CBS tubes . . . the tubes with the Good Housekeeping Guaranty Seal.

There are no better tubes made than CBS tubes.

Guaranteed by Good Housekeeping

CBS-HYTRON, Danvers, Massachusetts

A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

PAY-SEE TV, which has become as entangled in controversy among legislators, broadcasters, showmen, performers, set manufacturers, and consumers, as color, has become a major headache for the Commission. Originally scheduled for a quickie paper-hearing review months ago, it now appears as if the *yes* or *no* decision for the toll plan will be delayed indefinitely while the FCC experts pore over the shelves of briefs that have hit Washington. It will be months before the government body will be able to determine how to handle the comments to the written arguments for and against the plan, and then revcal exactly what procedure should be followed to arrive at a statement of policy.

Bags of mail, legal documents, and industry comments to the FCC have indicated that opposition to the fee idea is way up; although some very strong arguments in favor of the program have been received too.

A number who had declared publicly that the coding scheme was good, have now reversed their opinions. One set manufacturer, who a year ago had stated bluntly that the costs of black-and-white programs and color shows would mount so that stations would have to turn to subscription TV for help, told a group of dealers recently that he was all wrong, for approval of the scrambling idea would bring no relief; in fact, it would ". . . kill the goose that laid the golden egg . . ."

Under the pay-see TV deal, it was brought out, TV would no . . ."longer have the same appeal as free TV, and would be detrimental to sales." Dealers were urged to write to their Congressmen and tell them that they should see to it that the air remains free and in the public domain.

The fee move struck a snag in the House of Representatives, too. Here several Congressmen introduced bills which would kill any form of billed or *pay-in-advance* TV. Congressman Emanuel Celler presented legislation, to amend the Communications Act, which would prohibit the Commission from authorizing any television station to . . ."impose a toll, fee, subscription, or other charge, directly or indirectly, on the general public, for the privilege of viewing programs over television sets located in the home." Those who would be found guilty of violation, under the proposed measure, might have to pay a fine of $10,000 or face imprisonment for not more than five years, or both.

Another bill, introduced by Congressman Frank L. Chelf, would prohibit the Commission from rendering any decision that would be contrary to the expressed will and desire of the public. Said he, in describing his measure: "It is the sense of this legislation. that the great American public, the people themselves, shall have a voice as to whether or not they want to endorse or reject the question of pay-TV, now before the Federal Communications Commission for decision, since such a decision would directly affect the people's daily lives, their very freedom, and their happiness."

According to Representative Celler. subscription TV would black out all free television, screen out good free programs, and also divide the nation into camps of those who can pay and cannot pay for sight-and-sound programs.

Pointing out that television is still in its infancy, the Congressman said that already it . . ."has brought into the American home great boxoffice attractions . . . sports events, children's programs, educational programs, and current and patriotic events . . . All it needs is time to grow. Let us not be impatient."

COMMUNITY TV, now a sprawling. active operation in hundreds of towns and cities in the east and the west. providing reliable service to countless signal-hole areas, has become a victim of property-right litigation that may require a Supreme Court decision to resolve.

Out in Montana, KXLF-TV has told the Bozeman Community Television group that it had no authority to pick up signals from their station, and should discontinue reception and retransmission of such signals. Station management pointed out that KXLF-TV signals are for free public reception only, and are not transmitted for the purpose of a company, group, or individual to realize profit therefrom. In addition, the station said it had contracts with those from whom programs are purchased which forbid the . . . "duplication, use, and retransmittal for profit of such programs . . ."

Replying, the community-TV owners said that they were unable to comply with such a request, because the system simply involves operation of an antenna performing a service for subscribers.

"It is our understanding," continued the western antenna-system owners, "that the members of the public are entitled to receive the signals broadcast by your station. . . . The function of our company is merely that of receiving, on behalf of our subscribers, the signals which you have broadcast and to which they are entitled. This company does not realize any profit on the programs broadcast by your station. On the contrary, the remuneration . . . is for antenna service which we render, and is in no way related to the programs which may be broadcast by your station at any given time."

In a commentary on this stop-request, counsel for the association of community TV operators said that two points can be stressed in arguing the issue. Once a signal is broadcast, it was noted, a station retains no rights; this is based on the theory that the signal and program have been dedicated to the public. However, notwithstanding the possible existence of property rights in programs, community antenna operations, it was stressed, do not infringe those rights, and therefore no basis for injunctive action exists.

AS THE LAWYERS battled over the legalities of the remote pickups, a member of the Commission, John C. Doerfer, declared in an address before the National Community TV Association in New York City, that he felt that community TV certainly performed a definite service to the public.

Said the Commissioner: "No one connected with the modern miracle of electronic communication, particularly anyone taking part in the broadcasting field, is unaware of the development and growth of such community antenna television systems. . . . Today it is a 20-million dollar industry. . . . Approximately 400 companies are bringing a television service to more than 300,000 subscribers or roughly 1-million viewers."

Applauding the operators of CATV systems for their initiative, the FCC spokesman declared that if this enterprising spirit did not obtain, most of the people in the blacked-out areas would be without a service today. "This fact alone," Doerfer emphasized, "is a splendid tribute to your ingenuity. . . . Your honors are all the more deserved because you ventured into an uncharted sea full and still full of dangerous rocks and reefs. No government agency gave you any guidance nor substantial encouragement and none is in sight."

Describing the exact status of the community systems, as the Commission sees it, the FCC speaker said that because of the closed-circuit or party-line nature of the community opera-

(*Continued on page* 152)

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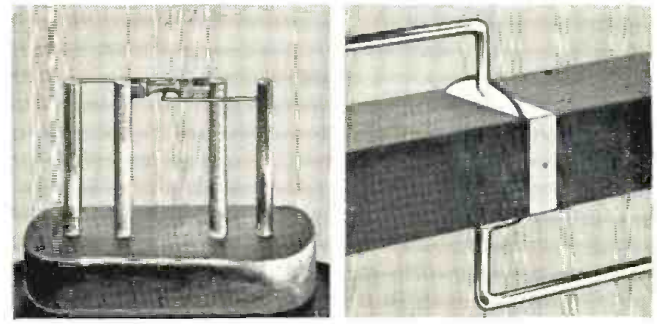
When the machine finds the layer, it orders a surge of current which bonds the wire to the bar. Then it welds the wire's other end to a binding post. Afterward, it flips the bar over and does the same job with another wire on the opposite side!

Once only the most skilled technicians could do this work, and even their practiced hands became fatigued. This development demonstrates again how Bell Telephone Laboratories scientists work in every area of telephony to make service better.



Transistor made by new machine is shown in sketch at left above, magnified 6 times. At right is sketch of area where wires are bonded. The wires are 2/1000 inch in diameter, with ends crimped to reduce thickness.

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TELLS HOW—

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INDUSTRIAL ELECTRONICS

"I have just started my new job at I. B. M. CIRE training helped me get the job. It also helped me get a good starting rate."

Stanley Renfro, Beacon, New York

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"I am now employed by the Permian Basin Communications, Inc. and now manage the service shop in Odessa, Texas for Motorola 2-way communication equipment. I got the job through your Job Finding Services. My sincere thanks."

Robert W. Cook, Odessa, Texas

ELECTRONICS TECHNICIAN

"I am now employed by the Collins Radio Company as a Jr. Lab Technician. (This job was listed in your bulletin.) I have used the information gathered from your course in so many ways and I know that my training with CIRE helped me a great deal to obtain this job."

Charles D. Sindelar, Cedar Rapids, Iowa

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EMPLOYERS MAKE JOB OFFERS LIKE THESE TO OUR GRADUATES EVERY MONTH!

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

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These are just a few of the examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs; it might have been you!

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Within the Industry

ALTON K. MARSTERS has been appointed general sales manager of *CBS-Hytron,* the tube manufacturing division of *Columbia Broadcasting System, Inc.*

In joining *CBS-Hytron,* Mr. Marsters leaves *Colt's Manufacturing Company* of Hartford, Conn. where he was vice-president and general manager of the packaging machinery division. Before this appointment, he was director of sales for commercial products.

Previous to this, he was with the *American Optical Company* of Southbridge, Mass. He joined this firm as attorney for patent license administration, but soon thereafter became interested in sales. He rose rapidly in this field, becoming general sales manager and finally vice-president in charge of sales.

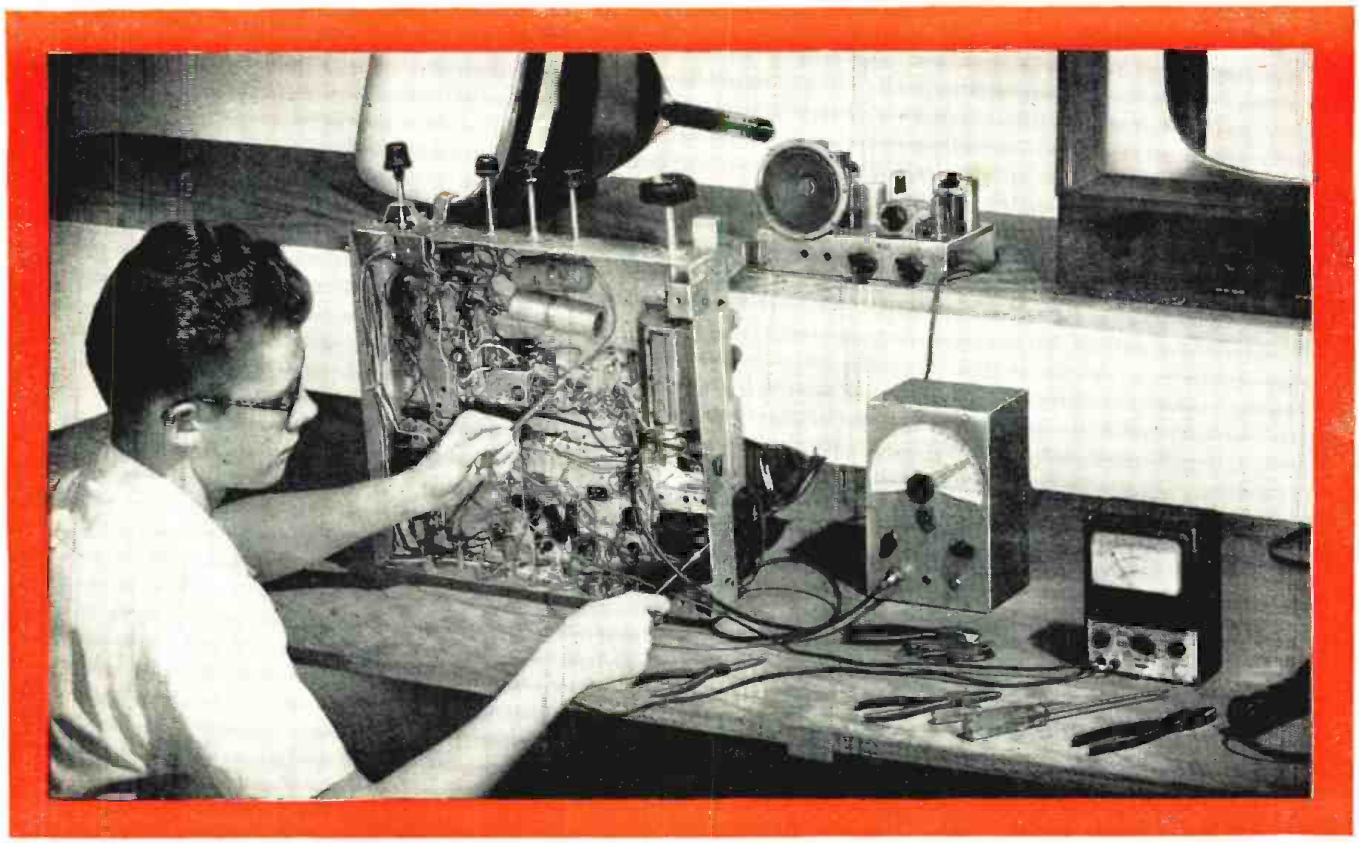
* * *

M. P. FIELDMAN has recently joined the *Perma-Power Company* as a vice-president. He was most recently general manager of *Halldorson Transformer Corporation* . . . The *Sparton* radio and TV division has named **ROBERT M. MARBERRY** to the post of director of sales and **MELVIN L. MYERS** as general sales manager . . . **LEON B. UNGAR** has been named director of sales and **ALVIS R. KNOWLES** is the new director of manufacturing for *Ungar Electric Tools, Inc.* . . . *TelAutograph Corp.* has appointed **DAVID M. GOODMAN** to the post of assistant chief executive officer for the firm . . . **DR. HARRIS M. SULLIVAN** has been named manager of the Electronics Laboratory at *General Electric's* Electronics Park in Syracuse . . . *Olson Radio Warehouse, Inc.* has appointed **J. ROBERT GOLDBERG** to the post of catalogue merchandise manager. He was formerly purchasing agent for *Allied Radio's* kit division . . . **C. J. TRESSLAR** is the new sales manager of *The Pentron Corporation,* Chicago tape recorder manufacturer . . . *RCA's* Tube Division has appointed **JOHN J. HEMBERGER** to the post of administrator of black-and-white picture tube sales in distributor markets. He has been with the company since 1934 . . . **A. J. W. NOVAK** has been elected vice-president of the *Technical Instrument Company* of Houston, Texas, a division of *Brush Electronics* . . . **RODNEY D. CHIPP** is the new director of engineering for all manufacturing divisions of *Allen B. DuMont Laboratories, Inc.* . . . **ANDREW H. BERGESON,** who retired with the rank of Captain from active Navy duty in 1954 to accept a position as consulting engineer in *Stromberg-Carlson's* Washington office, has been elected vice-president-engineering of the firm . . . **HARRY R. CLARK,** formerly president of *Telechrome Manufacturing Corporation,* has joined *Linear Equipment Laboratories, Inc.* as vice-president in charge of sales . . . **LYLE J. BISKNER** is the new general manager of *Electronic Products Corporation.* He was formerly manager of customer relations for the firm . . . *Wallace's Telaides* has named **W. P. READY** to the post of general sales manager of the publication firm . . . **SIDNEY HERBSTMAN** has assumed the presidency of *G & H Wood Products Co., Inc.,* manufacturer of the "Cabinart" line of cabinets, speaker enclosures, and kits . . . **JOHN F. McALLISTER, JR.** has been named manager of engineering for the *General Electric* radio and television department. He will be responsible for the design and development of all of the company's radio and TV receivers . . . **COMMODORE A. J. SPRIGGS,** former director of electronics, Office of the Chief of Naval Operations, has been elected a vice-president of *Packard-Bell.* He will represent the company in Washington, D. C. . . . *Airborne Instruments Laboratory, Inc.* has promoted **J. GREGG STEPHENSON** to the position of assistant supervising engineer of the company's applied electronics section of the research and engineering division . . . **MELVIN L. HAYDEN** is the new advertising-sales promotion manager of *National Company, Inc.,* Malden, Mass., manufacturer of communications receivers and hi-fi equipment . . . **RALPH E. FOSTER** has been promoted to the position of assistant manager in charge of the automobile tuner plant of *Radio Condenser Company* in Hoopeston, Illinois . . . **REESE B. LLOYD** has been named vice-president in charge of operations for the *Philco* television division . . . *Emerson Radio and Phonograph Corporation* has elected **MICHAEL KORY** to the post of vice-president in charge of sales and **LESTER KRUGMAN** to the position of vice-president in charge of marketing.

* * *

H. LESLIE HOFFMAN, president of *Hoffman Electronics Corporation* of Los Angeles, has been elected president of the reorganized board of directors of the Radio-Electronics-Television Manufacturers Association.

He will take over the duties performed last year by Max F. Balcom, as chairman of the board and Glen McDaniel, as president. Mr. McDaniel will continue as general counsel for the Association.



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A PRACTICAL COURSE... You receive completely workable kits and perform valuable experiments to demonstrate the theory learned. In fact, many students will be able to do service work *even before* they complete all the lessons.

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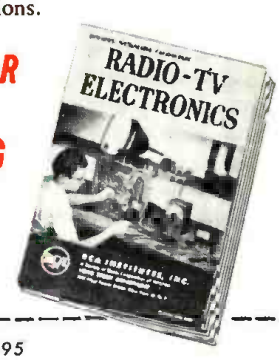

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Other officers elected by the RETMA board include: Leslie F. Muter, president of *The Muter Co.* of Chicago, treasurer and chairman of the Finance Committee; Dr. W. R. G. Baker, vice-president and general manager of the Electronics Division of *General Electric Company,* director of the Engineering Department; Joseph H. Gillies, vice-president in charge of manufacturing at *Philco Corporation,* director of the Government Relations Department; and James D. Secrest, executive vice-president and secretary.

* * *

GEORGE DETERS has been appointed manager of equipment picture tube sales for *Raytheon Manufacturing Company.* He will make his headquarters in Chicago. He will be responsible for the sales of black-and-white and color TV picture tubes to set manufacturers throughout the country.

Mr. Deters joined the company in January, 1954 after five years with *CBS-Hytron* as district manager for tube sales in the central territory. Prior to that he was with *Crosley.*

He will be located at the firm's new tube sales office and warehouse at Franklin Park, Illinois.

* * *

INTERNATIONAL RESISTANCE COMPANY, through one of its California subsidiaries, has purchased **EMEC, INC.** of Seattle, Washington. The newly-acquired firm manufactures magnetic clutches for electronic and electrical applications . . . The formation of **EATON ASSOCIATES, INC.** for the manufacture of printed circuits and printed circuit assemblies has been announced by Joseph O. Eaton, Jr. The new concern, located in Moodus, Conn., is already in production . . . **HERMETIC SEAL MANUFACTURING COMPANY** of Newark, N. J. has acquired the **GLASS SOLDERING ENGINEERING COMPANY** of Pasadena, California as its West Coast division . . . **AMPEX INTERNATIONAL** has been formed as a new division of **AMPEX CORPORATION** of Redwood City, California . . . **NEWARK ELECTRIC COMPANY** of Chicago has purchased **ACORN RADIO AND ELECTRONICS** of Inglewood, California and will operate it as a wholly-owned subsidiary under the **NEWARK** name . . . Don Workman will head a new firm, **DUNWELL MANUFACTURING COMPANY** of Carlstadt, N. J. The company has begun a program to provide parts distributors with new and inexpensive TV specialty items for resale . . . **SUPERIOR TUBE COMPANY** of Norristown, Pa. has acquired a majority interest in **JOHNSON & HOFFMAN MANUFACTURING CORPORATION,** Mineola, N. Y., manufacturer of precision stamping and deep-drawn parts for the electronics industry . . . **WELWYN ELECTRICAL LABORATORIES, LTD.** of England has formed a new American company to

(*Continued on page* 90)

Now

YOUR TV PICTURE TUBE INSTALLATIONS FINANCED BY GENERAL ELECTRIC

YOU can sell G-E picture tubes to your service customers *on the instalment plan!* First national tube credit program to be handled direct by a leading manufacturer!

- You tie up no capital—endorse no notes. You are reimbursed immediately for the full amount of your bill covering tubes, parts, and labor.

- You sell high-profit tubes and service where cash isn't available to your customers. You open the door wide to new business—more business! And those repaired TV sets piling up on your shelves which customers can't pay for, now will move out from your shop *FAST.*

- You have no collections or record-keeping to worry about. Credit arrangements with your customers are made quickly and easily.

GENERAL ELECTRIC

It's easy as 1-2-3

to sell new G-E picture tube installations on credit

1.

You find that your customer hasn't the cash on hand to pay for the new G-E picture tube that's needed, plus other General Electric tubes, also parts and labor. So . . .

2.

You explain G.E.'s easy payment terms. The customer welcomes the opportunity to sign the contract. You then proceed to make the installation, and put your customer's TV in tip-top shape.

One call to your G-E tube distributor will bring full

3. Next day you turn over the contract to your G-E tube distributor, who reimburses you for the complete installation job, including labor.

READ HOW YOU CAN USE THIS GREAT NEW GENERAL ELECTRIC CREDIT PLAN!

OFTEN the price of a new picture tube keeps customers from having their TV sets serviced properly. They are forced to get along with an inferior picture, or no picture at all, while you lose a profitable repair job.

Now G.E. gives you a way to turn these lost jobs into service dollars. No longer need your customers pay cash in full. You can give them as long as six months to pay out of income, with a down payment as low as $5.

Yet you get reimbursed immediately by your G-E tube distributor. Furthermore, you endorse no notes, have no collections to make. That part is handled by the General Electric Credit Corporation in cooperation with your distributor.

Act today! Ask your G-E tube distributor to show you how to obtain . . . on easy credit terms . . . picture tube installation jobs you've never been able to sell before! *Tube Department, General Electric Company, Schenectady 5, N. Y.*

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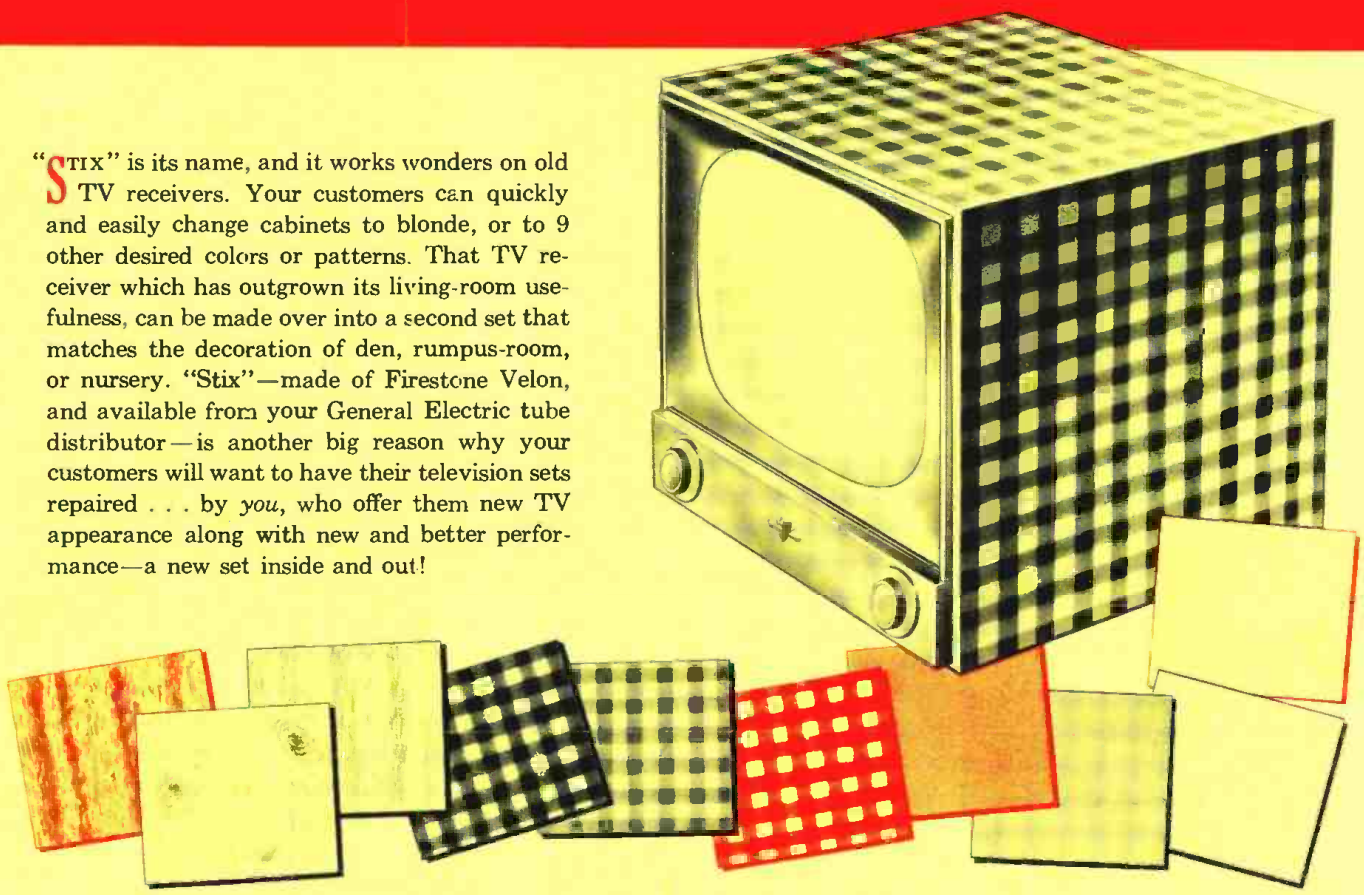
"STIX" is its name, and it works wonders on old TV receivers. Your customers can quickly and easily change cabinets to blonde, or to 9 other desired colors or patterns. That TV receiver which has outgrown its living-room usefulness, can be made over into a second set that matches the decoration of den, rumpus-room, or nursery. "Stix"—made of Firestone Velon, and available from your General Electric tube distributor—is another big reason why your customers will want to have their television sets repaired . . . by *you*, who offer them new TV appearance along with new and better performance—a new set inside and out!



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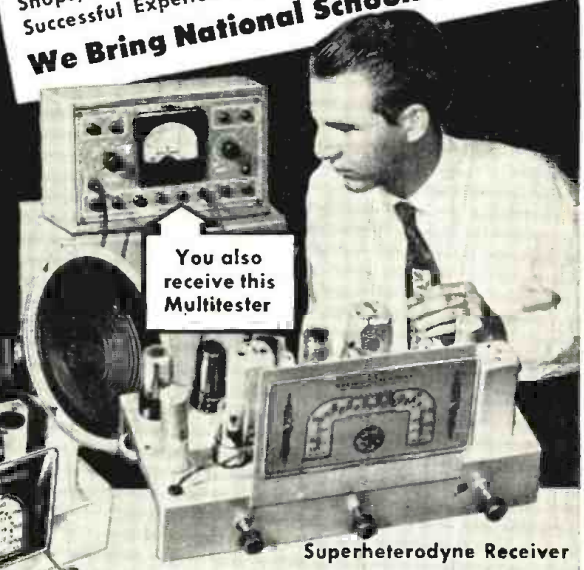
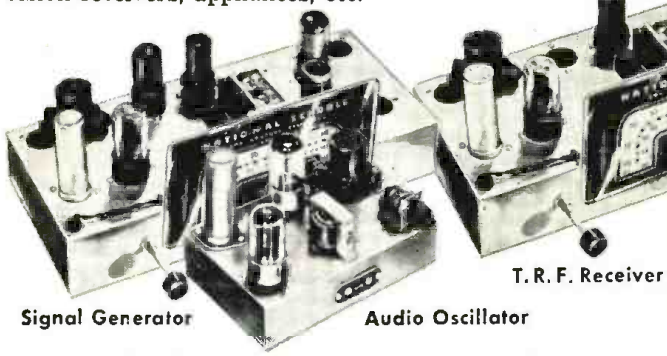


Superheterodyne Receiver



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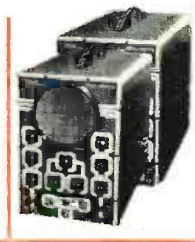

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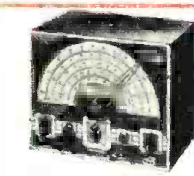

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A MODERN FM CARRIER-CURRENT TRANSMITTER

By J. P. NEIL

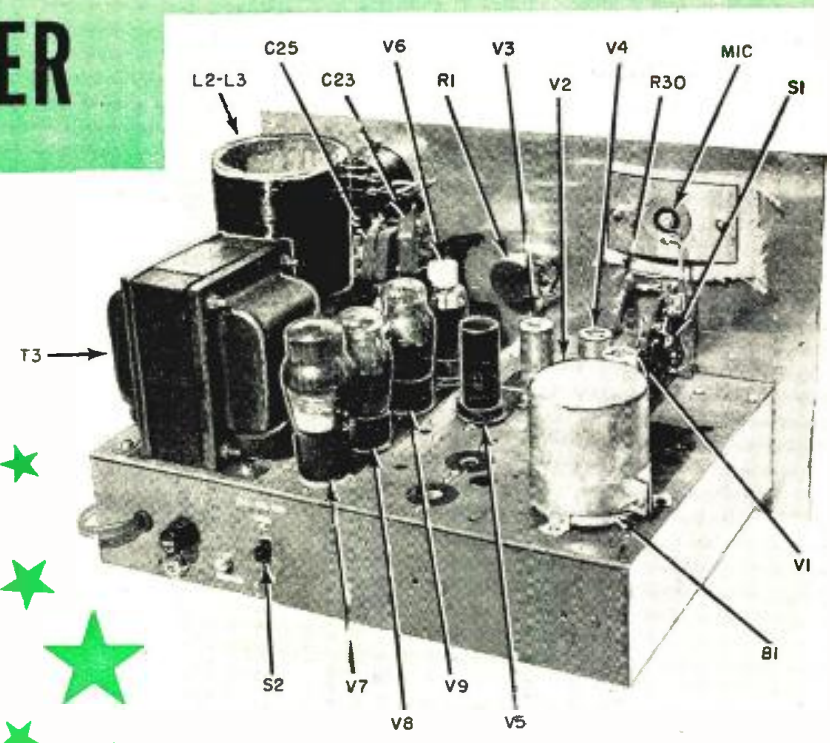


Fig. 1. Rear view of transmitter with major components identified. The two sockets at the center front of the chassis are for use with an alternate power supply using a higher output power amplifier tube. This particular circuit is not covered in this discussion.

Complete construction details on a compact transmitter which will operate on 148 or 206 kilocycles, as desired.

APPLICATIONS for higher power FM carrier-current apparatus are many, such as in the Armed Services, Civil Defense, utilities, police departments, large detective and security agencies, large industrial plants with separated buildings, field oil and gas operations, and amateur radio, to name a few. The equipment herein described has been operated at distances up to about a mile on ordinary domestic power lines. It was not possible to test its full range due to a change of substations and high-voltage distribution. Although present FCC regulations on this system are quite limited and sketchy, this unit appears to meet any possible requirements.

Power input to the primary on the basis of 117 volts a.c. (average) is approximately 70 watts. Power input to the final amplifier is about 24 watts average, with a measured output to the line of 16 to 18 watts, depending upon line loading conditions.

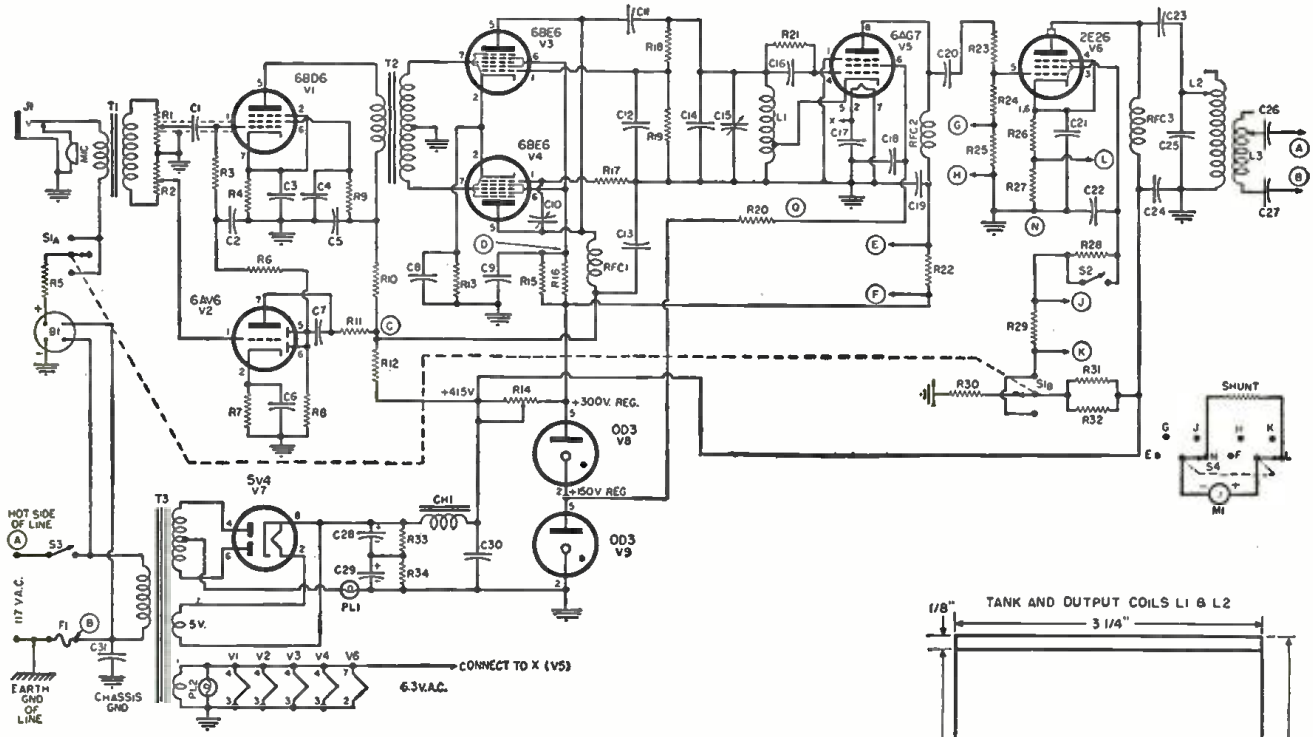
Fig. 3 is a front panel view of the transmitter. A microphone may be seen in the upper left-hand corner and, at the bottom of the same side, is a jack for an external mike or handset. Controls are: "Mike-P.A." lever-type transmit switch, positive upward and spring return downward for "push-to-talk"; mike level; meter switch; and line switch. A 0-25-250 milliammeter is provided for checking oscillator plate current, power amplifier grid and screen currents, and power amplifier cathode current. A red pilot jewel is also included (bottom center) to indicate when the power is on. The tube lineup consists of V_1—6BD6 audio amplifier; V_2—6AV6 audio a.g.c.; V_3, V_4—6BE6's, balanced modulators; V_5—6AG7 oscillator; V_6—2E26 power amplifier; V_7—5V4 rectifier; and V_8, V_9—0D3 regulators. The tubes are all visible in Fig. 1 except V_2, which is between V_1 and the telephone transmitter (microphone) battery eliminator, B_1, in the rear right-hand corner of the photo. Various major and minor components are visible in Figs. 1 and 4, the rear and under-chassis views, respectively.

Circuitry

Starting at the front end (Fig. 2) we have the speech amplifier; automatic gain control to prevent overdeviation on peaks; balanced reactance modulators; r.f. oscillator, and final amplifier. Without going into great detail, a brief description of the function of a balanced modulator (in this case) is that voltage variations cause opposite reactive effects in each tube, hence no effective variation of the oscillator frequency from this cause. If a single reactance modulator tube were used, it might to a slight extent result in the same effect as applied speech signals, *i.e.*, some frequency modulation. An electron-coupled oscillator is used for the sake of convenience, in preference to other types. Note that the bypass capacitor C_{17} must be connected right at the filament pin of V_5, due to the cathode being at r.f. potential. If this is not done, among other bad effects, it will be impossible to check the filament voltage accurately, especially with a v.t.v.m. Also note that C_{10}, C_{12} (and C_{16} as well if the grid resistor went to ground instead of shunting C_{16}) are, effectively, partially in parallel with the tuning capacitor, C_{15}, and must be taken into consideration. Any adjustment of C_{10} will therefore have a slight effect upon the oscillator frequency. The power amplifier stage is quite conventional except that a voltage dividing network R_{23}-R_{24} is used in the grid circuit to prevent grid current and r.f. grid voltage from exceeding normal ratings.

A meter with a basic 25 ma. range and 250 ma. shunt is used. The scale was marked 0-250 in addition to the original 0-25 ma. but this is not absolutely essential. The shunt, calculated for the particular meter, is connected across terminals L and N of the meter switch, S_1. Resistors R_{25}, R_{26}, R_{28}, and R_{27} are respectively metering connections to oscillator plate, power amplifier grid, screen, and cathode. They are located on a terminal (solder-lug type) under the chassis. The power amplifier cathode was chosen for metering instead of the plate circuit, for safety reasons.

Resistor R_{30} is behind the front panel and connected directly to the neutral terminal of S_{1B} and a solder lug under a screw holding the switch to the panel. Its purpose is to act both as a



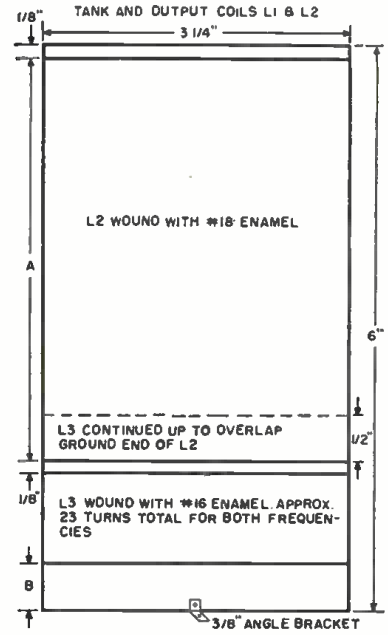
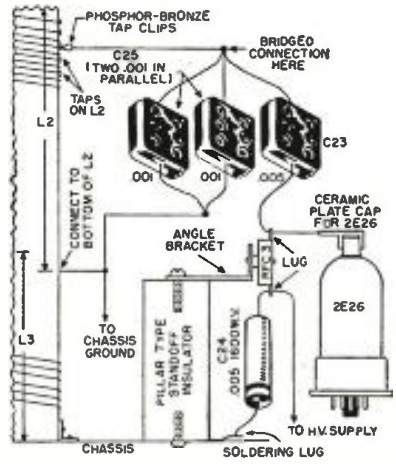


Fig. 2. Schematic of FM carrier-current transmitter and its power supply along with data for winding coils L_2 and L_3 and mechanical details for mounting and connecting RFC_3, C_{23}, C_{31}, and C_{25} to 2E26 tube and to L_2 for shortest connections.



WINDING CHART

FREQ (KC.)	L2 INDUCTANCE (μhy)		DIMENSIONS	
	CALCULATED FOR C25 OF 0.002 μfd	ACTUAL WOUND VALUE	A	B
148	450	480	4 1/4"	1/2"
206	380	410	3 7/8"	7/8"

R_1, R_2—500,000 ohm pot
R_3—1 megohm, 1/2 w. res.
R_4—470 ohm, 1/2 w. res.
R_5—30 ohm, 1 w. res.
R_6—330,000 ohm, 1/2 w. res.
R_7, R_{20}—4700 ohm, 1/2 w. res.
R_8—500,000 ohm, 1/2 w. res.
R_9, R_{11}—100,000 ohm, 1/2 w. res.
R_{10}—10,000 ohm, 1 w. res.
R_{12}—12,000 ohm, 2 w. res.
R_{13}—180 ohm, 1 w. res.
R_{14}—3000 ohm, 10 w. adj. wirewound res.
R_{15}—68,000 ohm, 1 w. res. (see R_{16})
R_{16}—22,000 ohm, 2 w. res. (in parallel with R_{15} to give approx. 17,000 ohms, 3 w.)
R_{17}—1000 ohm, 1 w. res.
R_{18}—47,000 ohm, 1 w. res.
R_{19}—500,000 ohm, 1 w. res.
R_{21}—22,000 ohm, 1 w. res.
R_{22}, R_{25}, R_{29}—270 ohm, 1 w. res.
R_{23}—12,000 ohm, 1 w. res.
R_{24}—33,000 ohm, 1 w. res.
R_{26}—450 ohm, 10 w. wirewound res.
R_{27}—50 ohm, 1/2 w. res.
R_{28}—6800 ohm, 2 w. res.
R_{30}—15,000 ohm, 10 w. wirewound res.
R_{31}—39,000 ohm, 2 w. res. (see R_{32})
R_{32}—47,000 ohm, 2 w. res. (in parallel with R_{31} to give approx. 21,000 ohms, 4 w.)
R_{33}, R_{34}—100,000 ohm, 1 w. res.
C_1, C_8, C_{12}, C_{16}, C_{21}—.01 μfd., 600 v. disc capacitor
C_2, C_4, C_7, C_9, C_{27}—.1 μfd., 600 v. tubular capacitor
C_3, C_6—10 μfd., 50 v. elec. capacitor
C_5—8 μfd., 450 v. elec. capacitor
C_{10}—25 μμfd. var. capacitor (Hammarlund APC-25)
C_{11}, C_{18}, C_{19}, C_{20}, C_{22}—.005 μfd. mica capacitor
C_{13}—250 μμfd. transmitting-type mica capacitor
C_{14}—100 μμfd. transmitting-type mica capcacitor for 206 kc.. 250 μμfd. for 148 kc.
C_{15}—140 μμfd. var. capacitor (Hammarlund APC-140)
C_{17}, C_{31}—.005 μfd., 600 v. tub. or disc capacitor
C_{23}—.005 μfd., 2500 v. transmitting-type mica capacitor
C_{24}—.005 μfd., 1600 v. tub. capacitor
C_{25}—.002 μfd., 1200 v. transmitting-type mica capacitor for 206 kc. (two .001 μfd. units in parallel), .00235 for 148 kc. (i.e., add an extra 350 μμfd., 1200 v. mica)
C_{26}—.014 μfd. capacitor (a .01 μfd. and .004 μfd. in parallel or .02 μfd. and .05 μfd. in series may be used)
C_{28}, C_{29}—4 μfd., 450 v. elec. capacitor
C_{30}—40 μfd., 450 v. elec. capacitor

RFC_1, RFC_2, RFC_3—60 mhy. unshielded, air-core choke (Miller 693)
T_1—Audio input trans., mic. to push-pull grids (Thordarson T20A00 or equiv.)
T_2—Driver trans., single plate to push-pull grids (Stancor A-4723 or Peerless D-006X)
T_3—Power trans. 400-0-400 v. @ 150-200 ma.; (6.3 v. @ 2 amps.—not used); 6.3 v. @ 3 amps.; 5 v. @ 3 amps.
S_1—D.p. 3-pos. non-shorting, spring-return lever switch (Centralab 1467)
S_2—S.p.s.t. slide switch
S_3—S.p.s.t. toggle switch
S_4—D.p., 4-pos. meter switch (non-shorting type)
F_1—2 amp., 3AG fuse (Slo-Blo)
PL_1—6-8 v., 250 ma. pilot light
PL_2—6-8 v., 250 ma. pilot light (with red jewel bracket)
Mic.—Telephone transmitter (Western Electric F-1)

B_1—Telephone transmitter battery eleminator (Type A3V-1C, Plate K598, Catalogue #K, Part 2. Available only from Western Railroad Supply Company. 2428 S. Ashland Ave., Chicago 8, Ill. Price $6.95 each. f.o.b. Chicago)
M_1—0-25-250 ma. meter
Shunt—250 ma. meter shunt
CH_1—10.5 hy., 110 ma. filter choke (Stancor C-1001)
L_1—2.5 mhy., 4-pie r.f. choke (Miller #4537)
L_2, L_3—See text
J_1—3-circuit, normally-closed mic. jack
V_1—6BD6 tube
V_2—6AV6 tube
V_3, V_4—6BE6 tube
V_5—6AG7 tube
V_6—2E26 tube
V_7—5V4 tube
V_8, V_9—0D3 tube

bleeder and to keep the voltage down when not actually transmitting. It has approximately the same loading value as the power amplifier screen grid. S_{1A} and S_{1B} are, respectively, in series with the microphone and power amplifier screen circuits, permitting steady "on" or "push-to-talk" facilities when transmitting. Switch S_2 in the same screen circuit will be discussed under "Operation."

The power supply, as shown in Fig. 2, requires only a few comments. The power transformer is one of the TV types delivering at the high-voltage winding, 400 volts r.m.s. each side of center at 225 ma. It has two 6.3 volt filament and one 5-volt @ 3 amp. rectifier filament windings. As shown, one of the 6.3 volt windings is unused. Filament voltage should be checked to see that it is nearly normal under average line-loading conditions. In the writer's case it was over 7 volts due to line voltage being in excess of 125 volts. A series resistor, consisting of four 1-ohm, 2-watt units in parallel, was installed. Care must be taken to connect the r.f. line leads from C_{26}, C_{27} to the line points designated *A* and *B* as shown. This is necessary to bypass the line switch S_3 (*i.e.*, to keep output resistance down) and to maintain the correct line-ground relationship. The "hot" side of the line plug and the corresponding wall outlet terminals should be marked with a spot of red paint for future reference. If it is necessary to move the transmitter to a different location, the new wall outlet should always be marked to indicate the "hot" side. The two capacitors C_{28} and C_{29} in series should not exceed 4 μfd. each. Their only purpose is to raise the output voltage but at no load (*i.e.*, during warmup period) the highest reading should not exceed 465 momentarily. A higher voltage might eventually damage C_{30}.

Construction Details

The chassis and panel are of aluminum. The chassis is a standard 10" x 14" x 3" unit and the panel was cut to 10" x 16" from #14 gauge stock. A wooden cabinet with hinged lid and chest (drop) handles was made to suit. The bottom of the cabinet has six rubber feet and a ventilation hole 5" x 8" cut out. A perforated metal cabinet would do just as well and might be better from the shielding angle. The panel was finished in blue-grey wrinkle lacquer and the cabinet in battleship grey. The top and rear lip of the chassis were also painted (see Fig. 1) to make the socket and component decals stand out.

Some of the main components are labelled in Fig. 1. The small aluminum clamp, visible in the upper right-hand corner, was fabricated to anchor the mike capsule and grille cloth to the panel. Capacitors C_{23} and C_{25} are located just above the ceramic plate cap of V_6; further construction details on the mounting of these capacitors are given in Fig. 2. Fig. 4, the under chassis view, shows the position of major

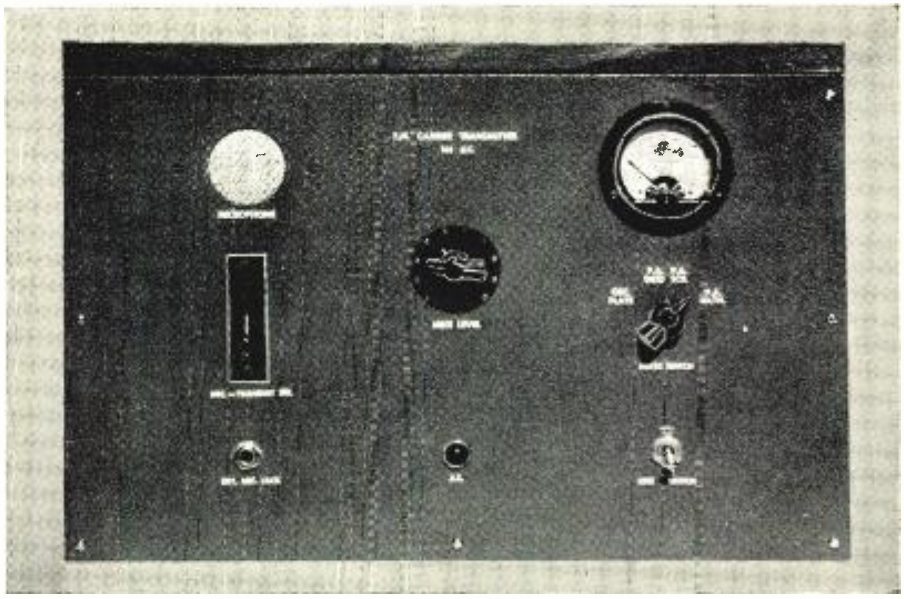


Fig. 3. Front panel view of transmitter. Controls are identified in text.

components. Audio transformers T_1 and T_2 are mounted inside small LMB box chassis, and attached under the chassis as shown. RFC_1 is soldered directly to C_{10} at right angles to the chassis, while RFC_2 is mounted parallel to the chassis on a 1½" x 6-32 machine screw, and with about ½" clearance from the chassis. The sockets for V_5, V_6, and V_7 are ceramic octals while the remainder are Bakelite. L_2-L_3 are wound on a 6" length of 3¼" diameter cardboard mailing tube attached to the chassis by two small angle brackets. The tube is first prepared by coating the inside, outside, and edges with shellac, and covering the outside with a layer of Pliofilm or Cellophane. Winding details are given later. R_2, the a.g.c. potentiometer, is mounted under the chassis so that the center (arm) solders directly to pin #1 of the V_3 socket. Choke CH_1 is attached to the inside rear lip of the chassis, immediately under the battery eliminator B_1 (see Fig. 4).

L_1, the oscillator inductor, consists of a 4-pi, 2½ mhy. r.f. choke with pigtail leads. Cathode connection is made to the junction of the first and second pies up from the ground end. The lead from the cathode pin of the V_3 socket, should be securely anchored to L_1 with plastic tape to avoid breaking the fragile choke wire.

The final and output coils, L_2 and L_3, (see Fig. 2) are wound with #18 and #16 enamel wire as described below. The bottom end of L_2 connects to C_{25} and to chassis ground with the shortest possible leads. The top (overlapped) end of L_3 connects to C_{27}, which in turn goes to the grounded side of the line. The bottom (nearest chassis) end of L_3 connects to C_{29}.

Starting about ⅛" from the top of the coil form, mark off the designated winding spaces "A" shown in Fig. 2. Commence winding from the bottom of L_2 upward, closewound, until within about 1" from the top mark. From here to the top, make twisted loop taps each 3 turns until finished, with no one tap directly over the other. Wrap the bottom ¾" of L_2 with three layers of Pliofilm or Cellophane, overlapping about ¼" below the bottom of L_2, and seal on with Scotch tape.

Starting up distance "B" from the bottom of coil form, commence close winding, making a twisted loop tap each 3 turns until 5 taps have been made; continue winding with no further taps, until within about ⅛" of the bottom of L_2 (about 15 turns by this time), then continue winding up across the empty (⅛") space, close winding over the bottom of L_2 for about ½", roughly about 8 turns. L_3 will therefore have a total of about 23 turns. This is not critical and may be varied one or two turns either way. Anchor the top free end of L_3 to L_2 by means of a few strips of clear Scotch tape at right angles to each other. This free end of L_3 should pass through (puncture) the first strip of tape, the remaining strips holding down the first. The bottom of L_2 and both ends of L_3 should have about 6" or 8" left for connecting purposes, later cut to proper length and tinned. A two-lug, soldering-type terminal strip should be mounted on top of the chassis between the bottom of the coil form and T_3 for terminating L_3, with leads from this strip brought down under the chassis to capacitors C_{26} and C_{27}, also on a lug-type terminal strip.

Finally clean and tin all taps and leads on L_2 and L_3 and give the complete unit a coating of clear lacquer, with an extra dose around each tap and the ends. Connections are made to the taps by means of small phosphor-bronze clips (*Mueller* #88).

Adjustments and Operation

Step 1: Disconnect the power amplifier plate supply lead. Switch on the transmitter, first with V_7 removed, and check filament voltage, adding a suitable series-heater resistor if line voltage is too high. Shut off, replace

V_7 and switch on again. Connect a d.c. vacuum-tube voltmeter from chassis to upper end of R_{14} (before switching on again). Voltage should rise to not more than about 465, then drop back to between 430 and 450 volts, assuming that a power transformer of the listed rating is used. Check voltages at points *C, D, F, Q,* and *K*. They should be in excess of 245, 120, 300, 120, and 200 volts respectively, with R_{11} set at about ¾ to full resistance in the circuit. Now adjust C_{15} to about ¾ full mesh and C_{10} to about 10% of full mesh. Set meter to "Osc. Plate." Current should be around 10 to 12 ma. Now switch meter to "P. A. Grid" and a reading of 3 to 4 ma. should be obtained. Shut off unit.

Step 2A: Set the oscillator to correct frequency (148 or 206 kc.). This can be accomplished with an audio signal generator covering this range, plus either a scope or an a.c. vacuum-tube voltmeter, preferably the former. If the signal generator is of the low impedance type, put a series resistance of at least 20,000 ohms in the "hot" lead and connect to the horizontal terminals of the scope, ground terminals of both instruments also connected together. With the generator at the desired operating frequency, gain of it and the horizontal amplifier should be adjusted to give a normal trace. The vertical scope input should be connected to the transmitter, the "hot" lead being connected to the power amplifier grid through a series capacitor of 20 μμfd. or less. Connect external sync of the scope to the vertical terminals. With the high-voltage power amplifier plate supply still disconnected (and left this way until otherwise instructed), switch on the transmitter and adjust the vertical gain of the scope for a pattern of correct height. Now slowly adjust C_{15} to either side of its present setting until a circular or nearly circular pattern is obtained on the scope. If the pattern is too unsteady, try connecting the external sync to the horizontal terminals instead of the vertical. Shut transmitter off.

Step 2B: This is an alternative to Step 2A if a scope is not available. Connect the signal generator to an a.c. vacuum-tube voltmeter but without any series resistor if low impedance, and adjust to give a reading of around 5 volts at mid-scale on the meter. Connect the "hot" lead of the meter to the power amplifier grid as mentioned in Step 2A. Switch on transmitter. If a.c. meter reads off-scale, cut series capacitor to about 5 μμfd. or simply clip it to the insulated portion of R_{23} or R_{24} or, if necessary, just place this lead close to the power amplifier grid circuit, enough to slightly increase the reading from the generator alone. Next adjust C_{15} until the meter reading starts to rise. Since this will be quite sharp and sudden, it will require very careful and slight adjustment of C_{15} at resonance. At resonance the meter reading may even increase enough to go off-scale. In this case, reduce the signal generator gain a little. Shut unit off.

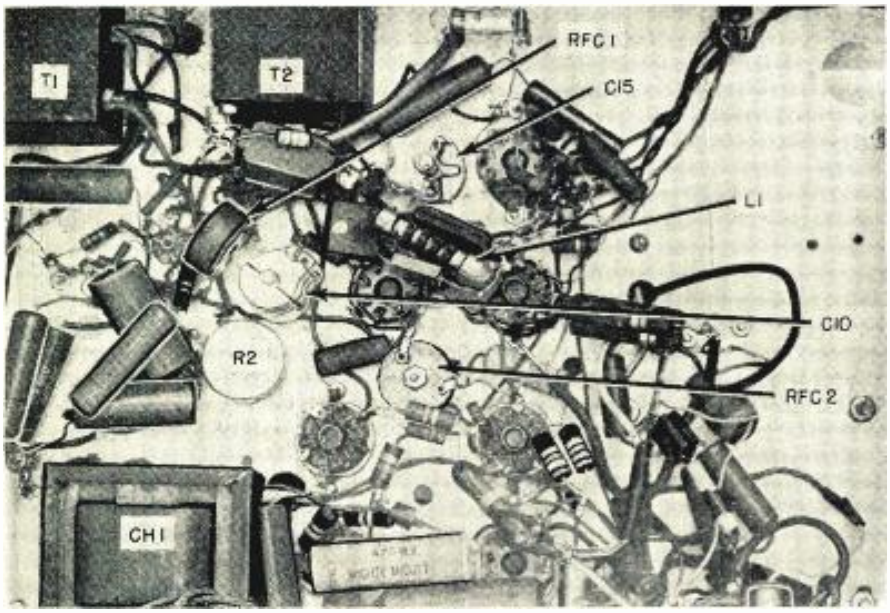
Step 3: Adjustment of balanced modulator. The value of C_{10} was chosen so that its setting would not be critical, somewhere around minimum capacity. By meshing it about 10% or so, it can be used as a final fine-tuning adjustment for C_{15} after the power amplifier stage is operating correctly. Balance will probably be correct anywhere from minimum to about half mesh of C_{10}. However, if a scope is available, it would be advisable to check balance with it. Connect it and the signal generator to the transmitter as in Step 2A. Now disconnect one of the control grid leads to V_3 or V_4 from T_2 prior to turning on the transmitter, and short the two control grids together at pins #7. Apply a constant audio tone from another generator, say about 1000 cps, either into the mike from some reproducer, or to the grid of V_1, starting with quite low gain. Switch on transmitter and adjust C_{15} for the circle pattern, but with the audio tone off to start. Next increase the gain of the tone input and watch the scope screen. If the circle pattern broadens or otherwise changes, adjust C_{10} a little one way or the other, followed by a new setting of C_{15} (with no tone) to the original correct frequency. When the tone either "on" or "off" makes no difference in the circle pattern, the modulator is balanced. Shut off the unit and connect the grids of V_3 and V_4 back as they should be, first removing the shorting lead.

Step 4: Deviation adjustment. As a start, set the a.g.c. and mike level potentiometers at about half scale. This should be a fair setting for NFM (Narrow Frequency Modulation) with about 2 kc. or not more than 3 kc. deviation. A listening test at a point a block or more from the transmitter should show no appreciable distortion. If there should be distortion, leave the mike level at mid-position, and adjust the a.g.c. until there is no distortion. Since this is a strictly inaccurate "cut and try" method, a test should be made with a scope and the setup mentioned in Step 2A. With mike level at zero, obtain a circle pattern. Next apply a constant tone to the microphone through some sort of reproducer (headphones, speaker, etc.) with mike level again at mid-position. Increase the tone output from zero gain on the audio generator until the circle pattern just broadens so that it is no longer a circle. Detune the 148 kc. (or 206 kc.) generator setting slightly, first to one side then the other of the original setting. It should be possible to again obtain a circle on both sides of the center frequency. If the new circles are obtained more than 2 or 3 kc. each side, increase the a.g.c. from its original mid-position until deviation is correct. If it is less than 2 kc., decrease the a.g.c. until the new circles indicate correct deviation. Shut off transmitter.

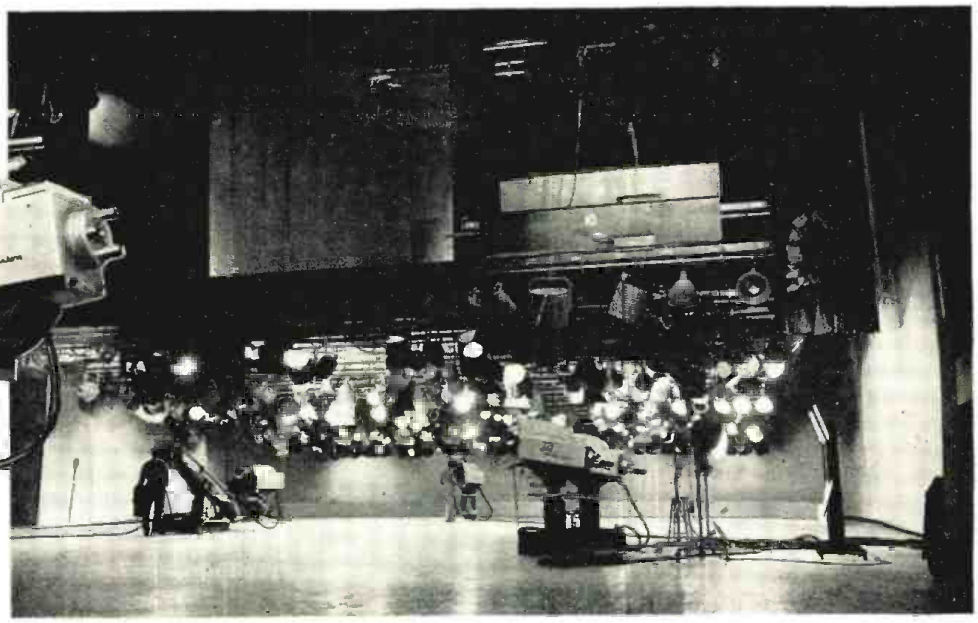
Step 5: Final amplifier adjustment. This should be done with plate voltage connected. An r.f. ammeter of 0-2 or 0-2½ amperes is required while adjusting for optimum output to the line. First, set the tap clip of L_2 at about the center position, and the L_3 clip at the first tap, that is, on the tap nearest to the bottom of L_2 (*i.e.*, minimum coupling). Switch on transmitter with S_1 in the neutral position. When unit has warmed up, depress S_1 momentarily, just long enough to note the three power amplifier meter readings, remembering that the cathode current is the sum of all three when calculating the power amplifier plate current. Cathode current should never be allowed to exceed 80 ma. other than momentarily. Normal current for the screen is 10 ma. and grid current can be anywhere from about 2.5 to a maximum of 3.5 milliamperes for the 2E26. If cathode and screen currents exceed these values with S_2 (on rear lip of

(*Continued on page* 162)

Fig. 4. Bottom view of transmitter with major under-chassis parts identified.



One of the four RCA color cameras in use at NBC's Burbank studio. Each of these color camera chains contains three RCA image orthicon tubes. Each camera has a lens turret which will permit use of four different lenses.



Over-all view of the NBC color studio in Burbank. There are 1260 lighting outlets, located on the lighting pipe battens and in outlet boxes along the walls. About 1000 Lighting fixtures, in sizes from 500 watts to 5000 watts, have been incorporated.

NBC's New Burbank Color Studio

Flexible design, which anticipates future developments in colorcasting, makes this new facility a "Television Dream City".

♦ ♦ ♦

THE National Broadcasting Company's $3,716,000 color studio in Burbank, California has a number of unique features which provide special facilities to meet the demand of colorcasting and the production of the network's series of "Color Spectaculars."

A control building, alongside the color studio proper, is a two-story structure containing all of the control functions for the existing studio as well as facilities for future expansion. The video control room contains a video console, black-and-white and color monitors, scopes, a special video equipment rack, and auxiliary camera equipment.

Each video engineer can talk *via* phone to his own cameraman separately or can hook into a conference circuit.

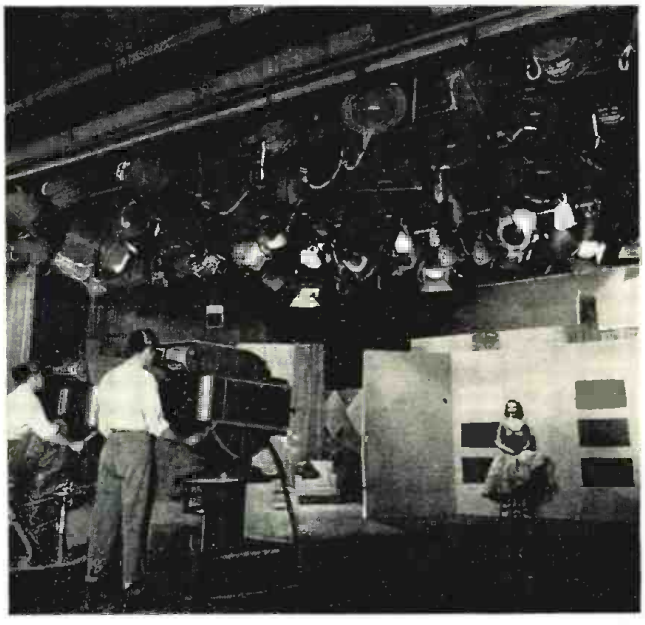
Signals for the cameras go into the switching system. This newly-designed system permits optimum transmission of the color signal and makes possible special video effects as well as providing simpler and surer operation through the use of a preset system.

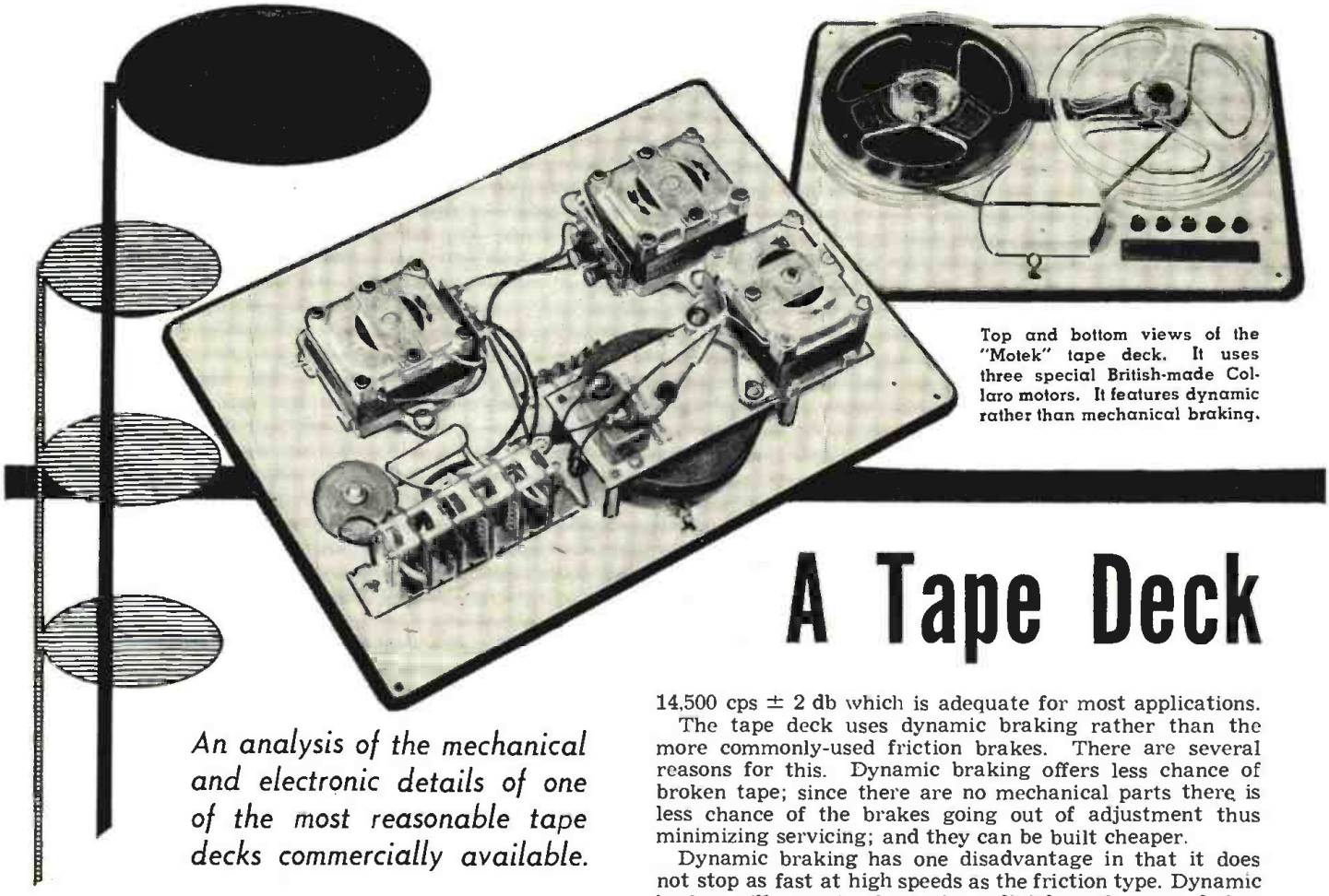
This preset feature permits the technical director to do all camera switching with one hand. This includes both previewing and program switching. The operation entails presetting the camera or remote signal by pushing the appropriate preset button. This presetting displays the picture on a color monitor. When the director wishes to put this shot on the air, he either pushes the cut bar, which is similar to a typewriter space bar, or he pulls either the dissolve handle or the special effects handle to transfer to that picture by means of a lap dissolve or by special effect. He is now ready to preset another camera and transfer it to an "on-the-air" status by one of the three means available to him.

In the program control room a monitor housing is fastened to the wall in front of the director's console. This housing contains black-and-white monitors connected to each camera's output as well as black-and-white monitors which are patchable to other signal sources within the studio.

The network emphasizes that the most noteworthy features are the provisions for color progress. —30—

The run-through on a colorcast includes setting up the cameras and presetting the special switching system. Live subjects and various color swatches are used for making needed adjustments.





Top and bottom views of the "Motek" tape deck. It uses three special British-made Collaro motors. It features dynamic rather than mechanical braking.

A Tape Deck

An analysis of the mechanical and electronic details of one of the most reasonable tape decks commercially available.

THE demand for assemble-it-yourself audio components continues unabated with the result that more and more such equipment is becoming available to the audiophile. Among such units are the "Motek" tape deck and the "Fen-Tone" tape preamplifier, both of which are being offered by the *Fenton Company,* 15 Moore Street, New York 4, New York.

The tape deck is made by *Modern Techniques* of London while the preamplifier is made in the United States by *Fenton.* The tape deck will function for both record and playback operations and incorporates a separate erase head. Although designed to operate at a single speed, the deck is available for 3¾, 7½, or 15 ips tape speeds. The 7½ ips speed is standard with the other speeds available on special order. It records one-half track and the deck will accommodate all reels up to 7" in diameter.

The "Motek" incorporates three special British-made *Collaro* motors. Each of these motors has two separate coils which can be connected in such a way that the deck can be operated on either 117 or 220 volts. The deck is supplied for operation on 117 volts, 60 cycles but other frequencies from 40 to 80 cycles are available on special order at a slight additional cost.

The deck comes equipped with a six-conductor cable; one shielded cable connects to the erase head, another to the record-playback head, while the other two single wires serve as the bias oscillator interlock.

The "Motek" will operate from a horizontal position up to about 89 degrees vertical. Wow and flutter is approximately .3 per-cent. Long term stability of the deck (error per hour) is ± 3 seconds.

The record-playback head is made of *Mumetal* and has a gap of .0005". The record bias is .2 ma., bias voltage is 35, while the required signal voltage is approximately 5. The erase head is of beryllium-copper laminate. Its gap is also .0005". Erase current is 500 mw. while erase voltage is 170 at 45 kc.

Frequency response of the record-playback head is 50 to 14,500 cps ± 2 db which is adequate for most applications.

The tape deck uses dynamic braking rather than the more commonly-used friction brakes. There are several reasons for this. Dynamic braking offers less chance of broken tape; since there are no mechanical parts there is less chance of the brakes going out of adjustment thus minimizing servicing; and they can be built cheaper.

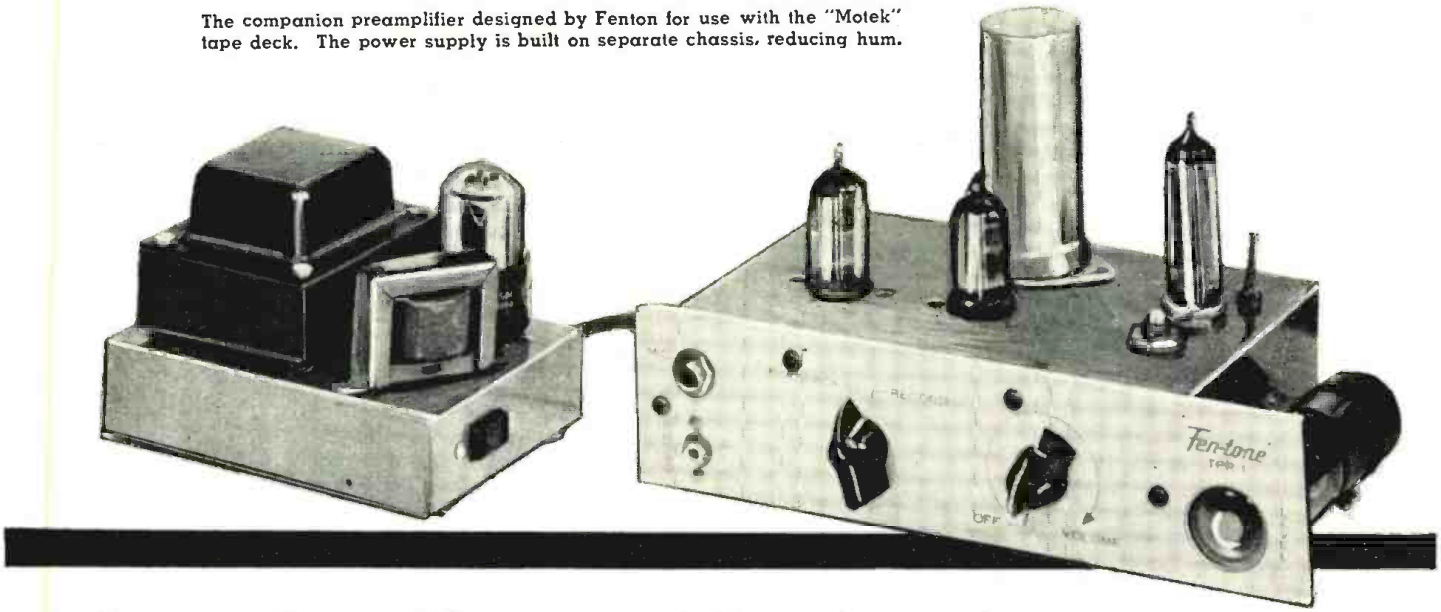
Dynamic braking has one disadvantage in that it does not stop as fast at high speeds as the friction type. Dynamic brakes will operate almost immediately at low speeds but will coast about 10 revolutions with a 7" reel before stopping at high speeds. This is no disadvantage except in cueing operations. In all cases, however, the same size reel should be used for both takeup and feed. If they differ in size there is some likelihood of tape spillage.

The design of the deck is such that erasing is only done just prior to recording. Should anyone desire to erase the tape several times, which is quite common, the only possible way in which this can be achieved is to switch the unit into the "Record" position and run the tape through with the volume control of the preamplifier set at the minimum point. There are no objections to this procedure unless the preamplifier has a relatively high hiss or hum level.

Since NARTB only established 15 ips recording standards, the 7½ ips curves vary according to the makers of pre-recorded tapes. Also, there are no established standards of R/P head characteristics; thus tape deck manufacturers have to build their own matching preamps and choose one of the many existing playback curves. *Fenton* has chosen the *Encore* "Treasure Tape" curve, therefore this pre-recorded tape will give optimum performance on the "Motek" TPR-1 combination. However, on its new, higher-priced preamp, the PRO-2, *Fenton* incorporates a choice of three individual recording curves. Let's hope that the time will come when recording heads and pre-recorded tape curves will be standardized, permitting music lovers to select any tape preamp of their liking, much the same way they now select their high-fidelity audio amplifiers.

Although interest in binaural is not too great at the present time, there are some individuals who contemplate using their tape machines for binaural operation. Obviously this unit, as marketed, was not designed for such service. Normally any machine can be converted to such operation by substituting a binaural head. This can also be done on this unit, however, it is not a simple task and is not advisable.

The companion preamplifier designed by Fenton for use with the "Motek" tape deck. The power supply is built on separate chassis, reducing hum.



for the Home Music System

Companion Preamplifier

Although the tape deck just discussed is a relative newcomer to the field—it was first shown to the public last October at the New York Audio Fair—the companion TPR-1 tape recorder preamp is an even newer development.

This unit provides all the necessary preamplification for both record and playback operation in addition to a bias-erase oscillator. The only other equipment required is a good high-quality power amplifier and speaker system.

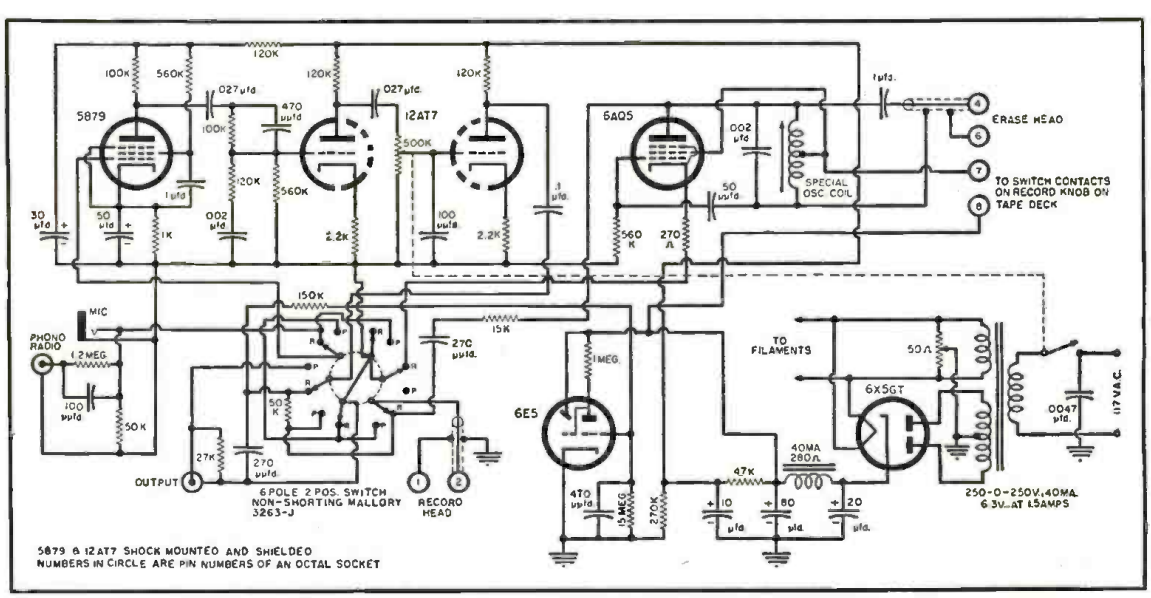
As can be noted from the photograph, the power supply for the preamp is built on a separate chassis. The advantage, of course, is that it can be placed in a remote location from the preamp, thereby reducing over-all hum pickup.

The preamp incorporates two high-impedance inputs—one for mike and the other for the phono, tuner, radio, or hi-fi amplifier tape output. A high impedance (2½ volts) output can be fed into the high-fidelity amplifier with which the unit is used. The "Record-Playback" switch is incorporated on the preamp.

The TPR-1 circuit uses five tubes—a 6X5GTA, 6AQ5, 6E5, 12AT7, and 5879, the last two shock-mounted. Bias and erase frequency is adjustable from 45 to 55 kc.; signal-to-noise ratio is —55 db; the record frequency is better than 50-10,500 cps ± 3 db, while the playback frequency is better than 50-14,000 cps ± 3 db.

In the "Record" position the unit functions as a record oscillator furnishing erase and bias voltages as well as the record amplifier, furnishing enough gain to fully modulate the tape from either a high-impedance crystal microphone (—55 db or more) or any source supplying 5 volt or more. In the "Playback" position, the unit acts as a playback preamplifier with enough gain to drive any high-level input amplifier to full output from an 85 per-cent modulated tape.

Although the preamp is being offered in both kit and assembled forms, the price differential of $5.00 makes the fully-wired unit the more attractive buy except for those who enjoy the challenge of assembling their own equipment. Factory-assembled, the preamplifier is priced at $39.75 net while the kit is $34.75. The kit is a prefab job which is partially assembled. All sockets, jacks, etc. are riveted to the chassis, the switch is partially assembled, and the connecting cable is precut and stripped. —30—



Complete schematic of the tape recorder preamp which has been designed to be used with the "Motek" tape deck. Instructions for building such a preamp are included with each tape deck so the builder can use his own parts. Components are standard with the exception of the oscillator coil which can be purchased from Fenton. Other parts can be purchased if desired, including chassis, panel, etc.

HOW TO IMPROVE YOUR HI-FI AMPLIFIER

By **MILTON S. KIVER**

Don't try to re-design your amplifier—but there are several simple improvements that can be made on any unit.

INTEREST in high-fidelity is at the highest pitch it has ever been and from all indications it is headed even higher. Alert service technicians welcome this growth for it means new sources of revenue. The expansion is also a boon to the hi-fi enthusiast because the more interest the public shows in a product, the more time and effort manufacturers will spend trying to improve it. As a result, everyone benefits.

The heart of a high-fidelity system lies in the amplifier. Here is the place where the audio signal receives the major portion of its amplification and, frequently, the major portion of its distortion.

Commercial amplifiers on the market and build-it-yourself kits come in a variety of power capabilities and in a range of qualities. It may very well be that the amplifier you finally purchase (either factory-wired or in kit form) does not have as low a noise level, or as clean a sound, or as wide a response as you would like it to have. But to get what you really want would entail more money than you care to spend. Must you, then, be satisfied with less or is there something you can do to improve the quality of your system?

While changes in basic circuit design are seldom feasible, there are a number of "fringe" modifications that can be made to measurably improve the characteristics of an amplifier. In most instances, the additional component costs are nominal and anyone with a basic understanding of amplifier operation may make the changes readily

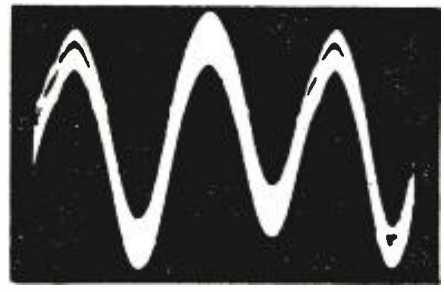
The important attributes of an audio amplifier include hum, noise, frequency response, output, and distortion (at rated output). For a well-designed amplifier, hum and noise would be on the order of 70 db or more below rated output and frequency response would be flat from about 30 to 50 cycles at the low end to well above 20,000 cycles at the high end. Distortion, to have any significance, must be measured at rated output and anything less than 2 per-cent intermodulation distortion can be considered excellent.

Here, then, is a set of figures to work against in evaluating the performance of your particular system. If you feel that your amplifier could stand improvement, certain simple steps can be taken to step up its performance.

Hum

The presence of hum in the loudspeaker is an indication that a.c. is somehow reaching the signal path of the amplifier. As a first step in dealing with this problem, a complete measurement should be made to determine just how much voltage there is. With this information on hand, you will then be in a position to know exactly how much improvement each corrective change provides.

Fig. 1. Appearance of hum on an oscilloscope connected across amplifier output.



The hum measurement is made as follows:

Disconnect the speaker voice coil from the amplifier and substitute an equivalent resistor of the proper wattage rating. In the usual case, this might be an 8- or 16-ohm resistor rated at 10, 20, or 30 watts, depending on the amplifier output. Then, with nothing connected to the input of the amplifier and the volume control wide open, measure the hum voltage appearing across the load resistor. This can be readily done with an oscilloscope and might appear as shown in Fig. 1. A v.t.v.m. can also be used for the same purpose provided it is sensitive enough. The oscilloscope, however, is the more desirable instrument.

If the hum power is desired, take the square of the hum voltage (r.m.s. value) and divide it by the resistance of the load. The result is hum power. Then, by the use of the formula:

$$db = 10 \log (P_1/P_2)$$

where: P_1 = rated power output of amplifier

P_2 = hum power output

you can obtain the number of db the hum level is below rated output. Any value in excess of 65 to 70 db can be considered good.

The sources of hum in an amplifier are many and diverse, but in the present discussion only those which can be corrected fairly readily will be considered. For example, parts placement has a very definite bearing on the amount of hum heard in the speaker. However, to remedy this situation would mean we would have to rearrange the chassis parts layout and this is seldom feasible in existing

equipment. Hence, this point will not be considered. To a certain extent, the same is true of shielding. Large components, such as transformers and chokes, are not readily shielded by adding auxiliary shields. On the other hand, tubes can be shielded quite easily. The problem, then, is to see what we can do to reduce hum simply, economically, and effectively.

One of the important sources of hum in an audio amplifier stems from the use of a.c. to heat the cathodes of the low-level stages. This alternating voltage can reach the other tube elements by electrostatic and electromagnetic coupling (between the cathode and the grid, screen grid and plate) and also by means of leakage paths from heater to cathode. To avoid these difficulties, many higher priced amplifiers (and preamplifiers) use d.c. to heat the cathodes. The required current can be obtained from a separate power supply (Fig. 2A) or by utilizing the cathode currents flowing through the power output amplifier (Fig. 2B).

In established circuits, a simple approach to hum reduction and one which is frequently quite effective is demonstrated in Fig. 3. A small 100-ohm, 2-watt potentiometer is shunted across the heater windings of the power transformer. The center arm of the control is grounded. (If the transformer winding itself has a center tap, this should be left unconnected.) Then, with the system in operation, the potentiometer arm is rotated until the hum level is at its lowest point.

An elaboration of this circuit is shown in Fig. 4. The potentiometer is retained, and a small positive voltage has been introduced into the heater circuit. The purpose of the "B+" voltage is to make each tube heater sufficiently positive so that no leakage current can flow from heater to cathode, thereby eliminating this method of hum introduction. The amount of positive voltage required is small, on the order of 30 to 40 volts, and it may be obtained by connecting appropriate resistors across the power supply output.

Another useful method of minimizing the amount of hum reaching the grid of an amplifier is through the use of a single grounding point for the grid and cathode circuits of any single stage. The reason for this stipulation is that if the grid and cathode circuits are grounded at separate points, any a.c. flowing through the chassis will develop a minute voltage across the chassis resistance between the two grounding points. This voltage is thus placed effectively in series with the signal voltage, causing hum to appear in the tube output.

As a matter of general practice, it is best to use a single bus bar (or No. 12 or 14 wire) as the grounding line for the entire amplifier. The bar is everywhere insulated from the chassis except at one point. This is usually chosen at the input to the system. By this means, the introduction of hum from currents circulating through the chassis is avoided.

Finally, all heater wires traveling from tube to tube should be carefully twisted about each other to effect as much of a cancellation of magnetic fields as it is possible to achieve. An interesting practice which may assist in hum reduction is to run the heater wires above the chassis—rather than along the underside. Holes are drilled at the heater terminals of each socket, enabling the wires to make suitable contact with the terminal lugs. In this way, the chassis acts as an effective shield between the 60-cycle a.c. fields and the various circuit components.

The foregoing hum sources have all been directly associated with the power line and hence the frequency is 60 cycles. There is still another source of hum, that due to insufficient filtering of the "B+" voltage. The ripple frequency here is 120 cycles due to the full-wave rectifying action common to all amplifier power rectifiers. As far as audibility is concerned, both sources of hum are equally annoying, however, the frequency is stressed so that the technician may use this difference to determine whether the hum is being brought in from the power supply or the heaters.

The obvious solution to hum in the "B+" line is additional filtering. As a start, shunt additional filter capacitors across the "B+" line and note whether the hum level decreases. If it does, and the existing capacitors are judged to be good, then the extra capacitors may simply be added to the system, or the original units may be removed and higher-valued capacitors inserted in their place.

Each of the foregoing suggestions will afford a certain amount of relief from hum and all together will reduce hum substantially. In instances where the technician has difficulty locating the source of the hum, a useful approach is to start at the grids of the output stages and work back to the input, one stage at a time. The grids of all stages prior to the one being worked should be grounded so that any hum they may contribute is prevented from reaching the part of the system being worked on. Try to reduce the hum of each stage to as low a level as possible before moving on to the next stage. In this way, systematic correction can be worked out.

Noise

Another important characteristic of amplifier operation is the amount of noise that the system develops. As with hum, it is the low-level stages that are most critical in this respect and it is specifically toward them that corrective measures are directed.

Noise in an amplifier is due to two main sources—thermal agitation and tube hiss.

Thermal agitation arises from the random motion of electrons in any conductor. The movement of the electrons, in both directions, constitutes a current flow. Since there are usually a few more electrons moving in one direction than in the other, a voltage is set up across the conductor which is

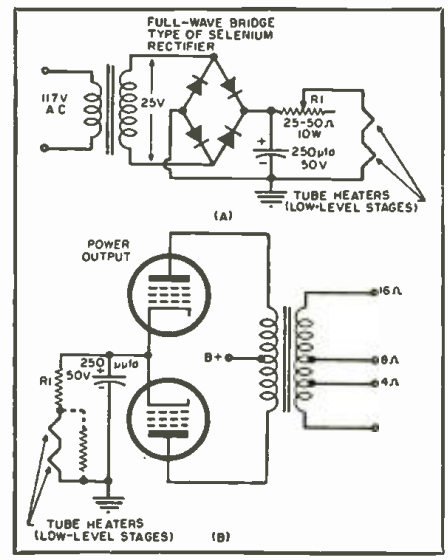


Fig. 2. (A) A suitable d.c. heater supply. The setting of R_1 depends on voltage output of rectifier and number of heaters in series. Also, shunting resistors for tube heaters may be needed if tubes require different currents. (B) Another method for obtaining d.c. power for the heaters of low-level stages. R_1 is chosen so that its voltage drop plus those of the heaters equals required stage bias. If too much cathode current is available, a suitable shunting resistor will be required.

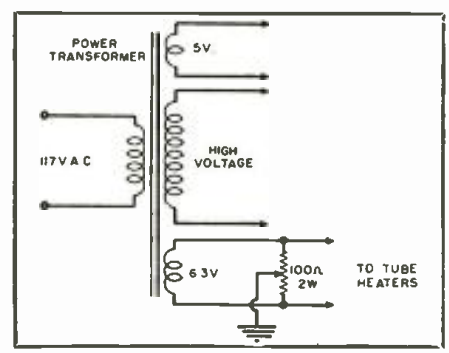
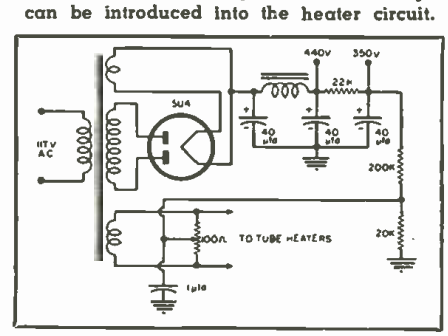


Fig. 3. A simple hum-reducing control. This can readily be added to existing amplifiers.

proportional to the net current flow and the value of the conductor resistance. The polarity of the voltage due to thermal agitation changes constantly, depending on the direction in which the maximum number of electrons is moving. Because of this, there is no definite pattern to the random voltage, or, for that matter, any one frequency at which the electrons move.

(*Continued on page* 126)

Fig. 4. How a small positive d.c. voltage can be introduced into the heater circuit.



RESISTORS

By WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

Do you always use the right resistor at the right time?

This review of commercial resistors should be of help.

THERE is no single application of electricity where resistance does not play an important part. Whenever electrons move there is some opposition to this flow, and the size of this resistance is a vital parameter in the most fundamental of electrical laws, Ohm's Law. For this reason, the resistance element is invariably found in every single application of electronics and the value of this resistance is usually essential to the circuit.

Although every component contains some resistance, the lumped or calculated resistance takes the form of a special component. One definition of an ideal resistor is that it offers equal impedance to the flow of d.c. and a.c. at all frequencies. An ideal resistor should not have any inductance or capacitance. In discussing the various types of fixed and variable resistors we shall point out their limitations as to inductance and capacitance, as well as the changes which temperature and humidity can effect on typical resistors.

The complexity of modern electronic equipment requires a great variety of specialized resistors with all sorts of different temperature, humidity, power, and other ratings. Another important aspect of resistance is the tolerance which may be desired in specific applications.

Fixed Composition

Fixed composition resistors are the most commonly used types, especially in radio and TV receivers. Surely the ⅛ watt, ½ watt, 1 watt, and 2 watt carbon composition types shown in Fig. 1 are familiar to all readers. These resistors consist of a core of carbon composition mixture, molded into an insulating material. The outside of the insulating material is painted with the value of the resistance in the color code, and the wattage rating of the unit is indicated by its size. These resistors are available in three standard tolerances, 20%, 10%, and 5% and, while the 5% units are marked with a gold stripe and the 10% units have a silver stripe, the 20% types have only the three colors indicating the resistance value. Resistor values standardized by the Radio-Electronics-Television Manufacturers Association (RETMA) are arranged according to tolerances. Thus, for example, 5% resistors are available in 270, 300, 330, 360, and 390 ohms while in the 20% types only the 270, 330, and 390 ohm values are standard.

Carbon composition types are occasionally found in ¼ watt sizes. Also, ½ watt composition resistors are available only down to 10 ohms. Lower resistances are made in the same size insulated body, but contain a resistance wire coil. This means they cannot be used in r.f. circuits.

When resistors are used in high-frequency circuits, the lead length often becomes critical as does the proximity of the insulated body to the chassis, since this increases the stray capacity of the system. If proper lead lengths and positioning of the resistor are observed, carbon composition resistors can be used up to 2000 mc.

In general, high temperatures in the area of a resistor will increase its resistance; with carbon composition types great resistance variations are possible. After heat has been applied for some time the resistance may increase far beyond the tolerance specified and remain high even when the heat is removed. For this reason, it is important when replacing resistors to avoid heating the resistor body with the soldering iron. It is good practice

Fig. 1. Some typical fixed composition-type resistors of various wattage ratings. These particular units are from IRC.

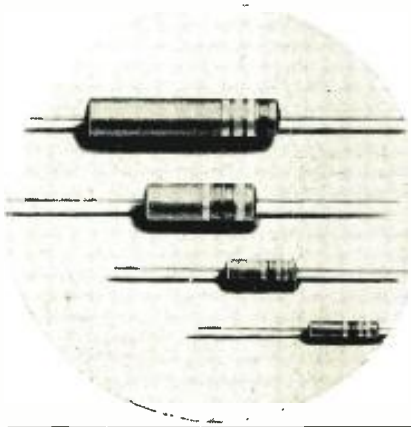


Fig. 2. Shown here are two Allen-Bradley composition-type resistors, metal encased to facilitate the dissipation of heat.

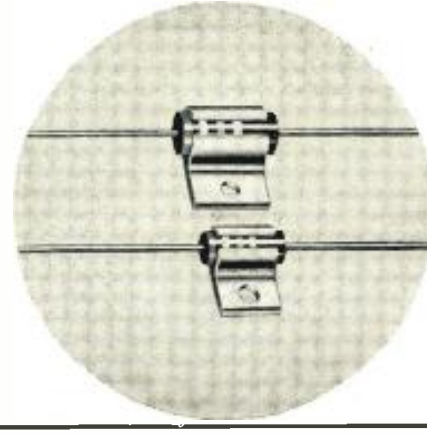


Fig. 3. Three types of resistive film resistors made by Aerovox are shown here: ceramic, metal, and lacquer exteriors.

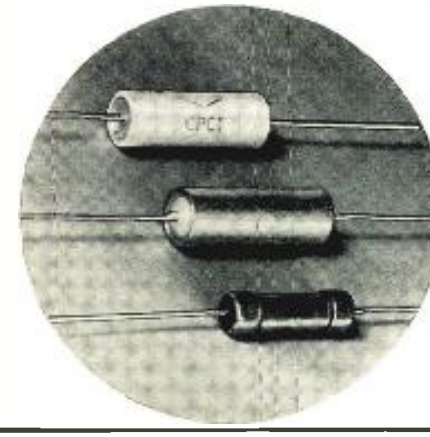


Fig. 4. Two Sprague spiral-wound film-type resistors; one is encased in plastic. These are used for high voltages.

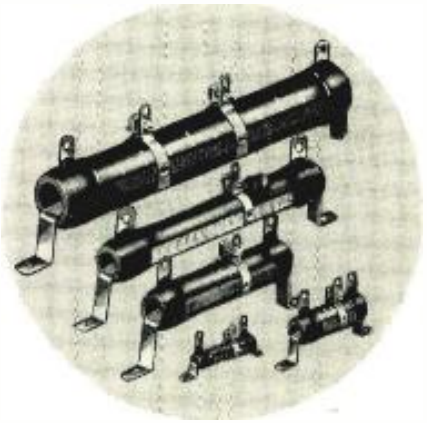


Fig. 5. Various sizes of adjustable wirewound resistors are shown here. These particular units are made by Ohmite.

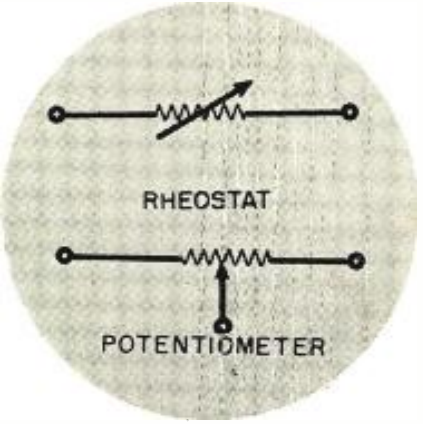


Fig. 6. The difference between a rheostat and potentiometer is shown here symbolically. Note that the "pot" has 3 terminals.

to apply the soldering iron only at the connection, holding the part of the pigtail lead nearest the resistor body with long-nosed pliers. The pliers serve to draw off some of the heat and thereby reduce the danger of overheating the resistance element.

Carbon resistors which have overheated in operation, possibly due to a short somewhere in the circuit, should always be replaced. They are usually discolored, have high resistance, and are quite brittle. TV service technicians will find that such overheated resistors often crack and cause intermittent defects.

In high voltage circuits carbon composition resistors must be used with great care to avoid internal arcing or breakdown of the resistance element. Many early TV receivers used a high-voltage doubler circuit with a bleeder consisting of 4 or 5 one-watt carbon composition resistors in series. The series arrangement was necessary to keep the voltage across each resistor below 1000 volts. This is generally the potential considered safe for 1-watt resistors. Later, special carbon-film high-voltage resistors were used.

For carbon composition resistors, the accepted practice requires that the actual power dissipated in the resistor be no more than half of the rated wattage. To keep components really cool to guarantee stable operation, one-fourth is sometimes used. Thus, if ½ watt is actually dissipated, a 2-watt resistor will be specified. In circuits where r.f. energy is present in addition to the calculated d.c. power, suitable derating is needed.

A novel way to improve stability and promote cool operation is the use of the copper encased carbon resistor, an example of which is shown in Fig. 2. The principle here is simply to dissipate the heat in the resistor by means of a copper ring which transfers the heat to the chassis or other large metal object.

Film Type

For applications requiring good stability with changes in temperature and humidity as well as great accuracy in resistance values, there is now a variety of film-type resistors available. Basically, these consist of a core of insulating material, usually a glass rod, which is coated with a thin film of the actual resistance material. To make connections there are small metal caps with pigtail leads at each end. The entire unit is either covered with a special lacquer or else molded into a solid insulating material. Typical coated film-type resistors are shown in Fig. 3. Power ratings of this type of resistor vary from ⅛ to 5 watts. Unlike carbon composition resistors, the film-type resistors can usually be used to about 80% of their rated wattage without damage or overheating. This is due in part to the fact that the resistance element and the glass core are quite stable under reasonable temperature variation.

Among the coated type resistors are the high-voltage resistors found in many TV sets. As shown in Fig. 4, the resistance element is applied in a spiral around the glass or ceramic core and may then be encased in plastic.

Film-type resistors are usually marked as to resistance and power rating and do not use the color code. Tolerances of 1%, 2%, and 5% are standard, but some very special applications may require a 0.5% tolerance. In general, film-type resistors should be replaced only with an exact equivalent. Most frequently, these units are found in test equipment and laboratory power supplies where accuracy is essential.

Wirewound

Most service technicians consider any resistor larger than a 2-watt unit as a power type, and generally do not pay much attention to these larger

Fig. 7. Ceramic core, wirewound resistors of fixed value used for relatively large power dissipations. These are by Sprague.

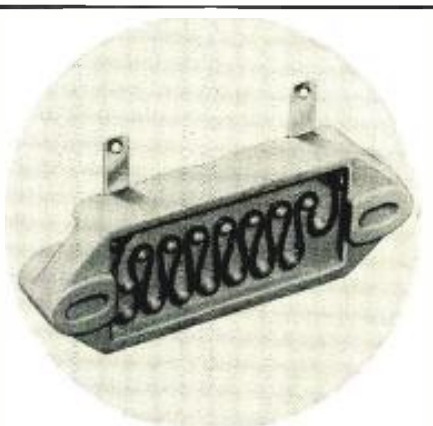


Fig. 8. Shown here is a noninductive wirewound resistor before it is filled with an insulating impregnant, by Ward Leonard.

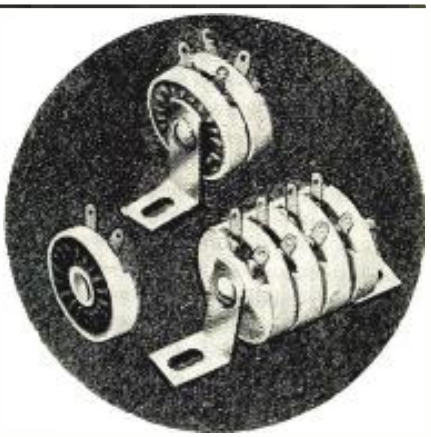


Fig. 9. These are noninductive wirewound resistors in ceramic disc cases which may be added together, by Ward Leonard.

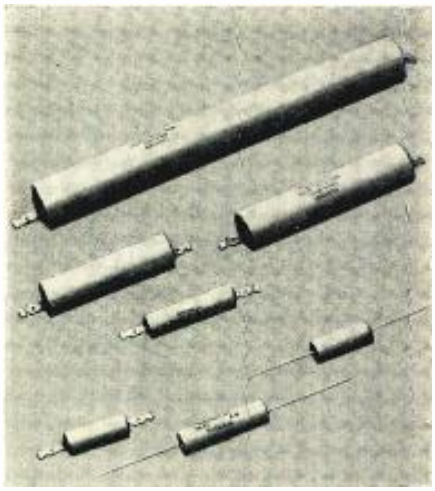


Fig. 10. Shown here are some varieties of a wirewound resistor using insulated resistance wire and made by Sprague.

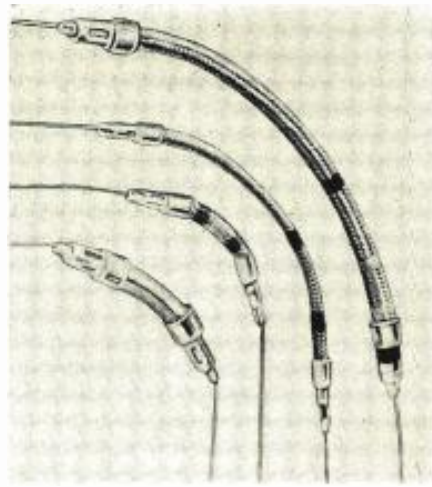


Fig. 11. The flexible resistors shown here are made of wire wound around a Fiberglas tube. These are by Clarostat.

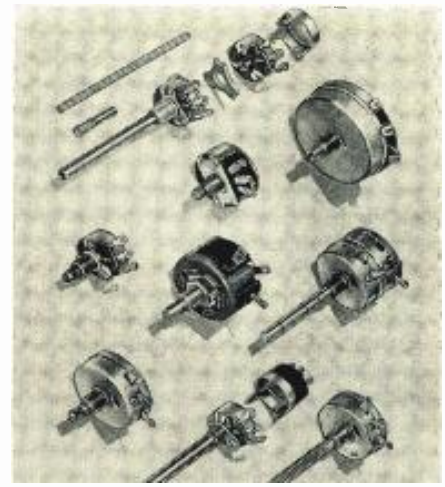


Fig. 12. Various types and sizes of potentiometers are shown here, both carbon and wirewound. These are from Mallory.

types since they rarely are the source of difficulty in a receiver. For the engineer, amateur, and hobbyist however, wirewound resistors are very important and extensively used. Wirewound units can be divided into two major groups, the fixed types and the variable types.

Typical adjustable wirewound power resistors are shown in Fig. 5. These resistors consist of a ceramic form on which the resistance wire is wound in a single layer. A ceramic coating holds the wire and the end terminals in place. The sliding tap makes contact with the wire through a small dimple in the adjustable ring. Loosening the screw on this ring permits it to be moved in any direction and allows for adjustment of the resistance. Caution is indicated here to keep the movable tap from injuring the resistance wire. This could happen if the screw is tightened too much or if the tap is moved without loosening the screw sufficiently.

At this point, a common source of confusion might be cleared up. The term rheostat does not describe the type of resistor shown in Fig. 5. A rheostat is an adjustable resistor with only two connections; a potentiometer always has three connections, see Fig. 6. In electronic work, practically all variable resistors are of the potentiometer type, whether they take the shape of the familiar volume control or are of the slide wire type shown in Fig. 5. Occasionally, several resistors are contained in a single ceramic form as in the well remembered early *RCA* 630 TV receivers.

Fig. 7 shows a typical assortment of fixed wirewound resistors ranging from the small 5-watt unit with axial pigtail leads to the large 200-watt resistor which requires mounting brackets. These resistors all have certain common features. They are quite rugged electrically, maintain their resistance under limited temperature variation, and are relatively unaffected by humidity. One disadvantage of the wirewound types is that the heat they radiate raises the temperature in adjacent components. Since most of the wirewound resistors are inductive, they are not suitable for r.f. circuits. Special noninductive windings are obtainable which keep inductance and distributed capacity to a minimum.

A special resistor which contains a noninductive type winding is shown in Fig. 8. The resistance wire is laid into a ceramic form which is then filled and sealed up. As a result of the peculiar way in which the resistive element is mounted, the inductance of this unit is kept to a minimum and the heat dissipation is greatly improved. A variation is shown in Fig. 9, where the same type of winding is arranged within a ceramic disc. As indicated, several such discs can be mounted with a single screw and a variety of circuit connections can be obtained. This type of resistor is used in rather specialized equipment and is not generally found in radio and TV receivers.

Still another type of wirewound resistor is shown in Fig. 10. Obtainable in a noninductive winding as well as conventionally wound, this resistor consists of a ceramic core, insulated resistance wire, and a ceramic type outer shell. Features of this resistor include relatively cool operation, protection against moisture, humidity, and other climatic conditions, and ruggedness.

Many other varieties of wirewound resistors are available in a great number of different shapes, sizes, and body materials. Some manufacturers use flat or oval cross sectional forms which allow greater compactness. Others offer precision wirewound resistors with low power rating, made of many layers of wound resistance wire. Still other types are wirewound on ceramic, sealed into glass. One interesting type is the flexible Fiberglas resistor where a resistance wire is looped around a core of Fiberglas filaments, and then covered by Fiberglas sleeving These elements are extremely flexible, as shown in Fig. 11, and are ideal for use in electric soldering irons, etc. Also included among wirewound resistors are ballast tubes and heater-type ballasts as well as resistance type a.c. line cords.

Potentiometers and Controls

The term potentiometer or "pot" is generally taken to mean a control of the type shown in Fig. 12, used as either a volume, tone, or picture control of some kind. Actually, there are over a hundred different kinds of controls varying widely in their electrical characteristics and in mechanical construction. Basically, there are two types of potentiometers—the wirewound and the carbon composition type. The former is distinguished by greater precision in many instances and, of course, by higher power ratings. Carbon composition "pots" are usually cheaper and allow higher resistance values in a limited space. They also tend to develop less contact noise, permit the use of a variety of tapers, and are almost noninductive.

The size and construction of potentiometers naturally vary with their power rating. The wirewound power potentiometers, 10 watts or more, are larger and often feature open construction. Usually only the smaller types, mostly the carbon composition potentiometers, have switches mounted on the back. A typical combination switch and potentiometer is shown in Fig. 13. A d.p.d.t. slide switch is added to the back of the control, permitting the use of a single shaft for tone control and high-low switching, or similar application.

Since the advent of TV, concentric-shaft potentiometers have become commonplace. A special type of potentiometer that is being used in color TV sets is shown in Fig. 14. The shaft is made of an insulating material, permitting adjustments to be made by screwdriver without affecting the capacity in the circuit. The same potentiometer has twist tabs for mounting it in automatic assembly processes and is available with special terminals suitable for printed wiring.

The size of potentiometers has been reduced greatly and miniature types are available for such applications as

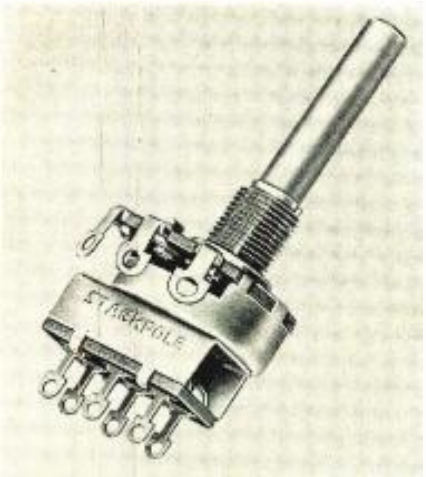


Fig. 13. Double-throw, double-pole slide switch mounted on a potentiometer, used widely in radio and phono, by Stackpole.

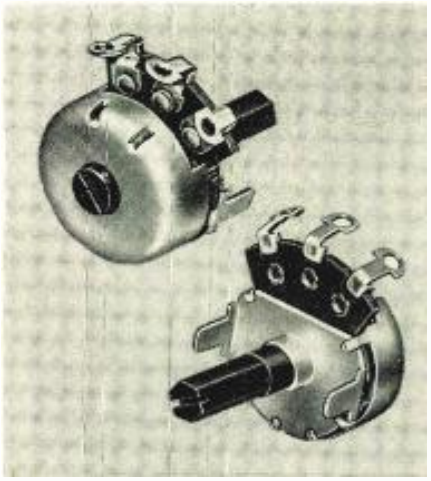


Fig. 14. This potentiometer by Stackpole has a Bakelite shaft for accurate screwdriver adjustments and has mounting tabs.

Fig. 15. Two varieties of Centralab miniaturized carbon potentiometers for hearing aids and other similar applications.

hearing aids and other subminiaturized equipment. Examples of these very small units are shown in Fig. 15; these units invariably are of the carbon composition type.

In addition to the control applications familiar from radio and TV, potentiometers are widely used in computers and telemetering equipment, requiring extreme precision and stability. Some of these special potentiometers are quite costly, use spiral windings for greater resolution, and are made with special resistance tapers and taps.

The taper of any potentiometer is quite important and indicates the manner in which resistance varies with rotation. In this connection, it should be mentioned that most commercial potentiometers are useful over about 270 degrees of rotation. The taper is defined as the relation between per-cent rotation and per-cent of total resistance. Most of the standard potentiometers have their tapers expressed as clockwise rotation, meaning that we look at the control from the shaft end.

Fig. 16 shows some standard tapers for carbon composition potentiometers. Clockwise rotation only is considered here. Note that all of the curves start at the 10% rotation point and end at 95% rotation point. This is due to the small area at either end of the control which is part of the end contacts. Curve "A" represents a linear change of resistance with rotation. This type of control is used in most TV applications except for the audio and tone controls. Tapers "B" and "C" are both used in tone and volume controls and are modified logarithmic curves. Curve "W" is also a modified log curve, but has 37% resistance at its center position and approaches the linear taper closely. The taper of curve "S" is linear over most of the range but represents slow resistance changes at either end.

It would be difficult to adjust volume in a set where a modified-log taper potentiometer has been replaced by one having a linear taper. For this reason, the taper as well as the resistance value and power rating of the potentiometer should always be ascertained before replacing a defective unit.

Power ratings among wirewound potentiometers range from 3 to 50 watts and are usually stated on the unit. Carbon composition types vary from ⅓ to 2 watts. The audio models are usually rated at 2 watts but should not be operated beyond 1 watt continuous dissipation. Naturally, the miniature potentiometers have much smaller power ratings.

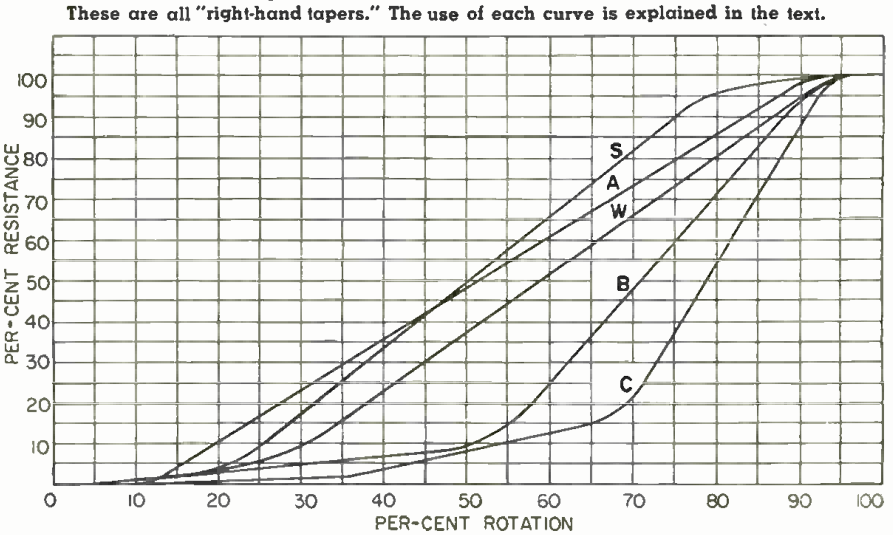
Special Types

Among specialized resistors are such varied types as thermistors, bolometer elements, temperature coefficient units and a variety of high frequency resistance elements. Typical of the latter are the carbon-coated card types used in some microwave attenuators, or the ferrite materials used in similar applications. Thermistors are usually part of a power measuring apparatus and indicate heat rise as a change in resistance. Thyrite and similar ceramic materials having a nonlinear resistance characteristic are used as resistance elements and these units exhibit great variations in resistance as temperature or current is varied. These changes are amplified and actuate a meter which is calibrated either in heat, power, or current, depending on the application of the thermistor. Bolometer elements are actually a variation of the thermistor but are generally used only for measuring r.f. power in small quantities.

One type of temperature coefficient resistor which is used in some TV receivers is a "Globar" unit which is connected in series with the tube heaters, as in some *G-E* receivers. The purpose of this resistor is to limit the flow of current during the initial warm-up period. As the resistor heats up, its resistance decreases and allows more current to flow. This reduces the danger of voltage surges which can damage series heaters. When replacing these resistors, exact duplicates must be used and their location in the set must be duplicated as well, to avoid over or under heating them.

Another current-limiting resistor which is used for the protection of TV and radio circuits is the "Fusistor," made by *Bradford Components, Inc.* They are furnished as plug-ins. —30—

Fig. 16. Standard taper curves for controls used in television and radio sets. These are all "right-hand tapers." The use of each curve is explained in the text.



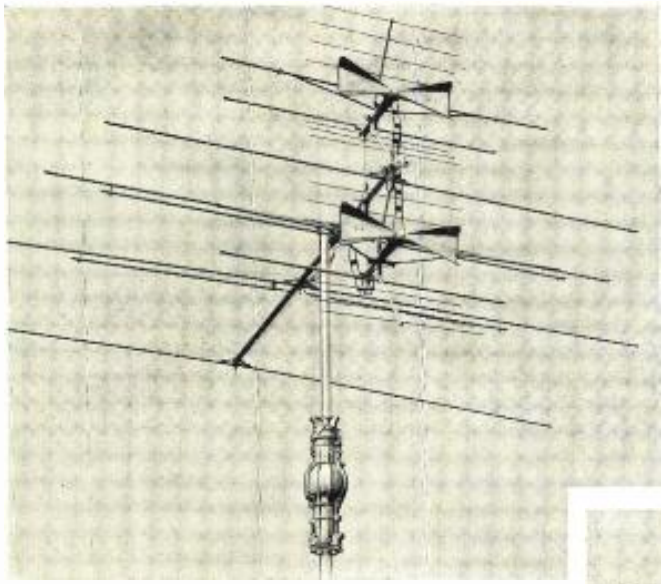
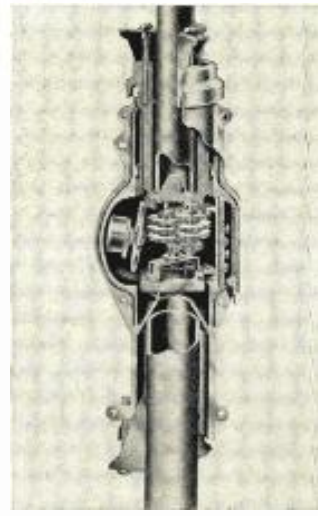


Fig. 1. A rotator installation with a combination type antenna for u.h.f. and v.h.f. TV reception. The rotator shown here is by Vee-D-X and is of the inline type. Guying wires which are actually used to help keep the installation rigid, are not shown here.

Fig. 2. Cutaway view of the Vee-D-X antenna rotator showing how the drive mechanism is positioned to allow the antenna mast to be in line with the support mast.



Why a Rotator?

By **L. F. B. CARINI**
Chief Engineer, La Pointe Electronics Inc.

Now is the time to push TV antenna rotator sales—the viewing season is reviving and there are more stations.

TELECASTERS have made great strides in increasing broadcast power and adding many new stations which reduce the number of fringe areas throughout the country. TV receiver manufacturers are busy improving TV sets, designed to bring in even sharper pictures on weak signals and, almost daily, a new antenna design featuring high gain is developed. Still there are many viewers who get weak and unstable reception.

For the TV viewer, there is almost always an immediate and noticeable improvement in reception resulting from the installation of a better antenna system.

Too often today, the common practice is to assume that a given antenna will work as well in one spot as in another, in the same general area. This is a serious miscalculation. For best results it is necessary to evaluate antenna requirements in terms of needed gain on the existing signal level in the exact location of the antenna. The antenna rotator, by increasing antenna system directivity and minimizing interference, can increase the efficiency of an antenna system in areas where a number of stations are in operation.

With the advent of u.h.f. stations, the antenna of today must be truly versatile. Weather conditions, seasonal variations, and transitory movements (clouds, airplanes, foliage, etc.) within the environmental field of the antenna influence reception. As most of these conditions can be corrected for by the re-orientation of the antenna, the practicability of employing a rotator assumes an added importance as an ideal means of compensating for any variables of propagation. Fundamentally, the rotator serves two basic functions. The first is to provide rotation of a combination v.h.f.-u.h.f. (or selective channel) antenna for reception of signals in any compass direction. The second function is to orient the response pattern of an antenna for the elimination of interference.

In the past, rotators were used mostly with v.h.f. conicals or multichannel yagis. Signal strength at v.h.f. being inherently stronger and more consistent than at u.h.f., antenna orientation by a rotator was principally a means of convenient mechanical expediency. At u.h.f., however, signals assume an elusive quality and directivity becomes sharper; therefore, orientation is much more critical, necessitating a careful positioning of the antenna in order to obtain optimum signal strength. Observations made at u.h.f. have also disclosed that a rotator can be used effectively to either "cut in" or "cut out" a station. This selective positioning of the antenna, known as "jogging," orients the response pattern and, in effect, acts to beam the antenna's directional pickup towards the desired station.

Because u.h.f. frequencies are of such relatively short wavelengths, multiple reflection of the waves from surrounding objects is common. These undesirable reflections are readily picked up by the rear or side lobes of the antenna and are responsible for the presence of ghost images on the screen. This fact explains why a highly directional antenna like the yagi or corner reflector, which inherently possesses a high front-to-back ratio, assures freedom from interference. To use such an antenna for reception from different directions requires a rotator.

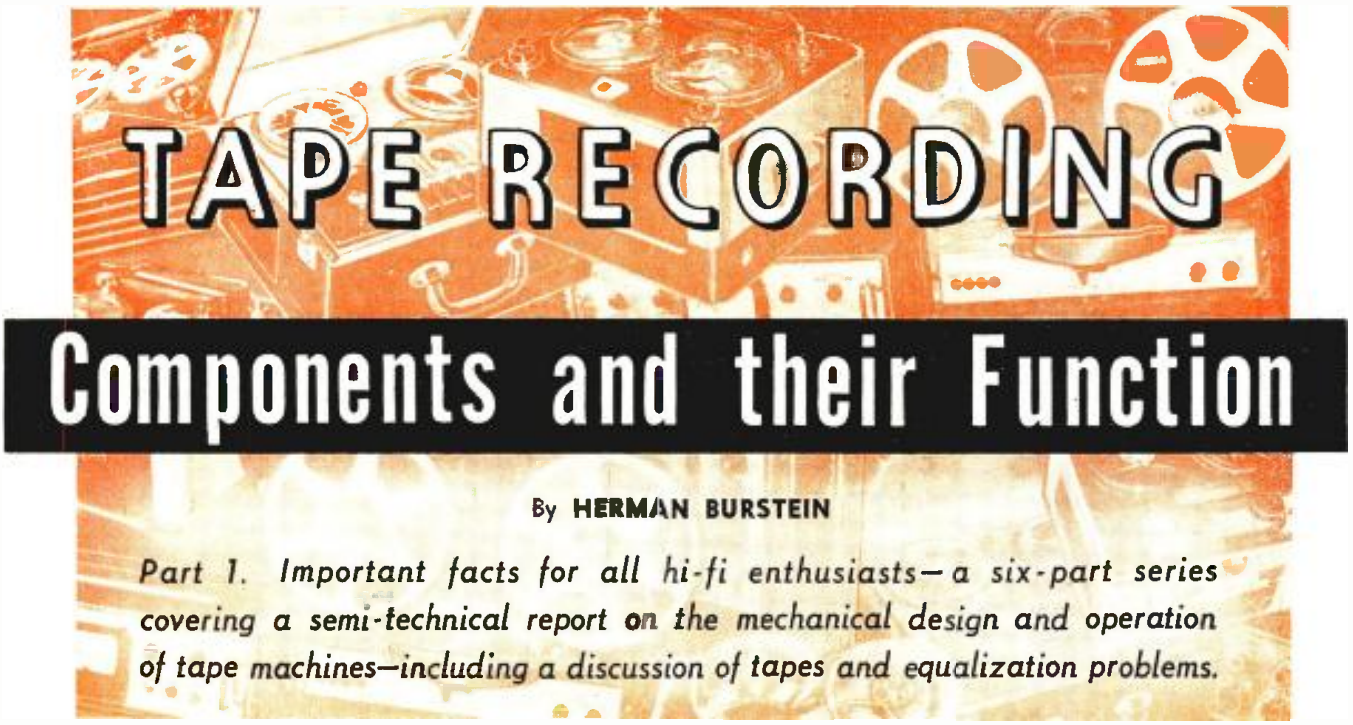
Investigation of some rotators now in use discloses that the basic mechanical design of the existing mechanisms could be vastly changed to obtain a different type unit which is compact and rugged without suffering a loss of efficiency. Many have large housings with staggered gear trains. The need for a large housing is furthered by the usual provisions for an offset mounting, creating a physical distortion which is both aesthetically and mechanically incongruous with ideal engineering design. However, most practical engineering design is a compromise in which some disadvantages are accepted to obtain some advantages. The offset-type mounting allows rapid interchange of drive mechanisms.

In considering the over-all design of a rotator, the obvious requirement is a rotator drive that is basically simple, compact, and foolproof in operation. To be sure, the normal working cycle of a rotator is not long, as it may be operated only several times a day, however, operations at wide extremes of temperature and during strong winds combine to subject the rotator to some rough service. Undoubtedly, all rotators operate equally well when new, but continued service over a period of years under these conditions will introduce wear and consequent trouble.

Gear trains that utilize thin stamped or die-cut gears obviously cannot be expected to render long service. Wear will introduce backlash and the thin gear face will readily cut into the mating gear when driven under load or high torque. Loosely meshed gears cut a track or groove causing inaccuracy due to backlash and introduce noisy operation due to the resulting poor coupling.

Rotators become inoperative as a result of various troubles, notable among which are:

(*Continued on page* 160)



TAPE RECORDING

Components and their Function

By **HERMAN BURSTEIN**

Part 1. Important facts for all hi-fi enthusiasts—a six-part series covering a semi-technical report on the mechanical design and operation of tape machines—including a discussion of tapes and equalization problems.

AMATEUR use of tape recorders has gained momentum through development of machines which give good performance at moderate prices. But tape recording is still in its infancy with respect to use in home music systems. Price and performance are not the only reasons. Tape recorders require frequency equalization, and lack of standard equalization also presents an obstacle to growth.

It is often observed that a tape made on machine "A" exhibits poor frequency balance when played back on machine "B." Bass or treble may be excessive or insufficient. The superficial reason is that seldom do two machines of different manufacture employ the same kind of equalization. In a more fundamental sense, the reason lies in different engineering approaches to maximizing frequency range and signal-to-noise ratio and minimizing distortion and cost. Equalization is tightly interrelated with these four factors as well as with tape characteristics.

The situation in tape recording is similar to that which existed in disc recording before early 1954, when the RIAA curve was adopted by most manufacturers. Until then, the disc makers had spent nearly six years turning out microgroove records with a wide variety of frequency characteristics, much to the confusion of many music lovers.

If amateur use of tape recorders is to attain its potential growth, equalization must be standardized. This means that a standard machine would turn out a tape with specific frequency characteristics. Conversely, given a tape which has been recorded with such characteristics, a standard machine would be equalized so as to produce flat response.

At least three good reasons exist for standardizing the equalization of tape recorders: (1) Pre-recorded tapes would sound right on any machine and thus would find a wider market; in turn it can be expected that a mass market would lower the cost of pre-recorded tapes. (2) Exchange of music tapes on a loan basis would be similarly facilitated. (3) Standardization would be desirable in itself to the extent that it reflects the best thinking and experience in getting maximum performance out of recorders.

The purpose of this series of articles is to explain the factors and problems involved in equalization and establishing a standard. To do so effectively requires a description of the principal elements and processes in tape recording. Therefore the discussion of equalization is preceded by an examination of (1) the essential elements of a tape recorder; (2) record and playback losses; (3) effects of bias current.

The essence of tape recording of audio frequencies is that a tape coated with a magnetic substance is magnetized in accordance with an audio signal as it passes a record head, and later the magnetized tape produces an audio voltage as it is drawn past a playback head. Fig. 1 shows the chief components in this process: tape transport mechanism, heads, record preamplifier, playback preamplifier, bias oscillator, and tape.

Transport Mechanism: The basic function of the transport mechanism is to draw the tape past the heads at an accurate and, still more important, constant rate of speed. Speed variations have undesirable effects, and the best machines hold such variations under .2 per-cent. Slow variations (wow) and medium ones (flutter) cause discernible changes in pitch, while high-frequency variations produce noise.

The tape unwinds from a feed reel, passes against the heads, and is wound onto a takeup reel. A spring-actuated roller presses the tape against the capstan, which moves the tape at constant speed. In turn the capstan is driven by a motor through an idler wheel or other mechanical linkage. Guides keep the tape in line with the heads and prevent it from weaving up and down.

The feed reel is actually driven in the direction opposite to tape travel, as shown by the broken arrow in Fig. 1, and the takeup reel is driven at a rate exceeding tape motion. Obviously the tape would break were it not for a clutch, belt, or other device which provides for slippage of the reels. Thus there is tension at both ends of the tape and at the same time each reel can rotate in the direction and at the rate required by tape travel.

To rewind a tape, the pressure roller is disengaged from the capstan and a greater driving force is applied to the feed reel than the takeup reel. Conversely, to wind the tape on the takeup reel, more force is applied to the latter.

The number of motors may vary from one to three. The better machines usually have three, one each for capstan, feed reel, and takeup reel. Others do with only one through a system of belts or other means of transmission.

In some machines, usually the more expensive ones, the arrangement of reels, heads, guides, and other devices is such as to maintain firm contact between tape and heads, which is vital. Other machines employ spring-actuated pressure pads to assure contact.

Transport mechanisms contain all or some of the following features: brakes to stop the reels; provision for more than one speed; interlock mechanism to prevent fast wind or rewind of tape

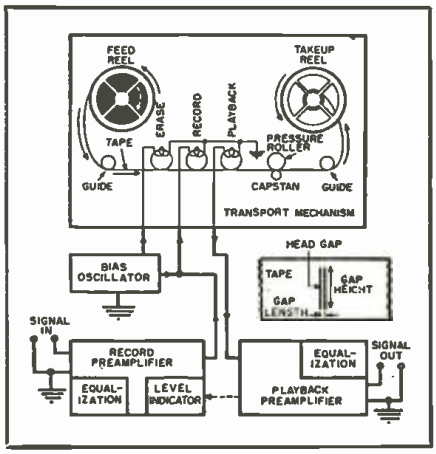


Fig. 1. Basic elements of a tape recorder.

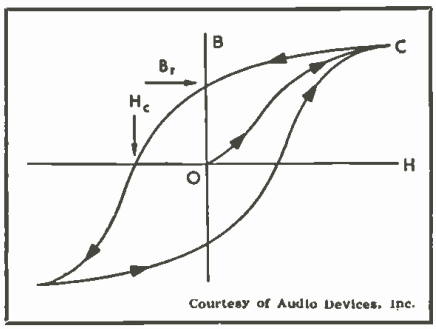


Fig. 2. Variation of magnetic induction (B) with magnetizing force (H). Refer to article.

during record or playback; lockout control to prevent accidentally putting the transport in record position, which would cause the tape to be erased; provision for lifting the tape from the heads during wind or rewind so as to avoid undue head wear; automatic shut-off when the tape runs out or breaks; withdrawal of the idler wheel from the capstan and the motor shaft when the transport is not in use in order to avoid flats on the rubberized idler wheel; and an odometer for counting reel revolutions.

Heads: In the sequence shown in Fig. 1, magnetic patterns on the tape are removed by the erase head, a signal is then impressed on the tape by the record head, and finally the tape induces a signal in the playback head. Playback may take place at the same time as recording or at a later date.

For purposes of monitoring tape recorder performance, as well as for rapid testing and adjusting, it is necessary to have three separate heads (Fig. 1) so that record and playback can take place simultaneously when desired. However, this is impossible in many machines because they use a single head for both record and playback, the function being determined by a switch. Generally, only the professional and semi-professional machines employ three heads.

The structure of each head is essentially the same, consisting of a coil wound about a ring-shaped metallic core with a fine gap. Contact with the tape is made at the gap. The core is an alloy possessing high permeability—easily magnetized and demagnetized. In the case of the record and erase heads, an a.c. current in the coil magnetizes the core. Inasmuch as the tape bridges the gap in the core, the magnetic flux in the core travels through the tape, magnetizing it. In the case of the playback head, the tape's surface induction—magnetic flux at right angles to the tape—enters the head and induces a corresponding voltage in the coil of the head.

The record head's flux magnetizes the tape in accordance with the audio signal current to the head. The maximum current needed varies with head construction and is roughly on the order of one-tenth to as much as several milliamperes. Excessive audio current overloads the tape and causes distortion.

The record head is essentially an inductance and its impedance therefore rises with frequency over the audio range. Rising impedance reduces current through the head and thereby discriminates against the recording of high frequencies. To produce a magnetic field having constant strength at all frequencies requires constant current. Consequently the record head is termed a constant-current device. In all further discussion it is assumed that, apart from the effects of equalizing circuits, constant current is supplied to the head for constant signal input.

To do so it is necessary that, at all audio frequencies, the plate resistance of the tube feeding the head and the coupling resistor to the head should provide most of the impedance of the circuit. This prevents the head from having an appreciable effect upon current flowing through the circuit and therefore through the head. Also, the coupling capacitor to the head should have relatively negligible reactance at low audio frequencies.

Tape recording requires application of a bias current (discussed later) to the record head. When a.c. rather than d.c. bias is used, as is generally the case today, the length of the record head gap (referring to the dimension parallel to length of the tape: see Fig. 1) is relatively unimportant because recording then takes place at the trailing edge of the gap; in Fig. 1 this would be the right side of the gap. If the tape recorder has a separate record head, its gap length is generally below .001". If a combination record-playback head is used, the gap length is determined by playback requirements, which necessitate a length of .0005" or less to maintain high-frequency response. This will be explained in Part 3, dealing with record and playback losses.

Given constant current and assuming no losses in the head, the record head *presents* to the tape the same strength of field at all audio frequencies (although at high frequencies the amount of signal *recorded* is subject to losses, as will be discussed in Part 3). By contrast, if the playback head is presented at all frequencies with constant magnetic induction, also termed flux density, it produces a decreasing voltage as the frequency is reduced.

The playback head, being an inductive device, has an output proportionate to the rate at which the induction on the tape changes per period of time (per second) as the tape passes the head. This rate of change, or velocity, is determined by (1) number of cycles-per-second recorded on the tape and (2) amplitude of the recording. For equal recorded amplitudes, the induction velocity increases as frequency rises, and therefore head output goes up. Consequently the playback head is termed a constant-velocity device: constant output for constant velocity.

The erase head performs its function by subjecting the tape to a relatively large amount of high-frequency current. Frequency is usually upward of 30 kc. and current may range from as low as 5 ma. to as high as 300 ma., depending upon head construction and performance specifications. Size of the gap is not critical and is preferably relatively long, upward of .005", so that the field of the head can adequately penetrate the tape.

The erase head current first saturates the tape, destroying the magnetic pattern which corresponds to audio signals. Then as the tape recedes from the head it is demagnetized as a result of being subjected to a magnetic field which is *rapidly* alternating in polarity and at the same time *gradually* decreasing in strength.

It might seem that erasure could be achieved simply by moving the tape past a strong permanent magnet. which after saturating the tape would gradually remove its induction as the tape recedes. But this is not so simple because the flux induced in a magnetic medium ordinarily does not vary linearly with magnetic force. Instead it follows what is known as a hysteresis loop, as shown in Fig. 2.

Fig. 2 represents the variation of magnetic flux density, or induction, (B) induced in a particle of the tape by magnetizing force (H). The hysteresis loop is marked by the outer arrows, OC being the start of the loop. Although final shape of the hysteresis loop is determined after force H has undergone many cycles of reversal, the ultimate shape is not important to this discussion. As H increases from starting point O, B increases slowly at first, then rapidly, slowly again, and reaches saturation at point C. Subsequently as H is decreased, B does not retrace its original path but follows a new path so that when H returns to O, the tape particle still contains induction equal to B_r. The fact that the residual induction is B_r rather than O explains the failure of a permanent magnet to erase satisfactorily. Although the magnetic pattern of audio signals has been obliterated, the residual flux on the tape produces a large amount of noise when a recording is made on the tape.

The chain of events in a.c. erasure is shown in Fig. 3. Magnetizing force H brings the flux in a particle of the tape first to saturation point a and

then to saturation point *b* of opposite polarity. The flux is alternately returned to points *c*, *d*, etc. Thus the induction in the tape particle undergoes successively smaller hysteresis loops as the tape moves away from the erase head, until a state of zero magnetization is achieved.

In the case of tape which has been overloaded by excessive audio current, the erase head sometimes cannot effect complete erasure. It is then necessary to use a "bulk eraser," which is an electromagnet weighing a few pounds and powered by the 60-cycle, 117-volt line. An entire reel of tape is slowly brought to the bulk eraser, rotated, and slowly withdrawn, achieving thorough erasure in about 15 seconds.

The portion of the tape which is affected by the erase and record heads or which induces a voltage in the playback head is only minutely greater than the height of the gap (dimension parallel to width of the tape). Therefore, using half-track heads with gap heights slightly less than half the tape width, it is feasible to record the bottom half of the tape and then, by turning the reel upside down, to record the top half. While the gaps of the record and playback heads are of the same height, the erase head gap is of somewhat greater height in order to cover more of the tape and insure erasure of all the recorded area.

The fact that several channels can be recorded on a tape without mutual interference is used in connection with stereophonic recordings, where two, three, or more channels are recorded simultaneously. Inasmuch as the heads are considerably larger than the space occupied by their gaps, it is generally necessary to stagger the heads lengthwise along the tape.

Although half-track heads are the rule for home tape recorders, full-track heads are commonly used in professional studio equipment. Editing, which involves cutting and splicing, is impractical when recordings have been made on bottom and top halves of a tape. Also, full-track heads give greater output because, using nearly the full tape width, they record about twice as much flux. Thus they have an advantage on the order of 6 db over half-track heads.

Preamplifiers: As shown in Fig. 1, incoming signal voltages are fed to the record preamplifier, which provides the necessary amplification and signal current to drive the record head. Gain must be sufficient not only for sources supplying a few volts of input, such as a tuner, but also for sources supplying but a few millivolts, such as a microphone.

Voltages induced in the playback head are of relatively low order and require considerable amplification in the playback preamplifier to develop an outgoing signal with the one or two volts required to drive most power amplifiers to full output. Fig. 1 does not show a power amplifier or speaker because these units, strictly speaking, are not part of a tape recorder, although they are often included in the same package, especially in the case of home machines.

Amplification is one of two basic functions performed by the preamplifiers. The other is equalization. Fig. 4 shows the unequalized frequency response of a high quality record-playback head. The same response could be obtained with a pair of separate record and playback heads. Reasons for this characteristic will be discussed at length in Part 3. It is sufficient here to point out that bass and treble boost are necessary in order to convert the curves of Fig. 4 into flat response. The general practice is to provide all or most of the treble boost in the record preamplifier and all or most of the bass boost in the playback preamplifier.

The record preamplifier must contain a means for indicating recording level so that the operator can avoid tape overload and distortion. The less expensive machines employ a "magic eye" tube or neon lamp, while the more expensive ones have a vu (volume unit) meter, which corresponds to a reading in decibels. In some machines the vu meter can be switched to indicate playback level, as shown by the broken arrow in Fig. 1.

The magic eye tube should be calibrated so that its shadow closes fully when the machine is recording at the maximum distortion level specified by the manufacturer. In the case of the vu meter, its pointer should hit zero (about the middle of the dial) when the recording level is about 8 or 10 db below the level which produces the maximum specified distortion. This margin of 8 or 10 db allows for the fact that the pointer, being a mechanical device, lags behind transients —precipitous increases in level.

Although Fig. 1 shows separate preamplifiers, it is frequent practice in low priced machines to use a single preamplifier that can be switched to either the record or playback function. Such a preamplifier may provide the same amount of treble and bass boost in both record and playback, or the switching arrangement may introduce different equalization networks in each function.

As Fig. 4 reveals, the unequalized frequency response of a record-playback head varies with tape speed. Therefore different equalization is required for each speed. Most tape recorders with more than one speed also provide means of changing equalization.

In view of the low-level signals that must be accommodated and the considerable amount of equalization required, the preamplifiers are high gain devices. Thus their design and construction must minimize noise and hum. Selected tubes, special tube types, d.c. heater supplies, shock mounting, low-noise resistors, judicious layout, ample filtering, and general adherence to good practice in constructing high-gain circuits pay substantial dividends in terms of signal-to-noise ratio.

Bias Oscillator: The oscillator supplies current to the record and erase heads for the respective purposes of applying "bias" to the tape and erasing the tape. Sometimes separate oscillators are used, but the common practice is to use one for both purposes.

Fig. 2 shows that the flux density induced in a magnetic medium such as tape does not vary linearly with magnetizing force. As a result, considerable distortion would occur in recording were it not for what is termed bias. Passage of a relatively large a.c. bias current through the record head simultaneously with audio current can reduce distortion to an acceptably low figure. Optimum bias current varies roughly from .5 to 10 ma., depending largely on head construction, while the corresponding peak audio current is, at most, one-fourth as much.

Bias current increases the amount of recording current that can be applied to the tape for a given amount of distortion. It also greatly increases the tape's magnetic induction for a given audio current.

(*Continued on page* 135)

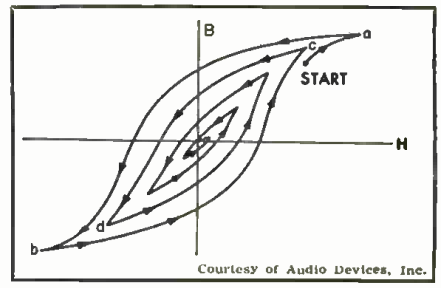


Fig. 3. Behavior of a magnetic particle during the a.c. erase process. See text.

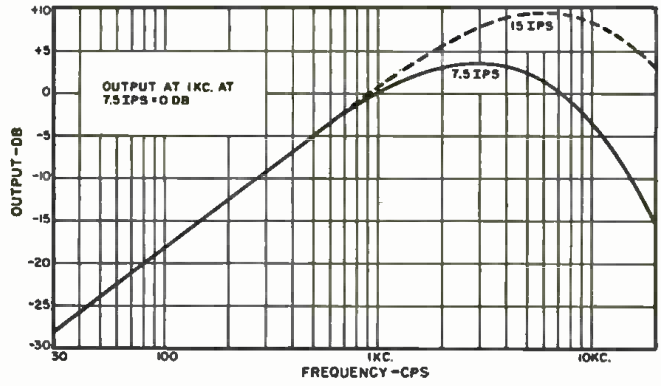


Fig. 4. The unequalized record-playback characteristic of a high quality record-playback tape head.

By **BERT WHYTE**

IT seems incredible that tempus can "fugit" so swiftly, but it has and this issue marks the beginning of the third year of publication for the "Certified Record Revue!" Once again, I feel obliged to thank all you kind people who have been so nice and encouraging with your letters over the past two years. Believe me, an author likes to know what his public thinks about his work, and I am most grateful (and if I may be permitted, a little proud) that most of your letters are laudatory, rather than lamentable! As I have reiterated on numerous occasions, this column is published as a service to *you* and I am always eager to hear your suggestions and ideas for improving the value of this department.

Since this is the September issue, it is time once again for the audio world to come to life after the traditional summer doldrums. Vacations are but fond memory and the average audiophile is taking a good hard look at his hi-fi rig. Will it do for this winter? (foolish question!) What can he do to improve it? A better speaker, or perhaps a new tweeter? Shall he give the cranky changer the heave-ho and enjoy the smooth-running turntable and the record-gentle arm? Is it time for the super-duper 30-watt amplifier to replace the valiant but weary old ten watter? And what about the state of the record library! A whole slew of new "goodies" are available for his aural delectation. Ah, yes! There is much to tempt friend audiophile! And the prime question is from whence cometh the wherewithal, the loot, the boodle to acquire these hi-fi boons? And this is where all I can offer, friends, is a sympathetic heart!

To make matters worse, the New York Audio Fair is looming large, but a month or so away. There more new treasures will be unveiled to the further dismay of your pocketbook! The Fair should be one of the most interesting of the past several years, with some radically new hi-fi developments shaping the trend of audio for several years to come. I can't guarantee any predictions, but my spies have told me to look for the following: several varieties of electrostatic speakers, mostly tweeters with crossovers at 1000 cycles and perhaps even as low as 400 cycles! Continuing developments in this field indicate the all-electrostatic loudspeaker is not far off, and with its coming it will revolutionize our present concepts of speaker size. Size will no longer be the criterion for bass response, nor a limiting factor in room dimensions.

Several new tape recorders will make their appearance. These will give professional performance in relatively small packages and will be radically priced . . . downwards! Hand in glove with these new machines will be the new super-thin one hour tape. Yessir, with 2400 feet of tape on a 7-inch reel, the need for larger machines (with larger and more expensive motors) to handle the 10½-inch reel will be greatly diminished. You can look for a number of new arms working on the overhead "bridge" method of tracking, in the same manner as records are normally cut. Whether friction losses can be sufficiently overcome to eliminate drag and subsequent side wall groove distortion is something we will be most anxious to find out.

The biggest bombshell of all, which will cause as much of a revolution in our audio thinking as did the advent of LP, will be the introduction of the *single-stylus, monogroove stereophonic disc!* My informants tell me these discs will work on a carrier system employing simultaneous vertical and lateral recording. Most likely the company issuing the discs will also offer a new pickup and arm designed for this system. If this isn't the major development that will lift the hi-fi industry up by its bootstraps then I'm a monkey's uncle. In terms of increased audio business alone, the prospects are fantastic, since to play these new records we will need *two* amplifiers, *two* speakers, etc. If these new stereophonic discs live up to their reputation, we will be on the threshold of a great new musical world, for the last obstacles to such things as multiplexed stereo-FM and TV, will have been overcome! Yes, friends, if you can get to the New York Audio Fair this year, you're bound to see and hear some history-making developments in the world of audio!

Equipment used this month: New *Weathers* viscous-damped arm and cartridge, new inductive tuned oscillator, *Marantz* audio consolette, *H. H. Scott* 70-watt amplifier, *Jensen* "Imperial" speaker, *Jim Lansing* "Hartsfield," *Components Corp.* turntable. Tape equipment. *Ampex* 600

MAHLER
SYMPHONY #9
SCHONBERG
VERKLARTE NACHT (TRANSFIGURED NIGHT)
Israel Philharmonic Orchestra conducted by Paul Kletzki. Angel 3526B. RIAA curve. Price $9.96. Two discs.

The third version of the Mahler 9th to appear on LP and by all odds, the best. This recording marks the debut of the Israel Philharmonic on discs and a most auspicious debut indeed! The promise that was heard in this group when they toured America last year is fulfilled in this recording. The precision of this orchestra as an ensemble and the luster of the first desk men, and the over-all, richly luminous tone makes this one of the major orchestra in the world today. Kletzki is one of those conductors who for some reason is not given his just due. His competence goes far beyond his reputation, and in none of his performances on LP is this more true than this Mahler 9th. Faced with the stern competition of an authoritarian Bruno Walter, he by no means comes off second best. If Kletzki has less insight into the score than Walter, he still has the essential feeling of the work and his projection of the score is meaningful. And for all of Walter's astuteness in the music of Mahler, Kletzki's handling of phrasing and his dynamics are superior.

The Horenstein/*Vox* recording of the 9th was a fairly good effort, but too much "individualism" on Horenstein's part takes it out of contention with this present disc. Neither of the two previous recordings comes anywhere near matching this *Angel* disc in matters of sound. Indeed, the Israel Philharmonic should consider itself most fortunate to be in a recording alliance with *Angel's* expert engineers. The sound here is typical of *Angel's* best efforts, which is to say that the string tone is very smooth and edgeless, with celli and contrabassi especially clean and sonorous, superb French horns reproduced without that annoying distortion which is so often present on discs, other brass is clean and bright, woodwinds have fine "presence," percussion is not as sharply focussed as it might be, but is nonetheless reproduced with good articulation. Acoustic perspective, so important in this work, is beautifully handled, with just the right amount of reverb.

This 9th symphony is one of Mahler's most ingratiating scores even if at times it may seem redundant and over-long. Hi-fi fans should not be intimidated by it, for there is much that they will enjoy, especially the mocking sardonic third movement entitled "Burlesque." The 9th takes up three sides of the 2-12" LP's and the 4th side is occupied by Schonberg's great score, "Transfigured Night," heard here in the orchestral transcription. There are other good performances of this work on LP, notably that of Eugene Ormandy, but this is first class in all respects and has the plus virtue of being the best sounding reading now available. String playing here is of particularly high order, and stands well the comparison with the Philadelphia strings, which is no small compliment! If you are not familiar with the music you should find this a most interesting musical experience. Quiet surfaces in my copy. No curve adjustment necessary.

HANDEL
CONCERTI GROSSI
The Boyd Neel String Orchestra conducted by Boyd Neel. London LLA-21. RIAA curve. Price $11.94. Three discs.

The price of this set is, in itself, an amazing thing. Who would have thought a few years ago that one would be able to buy a first rate recording of all of Handel's "Concerti Grossi," Opus 6, for $11.94! Yes, the opportunities to acquire musical treasures like this are one of the miracles of our age. Actually this album represents the culmination of several years of work by Boyd Neel and his orchestra. Many of the concerti have been previously issued by *London* on a number of 10-inch discs. Here they are all compiled into this one album and to my way of thinking, it's a better way of presenting this work. I might also add, that unless my ears are deceiving me, the sound is brighter and cleaner and bespeaks of reprocessing.

Boyd Neel is an old hand with Handel (ouch) and his readings are thoughtfully phrased, his tempi are just, his dynamics carefully chosen. As might be expected the

(*Continued on page* 148)

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

HI-FI AMPLIFIER

Instability

By N. H. CROWHURST

Should your audio equipment develop some form of instability—here are the answers on possible sources of trouble and their remedies.

WHEN you ask a man working on an audio amplifier what seems to be the difficulty, nine times out of ten the trouble turns out to be some form of instability. Even people with a better-than-average understanding of audio can be stumped by some of the perverse things that happen in this category. For this reason the author makes no apology for introducing another discussion of this subject.

The basic cause of all kinds of instability is positive feedback. It is important to bear this in mind, because it can often help in locating the exact spot where the instability occurs or in determining the cure.

Usually the instability occurs at either end of the audio band. When it occurs at the low frequency end it results in what is commonly termed "motorboating." Instability at the high-frequency end can result in high-frequency oscillation, usually at a frequency beyond the audio range. This will have the effect of blocking the signal, giving it an unnatural sound. This is caused by the high-frequency oscillation fully loading the amplifier. Such loading is not obvious because it is inaudible. However, when the audio signal comes along, its application, on top of the oscillation of the amplifier, temporarily reduces the amplitude of oscillation and allows some of the audio to get through.

Another form of instability occurs when the high-frequency condition is not quite sufficient to cause continuous oscillation but approaches it and sets off a damped oscillation at certain points in the audio waveform. This form of instability is called "parasitic oscillation."

Another form of instability that can occur gives rise to a terrific screech from the amplifier and this is due to positive feedback in the audio range which causes the amplifier to oscillate wildly at a random frequency. No doubt most of our readers are quite familiar with these forms of trouble. The problem is to track them down and stop them.

Motorboating

Motorboating is due to positive feedback at a low frequency. Usually the feedback is such that it does not produce a smooth sinusoidal waveform at the frequency of oscillation, but gives rise to a series of plops, from which the name "motorboating" was derived. It may be that the "B+" voltage at a certain point in the supply system gradually rises, or gradually falls, until a certain point is reached. When this occurs some low-frequency triggering action suddenly changes the current drain produced by the amplifier on the supply circuit, so as to return the voltage to the point from which it started, whence it slowly rises or falls, as the case may be, until the triggering action repeats itself. Although this complicates the shape of the waveform somewhat, the principle is still the same in that it can be regarded, broadly speaking, as a low-frequency positive feedback.

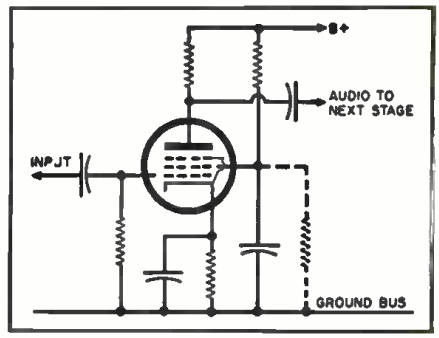
Sometimes it is helpful to first determine which way the pulses are going and find out just where such a triggering action could occur, by analogy with a multivibrator circuit. It is always helpful in tracking down the trouble to apply a d.c. voltmeter to various points in the circuit and watch for changes in voltage coincident with the plops.

When the point at which the change of voltage is greater than at other points is determined, this is a good place to start looking for the positive feedback region. It may be that there is insufficient decoupling to a screen or plate supply of some stage, according to the particular circuit used.

For example take the circuit of Fig. 1. The center of trouble may be this pentode stage. Although it would not oscillate by itself, the time constants of the screen decoupling capacitor and the plate supply decoupling capacitor may be such that, in combination with the rest of the amplifier, a low-frequency pulse can be fed around the circuit. Making the previously-mentioned voltage checks may show that the greatest change in supply voltage when the plop occurs appears at the screen of this tube. This indicates that the time constant of this circuit should be changed in order to avoid this condition.

If the low-frequency response of the amplifier is better than it need be, the use of smaller coupling capacitors might clear the trouble, but if the full low-frequency response is required, it may be possible to remedy the trouble by increasing the decoupling values in this particular part of the circuit, or it may be possible to make the circuit stable merely by changing the relative values of the resistors and capacitors in the decoupling circuit.

Fig. 1. This high-gain stage circuit can develop instability, either motorboating or h.f. blocking. The cure rests in adjusting the plate and screen feed resistor values or altering the screen feed to a voltage divider system (shown dotted).



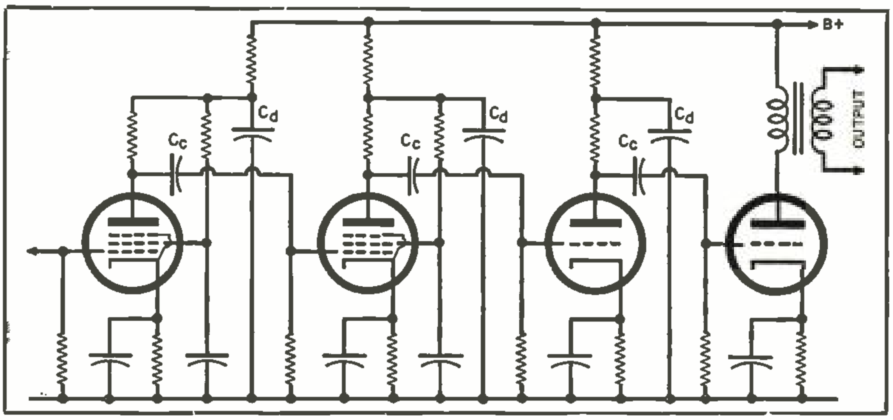


Fig. 2. This kind of high-gain audio circuit can cause motorboating troubles. Attention to the values of C_c and C_d can sometimes cure this particular circuit fault.

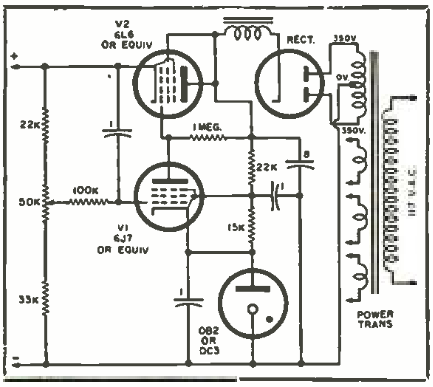


Fig. 3. Where other methods do not help, a stabilized power supply providing low internal-resistance "B+" supply, using this circuit, will usually effect a cure.

Sometimes it is advantageous to use a smaller value of screen decoupling capacitor or perhaps a lower value of screen dropping resistor together with a resistor in shunt with the capacitor in order to provide voltage-divider feed to the screen instead of series feed. These are just suggestions that have proved helpful in curing this particular kind of instability and which can readily be tried.

Sometimes, however, checking with a voltmeter seems to show that the fluctuation occurs all around the circuit and only to a slight degree. This means that the positive feedback is probably taking place throughout the amplifier as a complete entity and cannot be blamed on one particular tube or set of components.

Fig. 2 shows a typical circuit which is subject to over-all motorboating. In this case the simplest measure would be to reduce the values of coupling capacitors C_c or else to increase the values of decoupling capacitors C_d.

However, sometimes it happens that either of these changes merely alters the frequency of motorboating, but does not stop it. This often happens where there is a large amount of gain in the amplifier. Here the only remedy is to pay attention to the impedance of the "B+" supply unit because the motorboating is probably due to the coupling impedance provided by the supply unit.

Decoupling of a slightly different type, as shown in Fig. 4, can sometimes achieve satisfactory results without reducing the supply impedance. The important point in rearranging decoupling, over a multi-stage amplifier, is that two consecutive stages cannot, by themselves, introduce instability. The instability always occurs over three or more stages. For this reason decoupling of stages in pairs conserves parts and offers more stability than providing separate decoupling to each stage along the line.

If this step is not successful, a stabilized power supply utilizing the circuit of Fig. 3 or a similar arrangement can prove helpful. This uses two tubes to reduce the source impedance of the supply. In fact, the source impedance can be reduced very close to zero by careful adjustment of circuit values.

Adjusting the values of the resistors controlling the screen voltage of V_1 will change the source impedance of the supply and can even make it negative. V_1 should be a high slope pentode, such as a 6J7, while V_2 should be a triode-connected tube capable of passing the required "B+" drain. A 6L6 is good up to about 150 ma.

High-Frequency Blocking

When the amplifier oscillates at a high frequency, this oscillation, like the low-frequency variety, can occur either in a single tube or in the amplifier as a whole. If the amplifier as a whole is oscillating, then removal of any tube in the amplifier will stop the oscillation. If the oscillation is occurring in part of the amplifier, then removal of tubes not contributing to the oscillation will not stop the oscillation. This is a simple check that can be made both for motorboating and oscillation troubles.

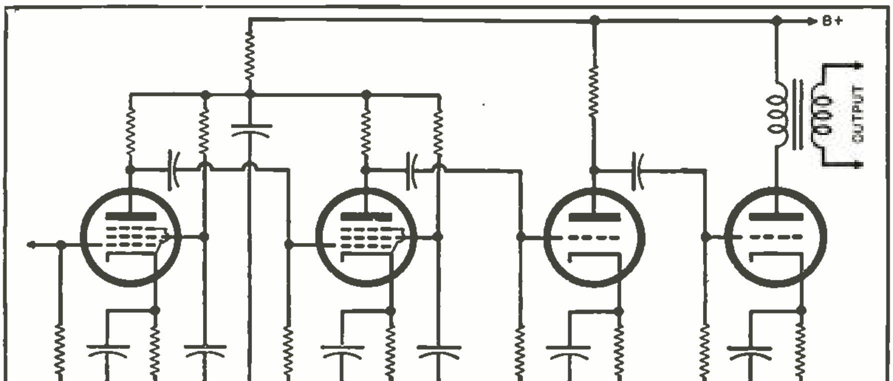
The only point to be remembered is that, particularly in motorboating, such a check is not necessarily conclusive. For example, removing a tube may alter the operating conditions of the remaining tubes, due to the change in current drain, so as to give a misleading result. One of two things may happen: removing the tube may allow the oscillation to continue, although the tube was contributing to the oscillation previously. This can happen because removing the tube changes the circuit voltages and another form of oscillation arises when the tube is removed (it should be noticed in this case that the frequency of oscillation is changed by removing the tube). Alternately, removal of the tube may stop the oscillation although the tube was not contributing to it previously—again because the operating conditions of the oscillating tubes are changed by the removal of this tube.

If scope examination reveals that the oscillation is occurring throughout the amplifier, there are two things to look for: (1) the placement of hot leads so high-potential leads from the output of the amplifier can feed back to high-impedance leads near the input of the amplifier; (2) bad ground returns, which introduce common ground resistance into successive stages of the amplifier. If the amplifier is already built and rearrangement of the layout is out of the question, the former trouble can sometimes be corrected by use of shielded leads, especially where such leads are fairly long. Fig. 5 shows one method of ground wiring that avoids instability and other troubles due to bad ground wiring.

If high-frequency oscillation can be traced to a single stage then the cure can best be approached by considering this stage as a single-stage oscillator similar to some kind of r.f. oscillator.

A beam-tetrode, high-gain stage can sometimes go into oscillation because

Fig. 4. Changing the method of decoupling used in Fig. 2 as shown here, sometimes cures such instability. This method also has the advantage of conserving components.



it acts as a negative resistance. This often occurs if the plate voltage falls considerably below the screen voltage. Changing the value of the screen dropping resistor is usually the cure for this kind of oscillation, so that the tube resumes stable operating conditions. Too high a plate load resistor, in relation to the screen dropping resistor, can cause oscillation.

Usually this kind of oscillation will start up without much warning even when the amplifier may have been operating previously under quite stable conditions. This is because the condition of oscillation itself reduces the plate voltage below the screen voltage and therefore the operating conditions change when oscillation starts. If it is not expedient to reduce the value of the plate coupling resistor, the value of the screen dropping resistor should be increased, or else the screen dropping resistor should be changed to a voltage divider, as mentioned in the section on motorboating.

Sometimes output stages can be responsible for oscillation. In its commonest form this occurs as a kind of oscillation similar to tuned-grid/tuned-plate oscillation in radio applications. The similarity exists in that the grid circuit is tuned by the interelectrode capacitance resonating with the leads and possibly the leakage inductance of the driver transformer. Miller-effect feedback causes oscillation due to the fact that the plate-load impedance at this frequency is basically inductive and hence the circuit behaves similar to a tuned-plate/tuned-grid oscillator at r.f.

One remedy is to damp the r.f. resonant circuits causing the oscillation. Plate blocking resistors will help swamp the inductance of the plate-load impedance at the oscillation frequency, while grid blocking resistors will help damp the resonant circuit in the grid. The method of connection is shown at Fig. 6A.

If the power stage is designed to draw grid current, *i.e.*, it is of the B_2 or AB_2 variety, then a series resistor in the grid will severely restrict the output power available. In this case a shunt resistor is necessary, as shown in Fig. 6B. Whichever method of blocking connection is employed, it is essential that the resistor be connected as close to the tube pins as possible, because the oscillation is occurring at high frequency and the inductance of the tube leads is part of the oscillator circuit, so the resistance must be inserted where it will successfully swamp this lead inductance.

Parasitic Oscillation

This is the final kind of oscillation under the heading of instability. It is sometimes difficult to diagnose, although it is quite easy to see as soon as the output is presented on an oscilloscope. However, the amplifier may perform quite well under normal test conditions; there will be no oscillation in the absence of an audio signal or the frequency response appears to be quite normal or perhaps a measurement of harmonic distortion shows satisfactory figures. But when audio is passed through the amplifier it is evident that something is wrong.

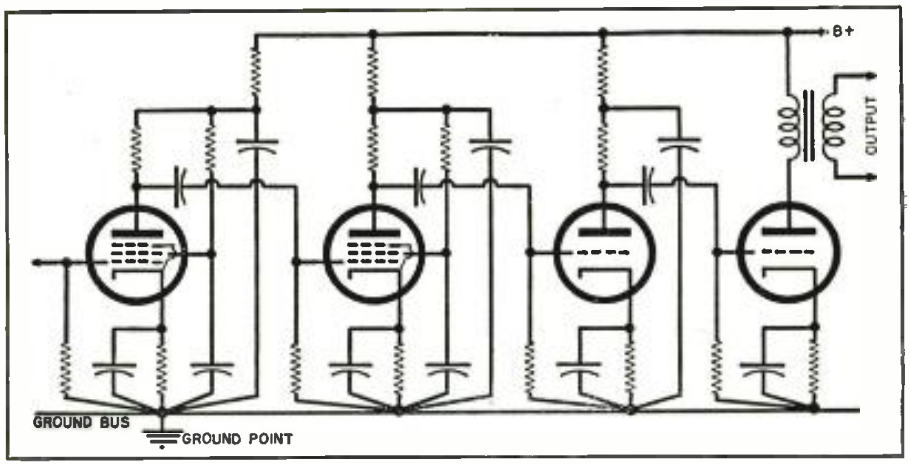


Fig. 5. Poor ground return wiring can cause either type of instability. This schematic shows the method of making returns, using the circuit of Fig. 2, to avoid the ground return as a possible cause of instability in the audio amplifier.

It produces results similar to fairly severe type intermodulation distortion. Looking at the output from a sine-wave input on an oscilloscope screen, the waveform is similar to that shown at Fig. 7. This is due to the fact that at some high frequency the amplifier is approaching a condition of instability but it does not actually oscillate, because the positive feedback is not quite sufficient to maintain continuous oscillation. However, if the amplifier operates under a condition where plate current stops abruptly, as in the case of class AB, or where the output runs into grid current at some point in the waveform and this grid current stops abruptly, then this parasitic oscillation may appear on parts of the audio waveform. The remedy is similar to that for continuous oscillation using grid—and plate—(and if pentodes are used, screen)—blocking resistors.

The cause of this trouble and the reason why it is hard to trace lie in the fact that with a single sine-wave input, its effect may be not noticeable, except on an oscilloscope screen. The frequency of parasitic oscillation may be too high for the harmonic distortion measuring equipment to register, and it is also too high to affect the movement of the loudspeaker diaphragm, and hence the output sounds quite normal. However, when several frequencies are passed through the amplifier simultaneously, a high-amplitude low frequency will set off this parasitic oscillation which will have a tendency to lose, momentarily, higher frequencies present on the same waveform, because of the saturating effect of the high-frequency oscillation. This is what causes the effect similar to intermodulation.

Tracking down various forms of instability in audio equipment can be a very frustrating experience. Fortunately, audio enthusiasts are not easily daunted. So stay with it, take a little time to figure out the possibilities, and remember, "Faint heart never won fair music." —30—

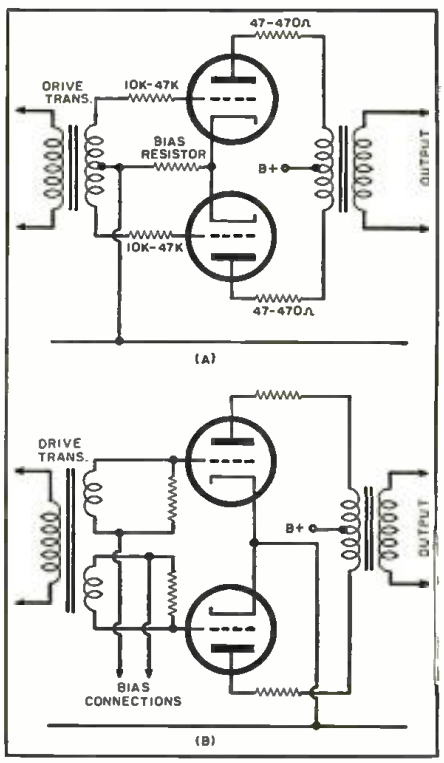
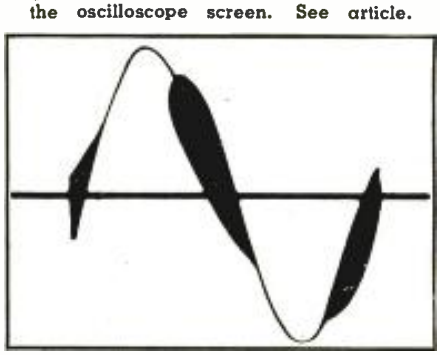


Fig. 6. (A) Push-pull output stages can sometimes go into high-frequency oscillation. Grid and plate blocking resistors, connected close to the tube pins, will stop this. In pentode or tetrode stages, such blocking resistors may also be required. (B) Alternative connections necessary for output stages running into AB_2 or B_2, to avoid stage loading by the grid current.

Fig. 7. Parasitic oscillation, with a single sine wave input, looks like this on the oscilloscope screen. See article.



1955 Motorola TV Receiver Test Points

By **WM. D. PRUSINOWSKI**
Service Dept., Motorola Inc.

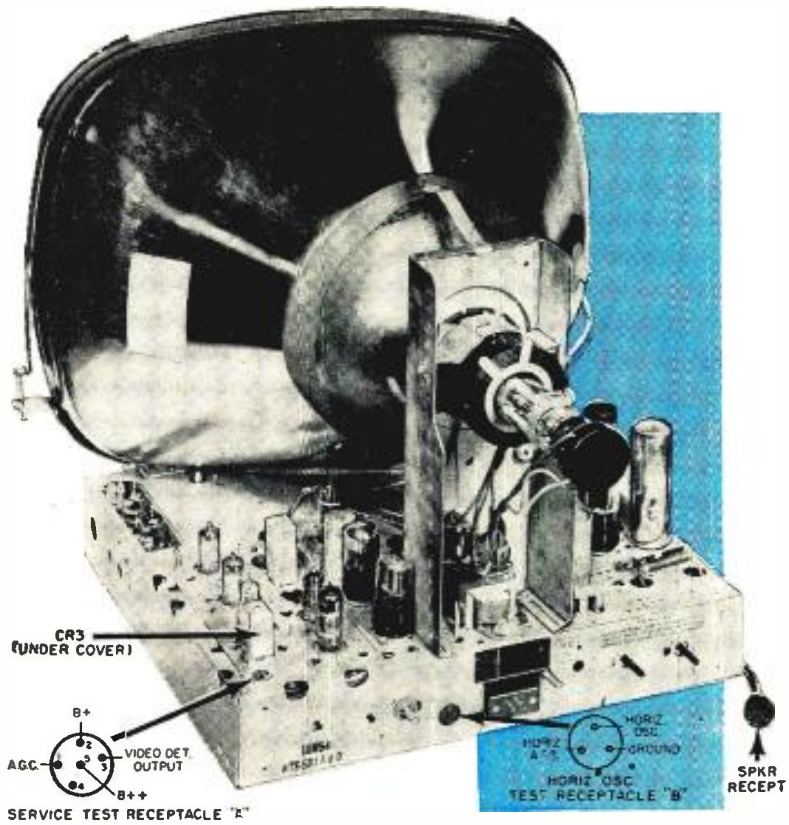


Fig. 1. Rear view of the Motorola TS-531 and TS-609 TV chassis with detail drawings of the two test point receptacles.

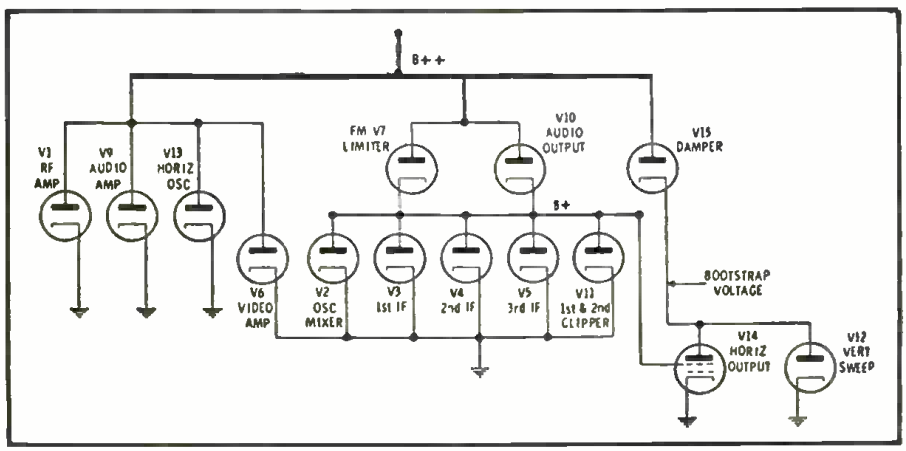
Five chassis comprise the basis of the new Motorola TV sets—all have test receptacles for rapid checks.

A SERVICE TECHNICIAN'S decision about when to pull a TV chassis into the shop can be made fast and conclusive, when using the easily accessible and identifiable test receptacles provided in 1955 *Motorola* TV receivers. These receptacles provide a wealth of information. To be of maximum value, however, they should be properly used and understood. With a little preparation plus the use of a v.t.v.m., which can easily be carried in the tube caddy, they may even save pulling chassis out of homes in many instances.

One *Motorola* 1955 TV receiver containing such receptacles is shown in Fig. 1. This is a rear top view of the Model TS-531 and TS-609 chassis. Using test receptacle "A," the "B+," "B++," a.g.c. voltages, and video detector output may be measured and observed.

The need for measuring "B+" and "B++" voltages needs little explanation. Without the proper low-voltage supply, a maximum number of defects occur in TV receivers. A quick spot check of the two available busses will reveal the condition of the low-voltage supply. Reference to the block diagram of Fig. 2 will show that aside from the selenium rectifiers, speaker field, and filters, three tubes are an essential part of the low-voltage supply. These are the FM limiter (3AU6), audio output (25L6), and damper (12AX4) tubes. If there is a "B+" voltage deficiency, check these tubes. If they are not the cause, the chassis needs to be pulled for further extensive checks.

Fig. 2. "B+" voltage distribution diagram for the Motorola TS-531 and TS-609 chassis. Note that the FM limiter, audio output, and damper tubes effectively convert the higher "B++" voltage to the "B+" voltage required by the other tubes.



Of most interest at test receptacle "A" is the a.g.c. terminal and the information relative to the r.f., i.f., and video detector stages that can be taken from it. For example, consider horizontal pulling. Many cases occur that are not a direct result of horizontal deflection system troubles but rather are caused by faults in the r.f., i.f., or video detector circuits.

A great deal of servicing time is consumed when more than one tube plus a detector crystal are bad at the same time. To eliminate this problem these circuits can be checked as follows:

1. Connect a 5-megohm potentiometer from the a.g.c. line to ground.
2. Connect a v.t.v.m. across the video detector load resistor (pin 3 of the test receptacle to ground).
3. With a medium-to-strong signal applied at the antenna terminals, slowly reduce the resistance of the potentiometer until the negative voltage

across the detector load reaches a peak. Further reduction of the potentiometer will cause a condition of overload and the detector voltage will fall below the peak.

4. If the peak voltage, as indicated on the meter, is less than 13 volts negative, replace the 3rd i.f. tube (6CB6) and/or the video detector crystal. The area selector switch must be in the "local" position.

To determine whether grid current is being drawn by one or more tubes in the a.g.c. circuit, measure with a v.t.v.m. the negative voltages from pins 1 and 3 of the test receptacle to ground. The voltages should normally be equal (the area selector switch must be in the "local" position).

Since the a.g.c. voltage is controlled by the video signal, any change in the r.f., i.f., or video amplifier circuits will affect the a.g.c. circuit. A "gassy" i.f. amplifier tube, for example, would result in reduction of the negative bias to the automatic gain controlled stages. With insufficient a.g.c. voltage applied to these stages, the signal would be over-amplified, causing picture overloading, negative picture, and poor synchronization.

An automatic gain controlled tube which begins to draw grid current is a common cause of insufficient a.g.c. voltage. If there is grid current it will flow into the a.g.c. line from the video detector output through a 180,000 ohm resistor, creating a voltage drop across the resistor in opposition to the a.g.c. voltage and lowering the a.g.c. voltage.

In a situation such as the one described, the area selector switch can prove to be a useful tool with which to help isolate the defective stage. This can even be done without removing the receiver chassis from the cabinet. In a receiver which exhibits symptoms of a.g.c. trouble, change the area selector switch from the "local" to the "suburban" position. If the condition is improved, a gassy tube in the tuner is indicated. (In the "suburban" position, the tuner is cut off the a.g.c. line, the loading of the line is ended, and a normal a.g.c. voltage is available to at least the first and second i.f. tubes.)

The *Motorola* TS-525, 528, and 603 chassis incorporate a keyed a.g.c. system with delayed a.g.c. applied to the tuner. Use of the a.g.c. terminal on the test receptacle in these chassis is limited to measuring the i.f. a.g.c. only.

By locating the tuner a.g.c. terminal, problems of horizontal pulling may be laid to r.f. and i.f. tubes or a bad detector crystal. To do this, short both a.g.c. busses to ground. Attach a signal generator, set to the mid-frequency of any channel, to the antenna terminals. Tune the receiver under test to this signal and increase the output of the generator while observing the developed d.c. diode voltage with a v.t.v.m. The voltage must increase to at least 13 volts. If limiting is observed, replace the crystal diode and/or last i.f. tube.

Where tubes may be suspected of drawing grid current, check the ratio of the i.f. a.g.c. voltage to the plate voltage of the keyed a.g.c. tube. (Location as indicated in Fig. 4.) The voltage ratio should be on the order of 1 to 3.5. If the ratio is lower than this, check the i.f. tubes.

The video detector output terminal in these chassis has a multitude of purposes. It can be used to check the video output in fringe areas and evaluate antenna performance, isolate cases of brightness but no picture, and isolate a.g.c. troubles that may be due to lack of video at the keyed a.g.c. tube.

A horizontal oscillator test receptacle "B" is available on all of the

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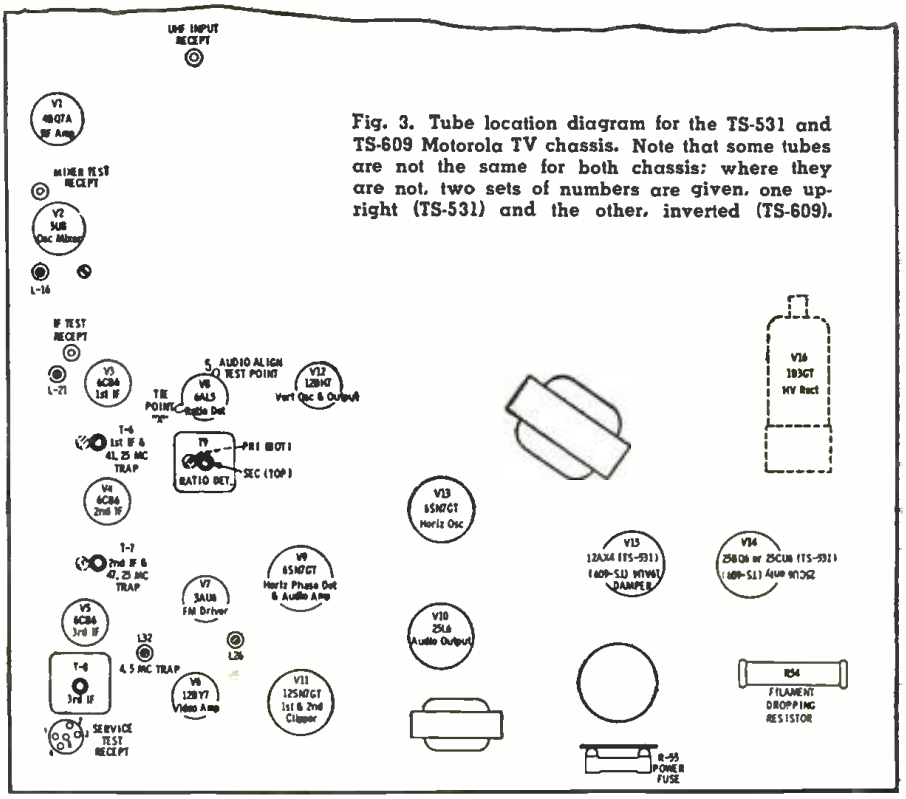


Fig. 3. Tube location diagram for the TS-531 and TS-609 Motorola TV chassis. Note that some tubes are not the same for both chassis; where they are not, two sets of numbers are given, one upright (TS-531) and the other, inverted (TS-609).

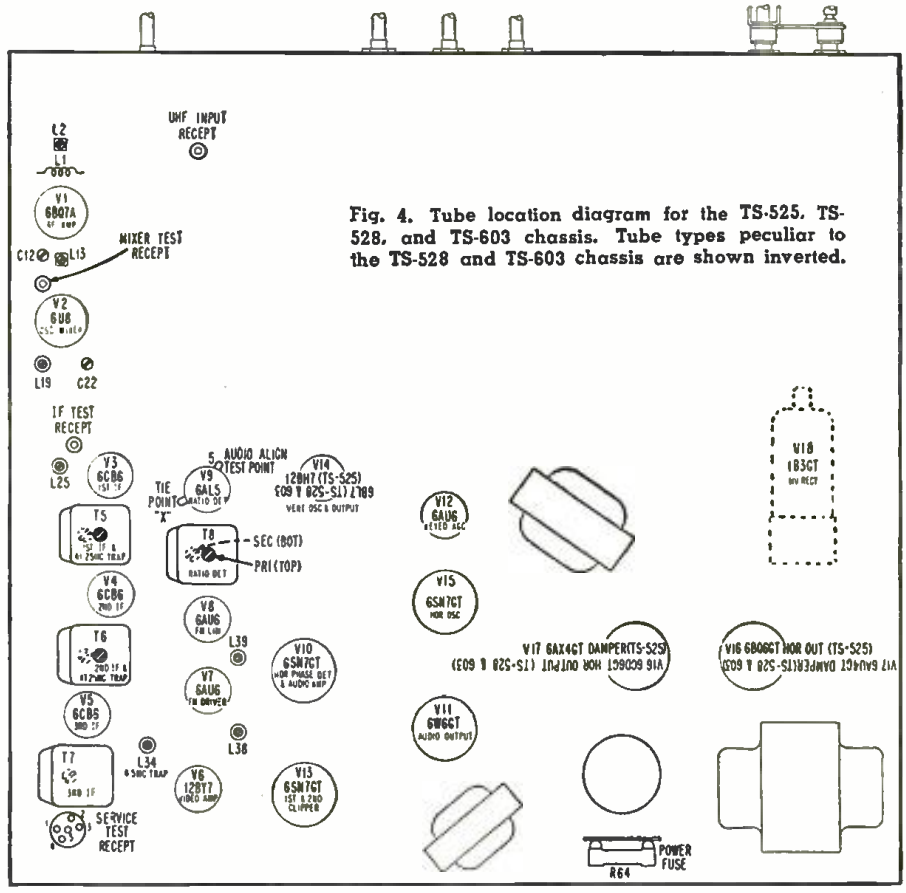
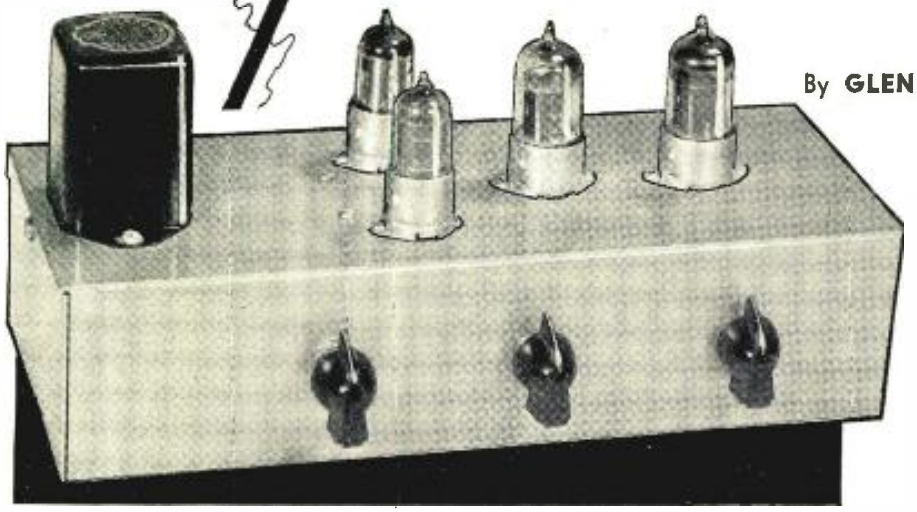


Fig. 4. Tube location diagram for the TS-525, TS-528, and TS-603 chassis. Tube types peculiar to the TS-528 and TS-603 chassis are shown inverted.

SPECIAL EFFECTS AMPLIFIER

By GLEN SOUTHWORTH



The special effects amplifier using miniature components. A separate power supply is used to minimize hum. The controls (left to right) are S_1, S_2, and R_{21}. Controls R_7, R_9 and R_{20} are screwdriver-adjust pots on rear of chassis.

Construction details on a balanced modulator which can be used in electronic music, p.a., or experimental work.

IF YOU'RE interested in electronic music, public address, recording, broadcasting, or just experimenting, the balanced modulator is probably one of the most useful devices that you're apt to encounter. This versatile gadget may be used in almost any phase of sound reproduction to control incoming program material or to actually synthesize conventional sound effects or create new ones. Basically simple and easy to construct, the balanced modulator is a worthwhile piece of equipment for nearly anyone interested in audio.

The purpose of the balanced modulator is to introduce controlled variations of amplitude level in a signal without allowing the control signal to appear in the output of the system. These amplitude variations may be relatively slow, as might be the case if the modulator were used as a conventional volume expander or compressor, or they might be very rapid in the case of special effects generation. Likewise, the modulating signal may be obtained from many different sources, depending upon the application desired, instead of just the incoming program as is the case with the expander or compressor.

Before developing specific applications of the balanced modulator, let's examine the schematic diagram. This will be the basic circuit around which further discussion will be developed, and it comprises two 6AU6 miniature, sharp cut-off pentodes connected so that the incoming signal is applied in push-pull to the grids, the modulating signal is applied in parallel to both grids, and the effective, static grid bias is adjustable from class A to a point beyond plate current cut-off.

Specific circuit details include the use of a split load phase inverter driver, using isolation resistors in the output to reduce the effects of the interstage coupling capacitors on the time constants of the modulator circuit. A balancing potentiometer, in the cathodes of the 6AU6's, is used to attenuate the modulating signal as well as to reduce the d.c. current flowing through the primary of T_1 and to lower second harmonic distortion occurring in the output stage. Also, a slightly unconventional method is used in connecting transformer T_1, but since it eliminates the need for a center-tap and causes virtually no direct current to flow in the primary, performance was improved. The output impedance of T_1 as used in this circuit is 500 ohms, which permits the use of short runs of unshielded cable, or longer runs of shielded cable, to the associated equipment. However, it should be noted that the undistorted level across the 500 ohm tap is relatively low and a matching 500 ohm-to-grid transformer may be desirable at the other end of the line.

A dual triode is used as a voltage amplifier and diode rectifier to provide modulating voltages for the system. By means of a simple switching system alternating current signals may be changed to either positive or negative direct current voltages which, in connection with the time constants of the filtering system, may be used to modulate the incoming signal at a relatively slow rate. A negative voltage tends to produce negative modulation or volume compression, and a positive voltage causes positive modulation or volume expansion. If the diode and filter combination is disconnected, then an a.c. signal will cause both positive and negative modulation at a rate which depends upon the frequency of the applied voltage.

To set the amplifier up as an expander both the signal input and the modulator input are paralleled, the bias on the two 6AU6's is adjusted until nearly cut off, and the cathode element of the diode is switched into the grid circuit of the 6AU6's. When a signal is applied to the system the gain control of the modulator amplifier may be advanced until the positive voltage developed across the 5 megohm diode load resistance counteracts the negative grid bias developed in the 6AU6 cathode resistances. Depending upon the setting of the 6AU6 bias control and modulator input control, a very large amount of expansion may be produced, even to the point of reproducing only the louder passages. In addition, the size of the filter capacitor across the 5 megohm diode load will determine the time required for the circuit to "take hold" as well as affecting the duration of the expansion action. As a result, a number of different capacitances is available on a rotary switch in order that a fast-acting, choppy time constant, or a slow-acting smooth time constant may be selected to fit the needs of the program material.

Volume compression is equally simple. Both inputs are paralleled, but the bias on the 6AU6's is adjusted to approximately class A, or full gain operation, and the plate of the diode is connected across the 5 megohm load resistor. Application of a signal then causes a negative voltage to be applied to the grids of the 6AU6's, reducing the gain and, if the modulator input level is set high enough, causing complete cut-off on peaks. Although this is desirable in some applications, it may be preferred to set the system up

as a volume limiter in order to guard against the sudden disappearance of the program due to an unexpected peak. This may be done by connecting the output of the system back into the input of the modulator amplifier.

The result is a form of dynamic balance that provides a limiting action rather than possible inversion of dynamics. Of course, the time constants in the output of the diode are of as much consequence as in the case of volume expansion and will depend upon the application desired.

While volume expansion and compression are well known techniques, in most cases to date the control voltages are derived from the input signal itself. Considerably wider utility can be achieved by modulating the audio signal by a voltage obtained from some other source. For example, a problem frequently encountered by restaurants and other public places using reproduced music is the fact that noise levels may change greatly during the day, with the result that the music may seem excessively loud during quiet periods, but almost inaudible during the busy hours. By setting up a microphone at some distance from the loudspeaker system the background noise can be used to produce a control voltage which will cause volume expansion as the noise level increases In an application of this nature a relatively large capacitance should be used in the diode load circuit in order to create a fairly long time constant, which tends to render the device insensitive to sudden loud sounds.

By using such a setup with shorter time constants in the diode load circuit a number of interesting, and sometimes amusing, effects may be obtained. For example, if the bias on the 6AU6's is set to cut-off and a signal applied, then nothing will be heard until someone speaks into the microphone. A synchronized accompaniment is then produced, which may be musical, a raspberry from a saw-tooth oscillator, or a chime-like effect from a sine-wave oscillator, depending upon your feeling for the dramatic.

Externally controlled volume compression is equally useful and provides a very smooth way of overriding music or other program material with special announcements. In this case the output of the microphone preamplifier is fed into the input of the modulator amplifier and also paralleled, through isolation resistors, with the output of the compressor. Music is fed into the signal input, the bias on the 6AU6's is set for class A operation and the diode connection switched so that a negative voltage is applied to the grids when announcements are made into the microphone. A smooth, automatic fade results that requires no adjustments of level controls or throwing of switches and which automatically restores the proper sound intensity once the announcement is completed.

So much for some of the useful, but more conventional, applications of the balanced modulator. Now to develop some of the aspects of the fascinating field of synthesizing sounds. The shape and duration of the modulation envelope are of primary importance in determining the audible effects of a particular sound and it is in this one major respect that most sounds in nature and in music differ considerably from the tones produced by an audio oscillator.

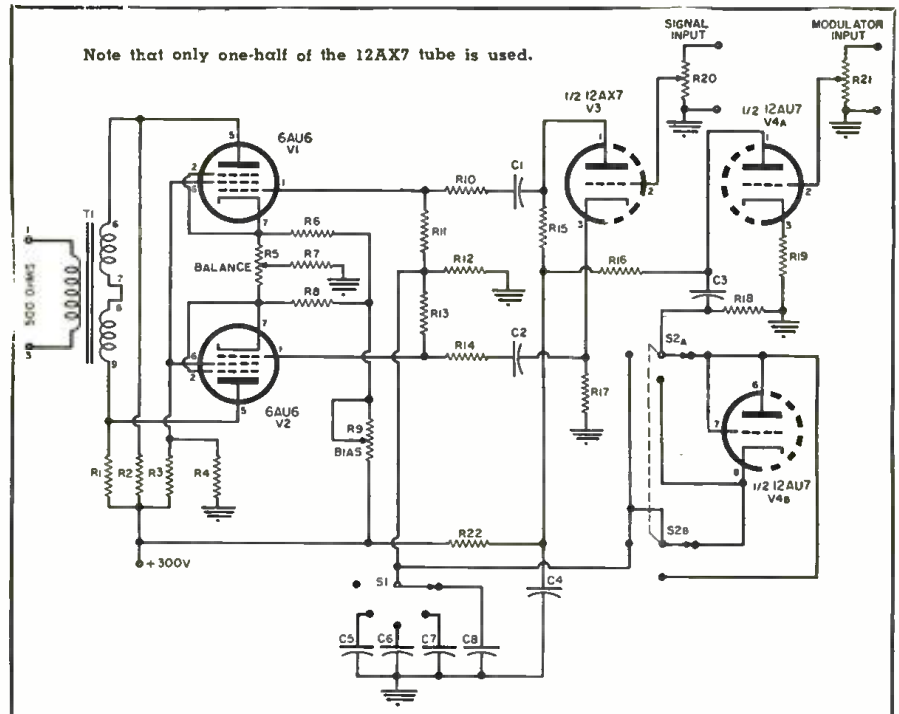
Probably the easiest effects to simulate with the balanced modulator are those of the triangle and chime family. In this case the output of a conventional sine-wave audio oscillator is fed into the input of the balanced modulator and the bias on the 6AU6 tubes adjusted to cut-off. The diode polarity is then set to apply a positive voltage to the grids and momentary excitation from a battery or some other source is applied to the input of the modulator amplifier. The resulting pulse charges the diode filter capacitor to a level which allows the 6AU6's to conduct and then, as the charge leaks away, the output of the amplifier decreases evenly to the point of inaudibility. For this simple case the tone of the output will depend upon the frequency and possible harmonic content of the audio oscillator and the time constants of the modulator. A large diode filter capacitor will create a big, full tone due to the long duration of ringing and relative absence of "clicks" caused by a slower attack time. A small capacitor will provide a shorter, more colorless tone, even to the point of being a click, pop, or other noise.

By changing the frequency of the audio oscillator it is possible to simulate different instruments that produce damped wavetrains such as triangles, chimes, plucked strings, drums, etc. but with a single oscillator the tone will tend to be quite artificial. A very great improvement in both naturalness and variety of effects may be obtained by using two or more oscillators. Particularly, this allows an extra modulation to be produced by beating two tones together and more nearly duplicates the tonal timbres produced by actual instruments. For example, many triangles and chimes may produce adjacent frequencies that beat together at a rate of from a few cycles-per-second to several thousand. thus producing a much richer and more interesting sound. The same factor seems to hold true in other instruments, even to the rich, vibrant effects sometimes found in lower register instruments such as the double bass and the bass drum, and which are seemingly caused by beats on the order of a few cycles-per-second.

Of course harmonic components are of prime importance in musical tones. and you may wish to experiment with pulse generators or saw-tooth oscilla-

(*Continued on page* 128)

Complete schematic of the balanced modulator. A separate power supply is required.



R1, R2, R10, R11, R13, R14—100,000 ohm, ½ w. res.
R3—1 megohm, ½ w. res.
R4—150,000 ohm, ½ w. res.
R5—5000 ohm wirewound pot
R6, R8—75,000 ohm, ½ w. res.
R7—1000 ohm, ½ w. res.
R9, R20, R21—500,000 ohm pot
R12—5 megohm, ½ w. res.
R15, R17—5000 ohm, ½ w. res.
R16, R18—50,000 ohm, ½ w. res.
R19—1500 ohm, ½ w. res.
R22—25,000 ohm. 1 w. res.

C1, C2, C3—.02 µfd., 400 v. capacitor
C3—.2 µfd., 400 v. capacitor
C4—12 µfd., 450 v. elec. capacitor
C5—.05 µfd., 400 v. capacitor
C7—.1 µfd., 400 v. capacitor
C8—.5 µfd., 400 v. capacitor
T1—Input trans., single to push-pull grids (Chicago C1S-1 was used as output trans. in this circuit)
S1—S.p. 5-pos. switch
S2—D.p. 3-pos. swicth
V1, V2—6AU6 tube
V3—12AX7 tube *V4—12AU7 tube*

Magnetic Convergence in Large-Screen Color TV

By J. JOSEPH HILL

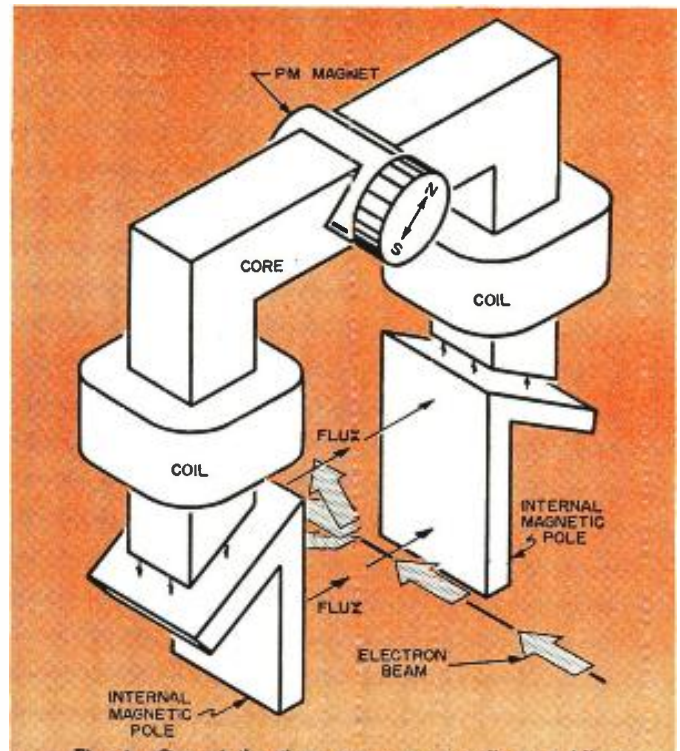


Fig. 1. One of the three convergence coil assemblies used with the large screen, 3-gun color picture tubes. This diagram shows the relation of the external assembly to the magnetic pole pieces in the interior of the tube neck, and its effect on the deflection of the electron beam.

Convergence circuits in large-screen color TV sets are becoming simpler; here is an analysis of three types.

THE basic principles of magnetic convergence have already been adequately covered in previous articles in RADIO & TELEVISION NEWS; this article will be devoted to an analysis and comparison of the leading convergence circuits in use today.

Fig. 1 shows a typical convergence coil assembly such as is used with each gun of a three-gun color TV picture tube. Each assembly consists of small coils wound on a horseshoe shaped core, with a small permanent magnet mounted in "V" cuts on both core halves. Rotating this small magnet varies the polarity and strength of the flux flowing through the core and thereby accomplishes d.c. convergence. This flux passes through the glass neck to the pole pieces within the color kinescope. These pole pieces are positioned at each electron gun so that each beam passes between a pair of poles and is deflected by the magnetic flux of the poles.

In addition to the flux introduced by the permanent magnet, horizontal and vertical signals are introduced into the coils wound on the core and result in a varying flux which deflects the beam in synchronism with the scanning of the raster.

The convergence yoke, shown in Fig. 5, consists of three coil assemblies, spaced to coincide with the pole pieces, and held tightly against the neck of the kinescope by means of coil springs.

In the "*CBS*-205" color TV receiver circuit, shown in Fig. 2, is found a direct approach to convergence. For best dynamic convergence a parabolic waveform is required, as illustrated in Fig. 6. In addition a tilt function is added, which shifts the peak of the parabola for further correction as shown in Fig. 3.

Horizontal pulses from a winding on the flyback transformer, see Fig. 2, are fed to the convergence circuits. A positive pulse is fed to a two-stage saw-tooth generator, which makes available a saw-tooth voltage. This saw-tooth voltage is amplified in the convergence amplifiers causing a *parabolic* current flow through the inductance of the convergence coil L_1, as shown in Fig. 4. In addition, a horizontal tilt pulse is applied to the grid of each convergence amplifier, which causes a *saw-tooth* of current through L_1. 47,000-ohm resistors are used to isolate these various waveforms from each other. By varying the parabola and tilt currents for each gun, horizontal dynamic convergence can be effected over the entire face of the picture tube.

The vertical convergence network of the "*CBS*-205" circuit consists of three separate 100-ohm center-tapped controls connected to the vertical output transformer, and a 560-ohm—25-μfd. network. Because the current through the vertical output transformer flows through the 100-ohm controls, a saw-tooth voltage at the vertical rate appears across them, and is applied to the L_2 coil of each convergence assembly through a 100-μfd. d.c. blocking capacitor and a horizontal frequency choke. Adjustment of the center-tapped controls varies the amplitude and polarity of the vertical saw-tooth current. Because L_2 is designed to be resistive at the vertical frequency, the saw-tooth voltage causes a *saw-tooth* current through L_2.

The 560-ohm—25-μfd. network generates a parabolic waveform because of the vertical signals passing through it. This waveform passes through a 150-μfd. d.c. blocking capacitor, and then a 2500-ohm potentiometer and horizontal frequency choke for each color channel, and is applied to coils L_1. The vertical parabola and tilt controls are adjusted for uniform convergence of the three electron beams throughout the vertical sweep.

Fig. 7 shows the *Motorola* convergence circuit, which is designed to eliminate the need for vacuum tubes and utilizes ringing coils as waveform generators. In the ringing coil convergence circuits, sine-wave voltages are substituted for the parabolic waveforms with little sacrifice of convergence, since the maximum error involved occurs during retrace blanking time, as shown in Fig. 9A, and therefore is not seen in the picture.

The vertical waveforms are derived

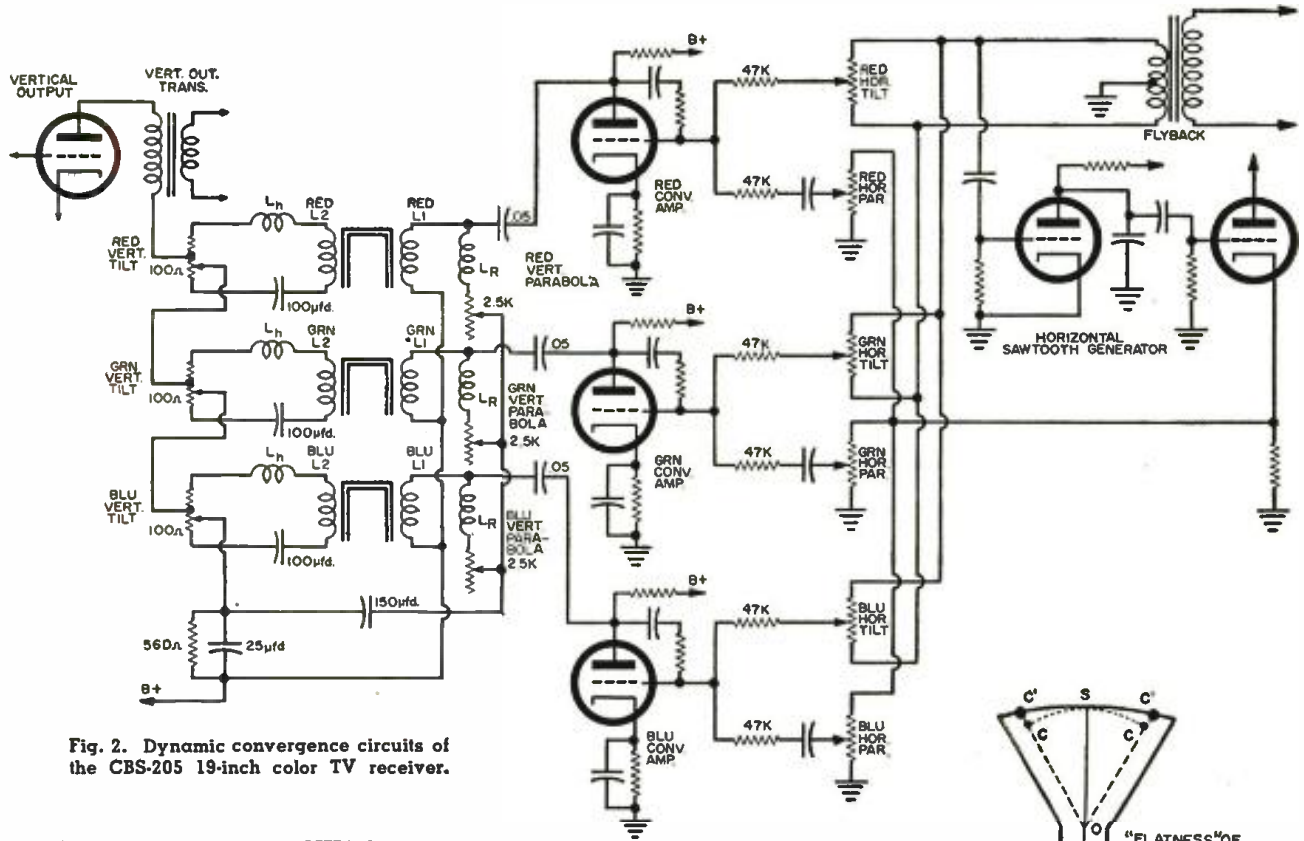
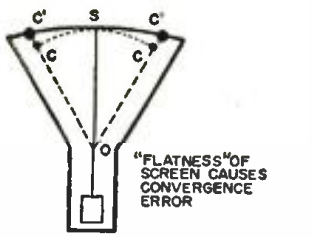


Fig. 2. Dynamic convergence circuits of the CBS-205 19-inch color TV receiver.



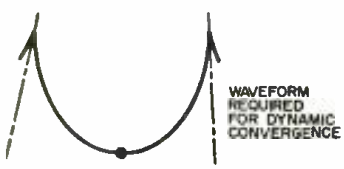


Fig. 6. Dynamic convergence. using a waveform such as illustrated here. varies the convergence of the three electron beams so that they coincide at the center of the tube screen (point S) as well as at the sides (points C').

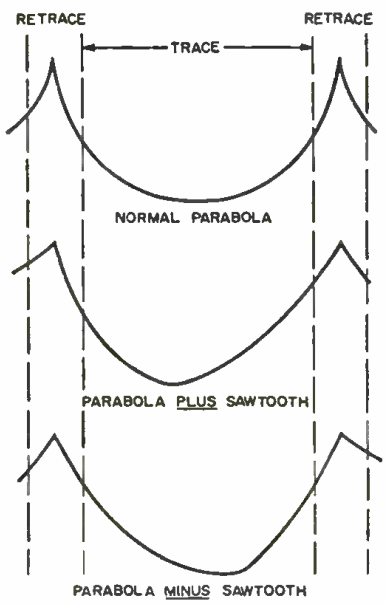


Fig. 3. Adjustment of dynamic convergence is effected by varying the "tilt" of the convergence parabolic waveform by adding or subtracting a sawtooth.

Fig. 4. Current waveforms through an ideal inductance corresponding to two voltage waveforms across it. The current waveform resulting from a sawtooth of voltage is a parabolic type.

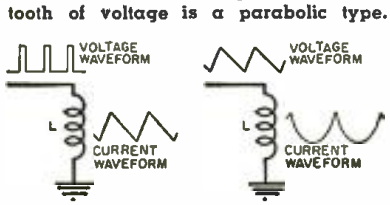


Fig. 5. Typical convergence yoke assembly. The convergence magnets are spaced 120 degrees around the neck of the tube to coincide with internal pole pieces in the neck of the tube.

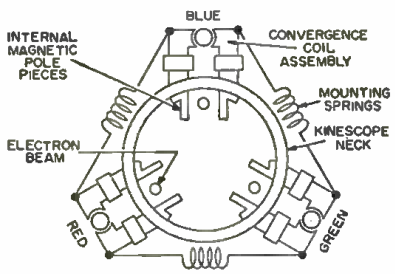
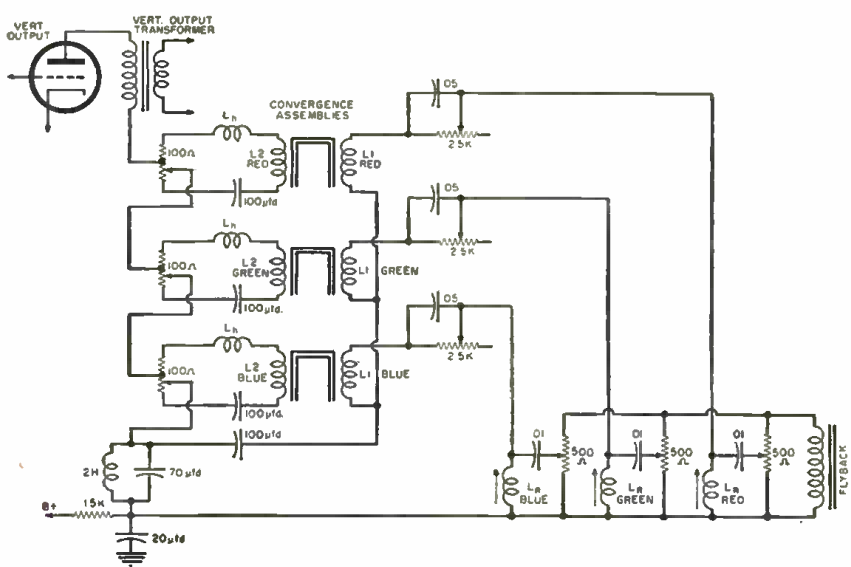


Fig. 7. Dynamic convergence circuits for the Motorola 19-inch color TV receiver.



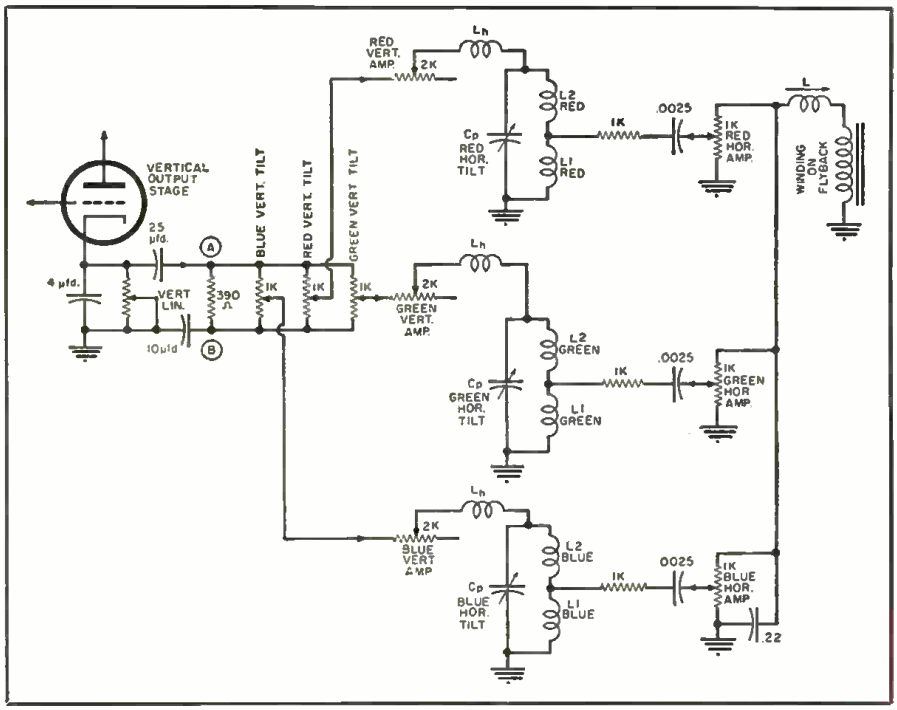
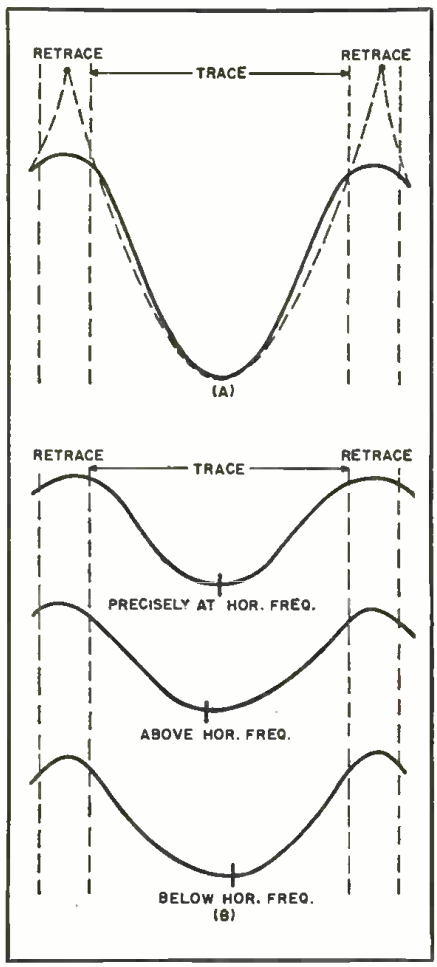


Fig. 8. The new RCA 21-inch color TV set uses the simplified dynamic convergence circuits shown here. Note the saving in vacuum tubes over the circuit of Fig. 2.

Fig. 9. (A) Comparison of sine wave and parabolic wave as applied to dynamic convergence. Note the similarity in their waveshapes during the trace period. (B) The effect of varying the phase of a convergence sine wave is to displace the point at which minima occur.

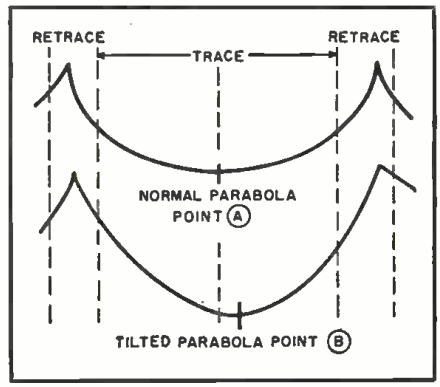


much as they were in the *"CBS-205,"* except for the vertical parabola generator, which consists of a 2-henry coil and 70-μfd. capacitor.

The vertical parabola is applied to L_1 (see Fig. 7) through a 100-μfd. capacitor, a 2500-ohm control, and the coil L_R. The vertical parabola amplitude is varied by the 2500-ohm control. The .05-μfd. capacitor bypasses the 2500-ohm control for horizontal waveforms, but is not large enough to bypass vertical signals.

The horizontal section utilizes ringing coils. For each gun, a horizontal pulse from the flyback transformer is applied through a pot to the coil L_R and the corresponding .01-μfd. capacitor. When the pulses strike this circuit a sine-wave oscillation occurs at the resonant frequency of the coil and capacitor, which is close to the horizontal rate. This waveform is shown in Fig. 9A. The amplitude of this sine wave can be varied by changing the amplitude of the pulse striking the coil. This is effected by adjustment of the 500-ohm control.

Fig. 10. The range of the vertical tilt adjustment possible for the parabolic dynamic convergence waveform produced by the circuit of Fig. 8 is shown here.



The horizontal tilt function is accomplished by adjusting the resonant frequency of the coil-capacitor combination. This is done by adjusting the coil L_R and results in the phase shift illustrated in Fig. 9B. By lowering the resonant frequency the lower crest of the sine wave is caused to occur to the right of center, whereas raising the frequency above the horizontal rate causes the crest to occur to the left of center.

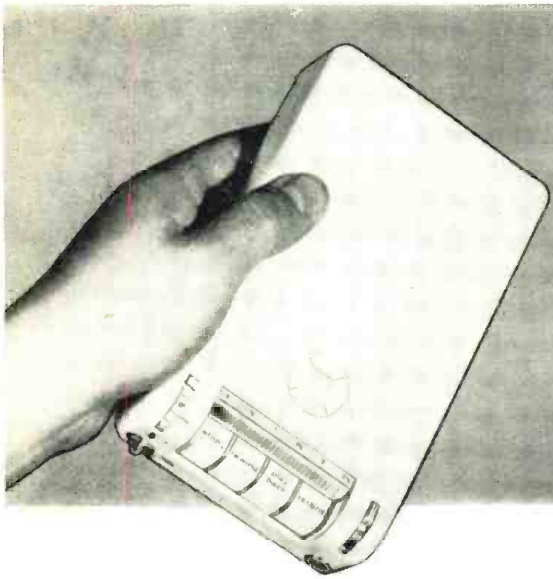
The horizontal convergence sine wave is applied to L_1 through the .05-μfd. capacitor bypassing the 2500-ohm potentiometer. Proper horizontal convergence is accomplished through adjustment of the horizontal amplitude control (the 500-ohm potentiometer) and the horizontal phase coil (L_R) for each gun.

The latest refinement in tubeless convergence is illustrated in the *RCA* 21-inch circuitry shown in Fig. 8. Starting with the vertical convergence section, it is seen that the signal is derived at the cathode of the vertical output stage. The parabolic waveform here is coupled by the 25-μfd. capacitor to a phase shift network consisting of a 10-μfd. capacitor and a 390-ohm resistor paralleled by three 1000-ohm controls. By varying the 1000-ohm controls the tilt of the vertical parabola is shifted between the limits shown in Fig. 10. The waveform picked off each 1000-ohm control is applied through a 2000-ohm potentiometer and 400-millihenry horizontal frequency choke L_h to the convergence yoke coils which are connected in series, and then to ground. Varying the 2000-ohm potentiometer controls the amplitude of the vertical waveform current.

From a winding on the flyback transformer, horizontal pulses are applied to the coil L, three amplitude controls, and a .22-μfd. capacitor. The voltage pulse causes a saw-tooth current through the coil, as in Fig. 4, which is modified by the .22-μfd. capacitor into a parabolic waveform across the controls. This is accomplished by the choice of coil and capacitor used. This parabolic waveform is applied to L_1 through the .0025-μfd. capacitors and 1000-ohm resistors. By autotransformer action between L_1 and L_2, this voltage is stepped up, resulting in a greater convergence range.

The convergence coils L_1 and L_2 are tuned by a variable capacitor C_p at the horizontal frequency. At resonance, the coils are predominantly resistive, so that a parabolic current results in the coil. By tuning the coils above or below resonance, the parabola is altered, resulting in a tilt similar to Fig. 3. By adjustment of the horizontal amplitude controls and the tilt capacitors, uniform convergence of horizontal lines can be achieved.

From this analysis it can be seen that convergence circuits are tending to be simplified, but the number of controls remains essentially the same. -30-



the "Minifon" P55 Recorder

A newly-redesigned version of the German tape recorder offers increased flexibility.

A NEW model of the German-built "Minifon" magnetic tape recorder has recently made its debut in the United States as the P55. *Geiss-America* of Chicago 45, Illinois is the exclusive U. S. representative for the device.

Those who recall the earlier "Minifon" (RADIO & TELEVISION NEWS, May 1953) will be pleasantly surprised by this redesigned and improved model.

The P55 can be used anywhere, indoors or out. Utilizing what is claimed to be the world's smallest electric motor, the "Minifon," although small enough to be concealed in a man's pocket, will make speech recordings up to 5 hours; music recordings (by switching to the faster, higher-fidelity speed), up to 2½ hours—all on a single reel of wire light enough to be placed in an envelope and mailed with a three-cent stamp. As with other types of recorders, the "Minifon" wire recordings can be erased and used over again. The wire itself is thinner than a woman's hair!

Another important consideration with this newly-redesigned unit is its operational versatility. With its standard crystal microphone, recordings can be made at distances up to twenty feet. Push-button control provides instantaneous action for recording, stopping, rewinding, playing back, erasing by re-recording, and rewinding. With its dictation footage clock, the unit is suited for dictation purposes. Recordings can be played back through earphones, speaker-microphone, through any radio, TV set, or external amplifier.

Among the accessories that are currently available for use with the recorder are a combination speaker-microphone for recording and playback, an accessory telephone adapter, a "wristwatch" microphone that looks like a chronometer, a dictation footswitch for operating the unit by foot alone, and an assortment of other accessories such as various carrying cases, spare wire reels, etc.

Although normally the recorder is operated on its own self-contained batteries, a transformer for 110-220 volt a.c. operation is available as an accessory. With a standard 9 volt motor battery, the unit will operate approximately 15 hours. The other battery requirements include a 30 volt "B" battery and a 1½ volt penlight cell. "B" battery life is estimated at from 150 to 200 hours while the filament battery lasts approximately 20 to 30 hours.

Frequency response of the unit is 150 to 5500 cps. Recording speeds of 4½ ips and 9 ips are available.

The new "Minifon" measures $3^{15}/_{16}$" x $6^{11}/_{16}$" x $1^{9}/_{16}$". The total weight, including batteries, is 28 ounces. The price is $289.50 including crystal microphone, earphones, ½ hour reel of wire, and batteries. -30-

Cartoonist Bob Kane, creator of the "Batman," finds it easy to make a permanent record of future episodes—when Beverly Kane has the "Minifon" ready.

Nick Kenny, the "New York Mirror" columnist and song writer, finds the "Minifon" handy for recording those elusive tunes and yarns when they occur to him.

DYNAMIC Crystal Diode Tester

Fig. 1. Over-all view of the home-built tester that checks the dynamic characteristics of crystal diodes used in television sets, etc.

By **RICHARD GRAHAM**

At last! A tester for crystal diodes that is easy-to-build and as reliable as a good tube checker.

CRYSTAL DIODES, while functionally simple, find use in widely different applications in industry, TV, and radio. Different applications require different diodes. Many more uses for crystal diodes, as yet undeveloped, will inevitably be followed by an even greater selection of diodes. The unit described fulfills the need for a reliable device to evaluate the performance of a diode, and it does this in terms of "good" or "bad"—just as the familiar tube tester does.

The era of testing crystal diodes by placing them across the terminals of an ohmmeter is just about over. Checking crystal diodes in this manner has probably damaged more crystals with excessive current than not. The quality of those that survived is still doubtful for this test tells nothing about the dynamic characteristics of the unit.

Most modern tube testers test vacuum tubes dynamically, *i.e.*, by applying an a.c. voltage to the grid and measuring its effect in the plate circuit. Static testing of the tubes by means of emission checks have little value for most work. This same philosophy applies to the testing of crystal diodes. The simple diode tester described tests these units dynamically by applying a positive pulse across the diode in the forward direction and measuring its effect; and then applying a negative-going pulse in the reverse direction and measuring its effect. In so doing, the diode is tested for all its important characteristics. Specifically, the diode is tested for its inverse current leakage at all values up to its peak inverse voltage; it is tested at its maximum average forward current and at all values up to its peak forward current.

The principle of the tester is quite straightforward and to make it even simpler for discussion purposes, the switch is removed and the circuits for the tester in the forward and reverse positions are shown separately in Figs. 2 and 6 respectively. The switch S_1 (shown in Fig. 5) merely serves to reverse the vacuum diode and switch the meter from a microammeter to a milliammeter in the reverse and forward positions respectively.

Referring to Fig. 2, the potentiometer R_1 is placed across the a.c. line. The arm of this potentiometer places a variable voltage at the plate of the vacuum diode V_1. This voltage will, of course, depend on the position of the arm with respect to the bottom end of the potentiometer. The output of the diode V_1 consists of positive-going, half-wave pulses that are applied to the diode under test in the forward direction. However, the potentiometer R_1 must first be preset to a position which will allow the diode to be subject to no more than the maximum average forward current as listed in the characteristics sheets as published by the crystal diode manufacturer. Once this position is known, it can always be reset by the calibrated dial on R_1. Likewise, the setting of R_2 must be determined and preset to obtain accurate results. More will be said on the calibrating procedure later.

TABLE I

DIODE	FORWARD		REVERSE	
	R_1	R_2	R_1	R_2
1N34A	4.0	1.5	4.0	6.0
1N38A	3.5	1.0	5.0	7.0
1N54A	3.5	1.0	4.0	10.0
1N55A	4.0	2.0	10.0	3.5
1N56A	4.0	4.0	2.5	5.0
1N58A	3.5	1.0	7.0	3.0

In the setup of Fig. 2, the crystal is simultaneously tested at its maximum average forward current and its maximum peak forward current by virtue of the fact that the average value of the pulse is approximately one-third the peak value. This means that in the case of a 1N34, which has a maximum average of 50 milliamperes forward, the peak current it is passing is 150 milliamperes. This is also the maximum peak forward current for this crystal diode. This also applies to other diodes as well.

In Fig. 3 the positive pulses are shown as they are applied to the curve of a typical germanium diode. The output current pulses are slightly distorted due to the square-law characteristics of the crystal in the lower current regions and the saturation in the higher current regions. At any rate, the ability of the diode to conduct over its forward range will be immediately detected by the ability of the crystal to pass the current for a given applied voltage pulse.

The potentiometer R_2 in series with the meter in Fig. 2 serves as a variable meter multiplier to adjust the meter to read on the "good" portion

on the forward (upper) meter scale. This can be seen in the front view of the instrument in Fig. 1.

To test the crystal in the reverse direction, the polarity of the vacuum diode is reversed as shown in Fig. 6. Now the potentiometer R_1 is adjusted to make the peak of the negative-going pulses equal to the peak inverse voltage rating of the diode under test. The current being forced through the diode in the reverse direction is measured by the microammeter. This is shown in the typical crystal diode curve of Fig. 4.

Once again the potentiometer R_2 is adjusted to keep the meter on the "good" portion of the scale in the reverse direction. However, with the tester in the reverse direction, R_2 serves as a meter shunt instead of a multiplier as in the forward direction. This bit of circuitry is necessitated by the different current ranges required in the forward and reverse directions. In the forward direction, current on the order of 50 milliamperes is usual while in the reverse direction 100 microamperes is the usual figure.

Thus any variation from the published curve in the reverse direction can be detected since the average value of the current pulses will change if the general slope of the characteristic curve changes.

Construction

The unit is constructed in a "Flexi-mount" case 3½ x 6 x 8 inches. Nothing in the way of layout or construction is critical. Thus any box or layout suiting the constructor's convenience may be used.

The meter scale was made by disassembling the meter and cementing a paper scale over the original meter scale with rubber cement. This cement has two advantages which make it desirable for use in this application. One is that it does not shrink the paper scale, the second is that the scale can be pulled off and the cement removed by rubbing slightly, thus restoring the meter to the original condition if desired. The line separating the "good" and "bad" portions of both scales is drawn approximately at three-fourths full scale. This is a compromise between maximum sensitivity and the fact that "bad" crystals may read off-scale in the reverse position. A typical meter scale is shown in Fig. 7.

A list of suggested settings for various types of crystal diodes is shown in Table 1. However, the calibrating procedure for determining these settings is so easy it is worthwhile calibrating the instrument yourself. Furthermore, the list in Table 1 is by no means complete since each manufacturer has his own line of diodes, many with different characteristics from those listed.

The equipment necessary to calibrate the instrument consists of a milliammeter with a 0 to 75 or 100 milliampere range, and either a peak-

(*Continued on page* 144)

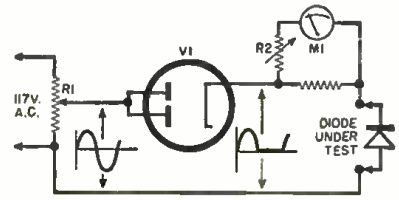


Fig. 2. Simplified schematic diagram showing the tester set up for checking crystal diodes for forward conduction.

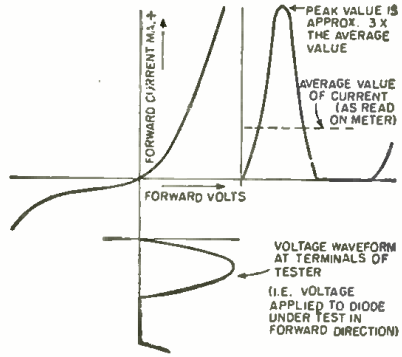


Fig. 3. Typical germanium diode curve showing the output resulting from a pulse applied in the forward direction.

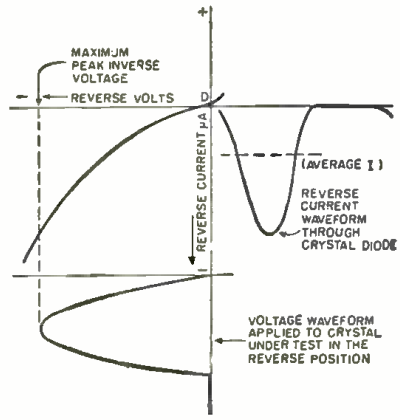
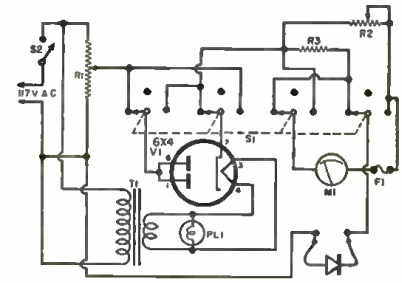


Fig. 4. Typical crystal diode characteristic curve for reverse conduction.



R1—500 ohm, 25 w. pot
R2—1000 ohm, 2 w. pot
R3—1 ohm, 1 w. res.
T1—Fil. trans., 6.3 v. @ 1 amp.
S1—4-pole, 3-pos. switch
S2—S.p.s.t. toggle switch
M1—0-50 microammeter
PL1—6.3 v. pilot light
F1—5 ma. fuse
V1—6X4 tube

Fig. 5. Complete schematic diagram and parts list of dynamic crystal tester.

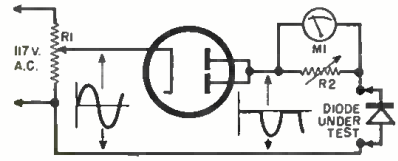


Fig. 6. Simplified schematic of the tester when the selector switch is in the reverse position for checking the reverse conduction of crystal diodes.

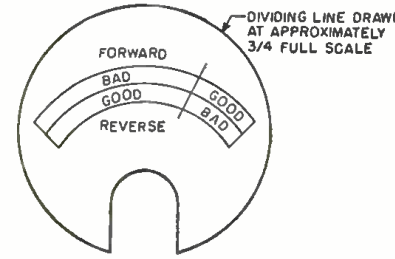
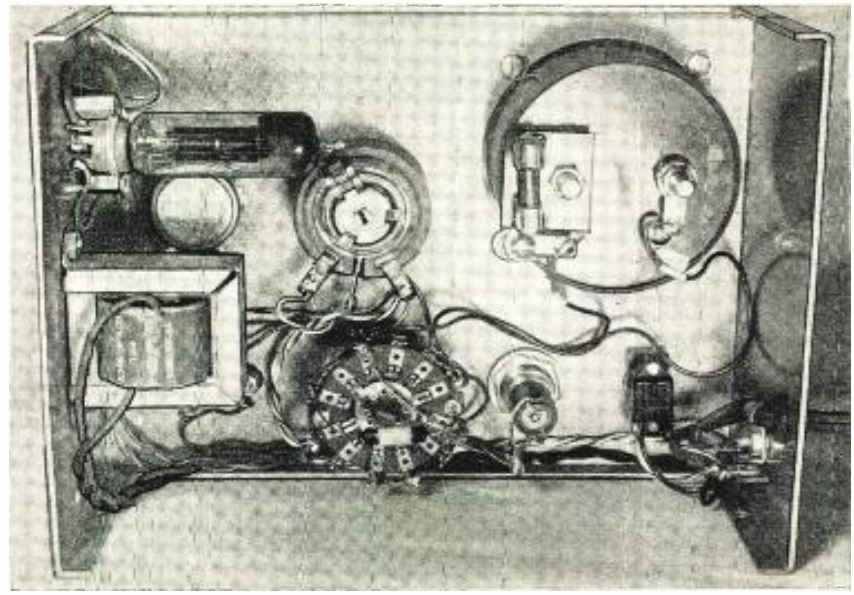


Fig. 7. Example of meter scale that may be used on tester. Builder may use others.

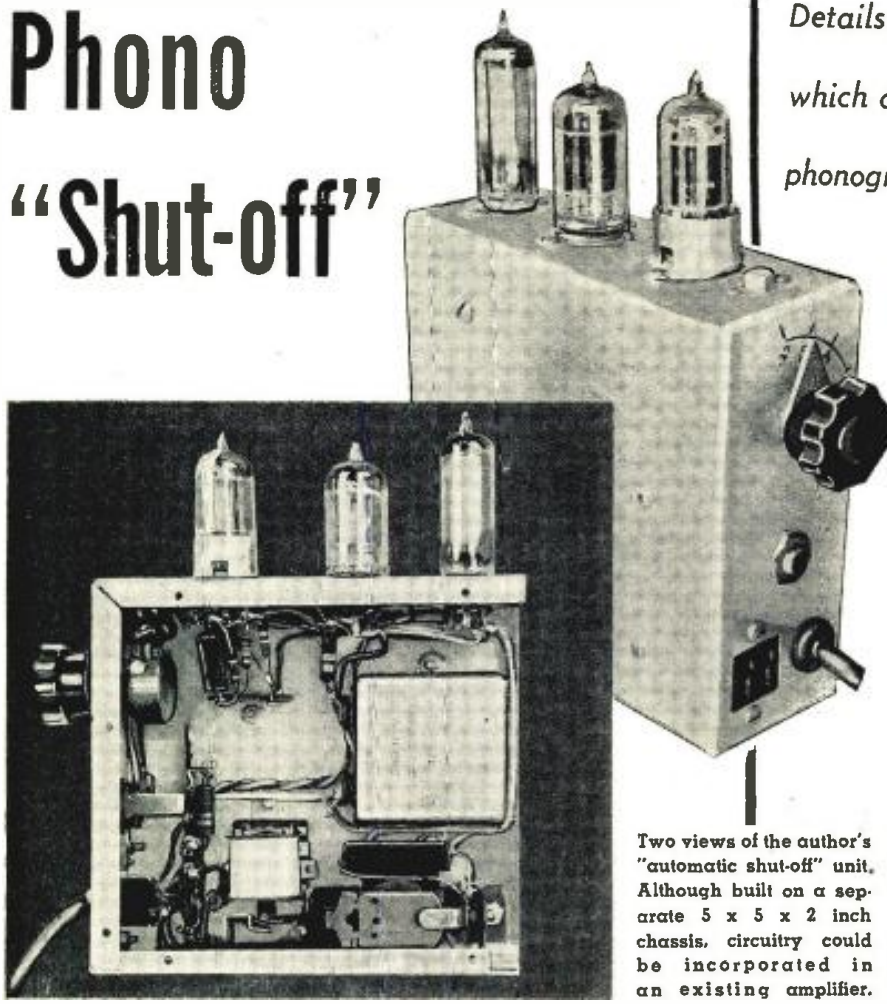
Fig. 8. Rear view of the complete crystal diode tester. Note fuse on the meter.



An Electronic Phono "Shut-off"

By ROBERT W. TIMMERMAN, W8YIF

Details on a signal-controlled switch which can be added to any existing phonograph-audio amplifier combination.



Two views of the author's "automatic shut-off" unit. Although built on a separate 5 x 5 x 2 inch chassis, circuitry could be incorporated in an existing amplifier.

AFTER a session of serious listening, are you in the habit of putting on a record of background music and then proceeding to some other occupation such as napping, reading, eating, or building that new amplifier? If so, and you use a standard single-play type turntable, no doubt you have, on occasion, been slightly annoyed by the need to interrupt the new activity to turn off the playing equipment. The device to be described was designed to take care of that little chore for you, in response to the absence of a signal in the amplifier circuit. It is entirely electronic and requires no mechanical connection to the pickup arm. No additional controls are needed.

The operating principles are, briefly, as follows. A sample of the program signal is amplified, rectified, and filtered. The resulting d.c. output operates a relay, holding the contacts closed as long as the signal is above a predetermined level. At the conclusion of the program, after a short interval, the relay contacts are opened, thereby interrupting the primary power to the equipment.

Characteristics required of this signal-sensitive device are influenced by the signal-to-noise ratio and the continuity of signal in typical program material. To be usable as a control actuator, the minimum signal plus noise must be greater than the maximum noise, a condition which is met by most present-day recordings. The control must also have a delayed response in order to keep the equipment in operation during the longest pause or rest that is likely to occur. The signal for the control unit must be sampled at a point of relatively constant voltage level, say, just before the master loudness or volume control. In order that bridging by the control input will not noticeably affect the signal feeding subsequent stages of the sound system, a low-impedance circuit such as the output of a cathode follower is preferable. A triode plate circuit would not be seriously influenced by the presence of this unit, however.

Fig. 1 is the schematic diagram of the author's unit. Conventional circuits are used. After an input potentiometer the signal goes to a two-stage 12AX7 voltage amplifier having a mid-range gain of 1900. By maintaining a low plate supply voltage, the output is limited to about 23 volts, thus any input signal over 0.012 volt will saturate the amplifier. Distortion is of no consequence here, and the limited output is established as part of the time delay control, which will be explained later. To minimize the influence of rumble and noise, circuit constants were chosen for maximum gain in the region of 800 cycles, and down 20 db at 50 and 20,000 cycles.

The amplified signal is rectified by one side of a 12AU7, diode-connected, the resulting direct current charging the timing capacitor, C_4. Resistors R_7 and R_8 provide a high-resistance discharge path for C_4, so that its charge is gradually dissipated after the signal stops. The second half of the 12AU7 is the control tube, a triode d.c. amplifier. Its input is connected across C_4 and its plate circuit is in series with relay RL_1. Quiescent plate current is about 12 ma., which holds the back contacts of the relay in the open position. With the application of signal voltage, the grid side of C_4 is charged negatively, thereby decreasing the plate current, which reaches cut-off with the grid at about —12 volts. The armature of RL_1 is released under this condition and the back contacts close. These contacts are in a 6.3 volt a.c. circuit operating an indicator lamp and a second relay. Contacts of the second relay are connected in the main power line in a manner to be described later.

Circuit component values are not critical and considerable deviation from those specified can, in most cases, be tolerated. The input potentiometer R_1 should have a logarithmic or audio taper. Since all grid circuit resistances are high, the coupling capacitors C_1, C_2, and C_3 should be of good quality, such as ceramic or mica. The timing capacitor C_4 must have very low leakage if an adequate time delay is to be obtained. Ratings of 4 μfd. at 50 volts are not standard for an oil-filled capacitor, however, surplus units with these specifications have been available at an attractive price. A higher voltage rating could, of course, be used. A fresh, high-grade electrolytic capacitor could be substituted, although adjustment of R_7 may be necessary to obtain the de-

sired time delay. Since the characteristics of electrolytic capacitors tend to change with time, the oil-filled type is preferable. If an electrolytic unit is used, be sure that the negative terminal is connected to the 12AU7 triode grid and the positive terminal to ground.

A 6BF6 diode-triode would be a more tailor-made fit as the rectifier and control tube in this circuit, rather than the 12AU7, but the latter is a more commonly used type, and is probably in the spare stock of most audio fans.

The plate circuit relay RL_1 has a 2500-ohm coil and, preferably, has armature spring tension adjustment. Single-pole, normally-closed contacts are used here, although a single-pole, double-throw relay will be more readily obtainable. The power relay, RL_2, has a 6.3-volt a.c. coil and medium-duty power contacts, s.p.s.t., normally-open. Pilot lamp PL_1 may be built into the control unit or mounted externally at any convenient location.

The plate supply is regulated at 150 volts by the 0A2 gas discharge tube. If a suitable source of 150 volts at 15 ma. is already available, this portion of the circuit may be omitted. The circuit, as shown, requires 200-300 volts at 20 ma. It is assumed that a properly grounded or biased 6.3-volt a.c. heater supply is available. Connections to the power supply, which may be that of the main amplifier, are made by means of any convenient plug and cable arrangement.

The author's unit was built in a 5 x 5 x 2 inch aluminum box, as shown in the photographs. Arrangement of parts and wiring is not important aside from the usual precautions in constructing a high-gain amplifier. If space is available on existing or new equipment chassis, this circuit could be assembled directly on the main amplifier or power supply. Adjustment of R_1 is made infrequently, thus it need not be accessible as a routine control.

After assembly, several tests and initial adjustments should be made. The series dropping resistor, R_8, to the voltage-regulator tube is to be set so the total "B" current is around 18-20 ma. Voltage at terminal 5 of this tube, with reference to ground, should be 150 volts. Checking of the signal portions of the circuit is greatly facilitated by the use of a milliammeter plugged into jack J_2. The cathode current so indicated should be between 11 and 12 ma. with no signal input. If it is more than 12 ma., a resistor may be inserted between the relay coil and the control tube plate. Low plate current at "no-input" condition indicates trouble in the 12AX7 section, possibly oscillation or excessive hum. Either of these troubles can be confirmed by temporarily disconnecting C_1 from the grid. The armature of relay RL_1 will vibrate under this condition.

After making these tests and adjustments, the control action should be checked. With power on and R_1 set at maximum, momentarily touch the live input terminal with your finger The control tube current should decrease rapidly to zero, thereby closing the contacts of relay RL_1, and energizing relay RL_2 and the indicator lamp. About 20 seconds after removing your finger, cathode current should begin to flow, slowly increasing to the initial value over a total time of slightly more than one minute. Adjust the tension of relay RL_1 spring, if necessary, so that the armature pulls in at 9 ma. The release current of RL_1, which is not critical, will be around 6 ma.

If an audio generator and a.c. vacuum-tube voltmeter are available, the sensitivity can be checked further. An input of about 4 mv. at 800 cps should be sufficient to reduce the control tube current just to cut-off.

After passing the preliminary tests, the unit is ready for connection to the power control circuits. Wiring may be arranged so that the control unit will turn off the turntable motor or the entire system. Connect the contacts of relay RL_2 to the terminals of the line power switch operating the desired equipment. This switch must be a single-pole (two connections) type. If a double-pole switch is in the equipment, connect a jumper wire across the second pole. When the automatic control unit is in "signal-on" condition, the RL_2 contacts then complete a circuit parallel to the manual power switch, and the latter may be opened without interrupting operation. The control unit is thus placed in charge by opening that switch. Upon completion of the number in progress, the primary power circuit is opened by relay RL_2, and everything stops. Operation cannot be resumed except by manually closing the power switch. It is seen that there need be no additional switches or controls on the playback system panel. The indicator lamp is not absolutely necessary, but it is useful in determining at a glance that the automatic unit is ready to assume control.

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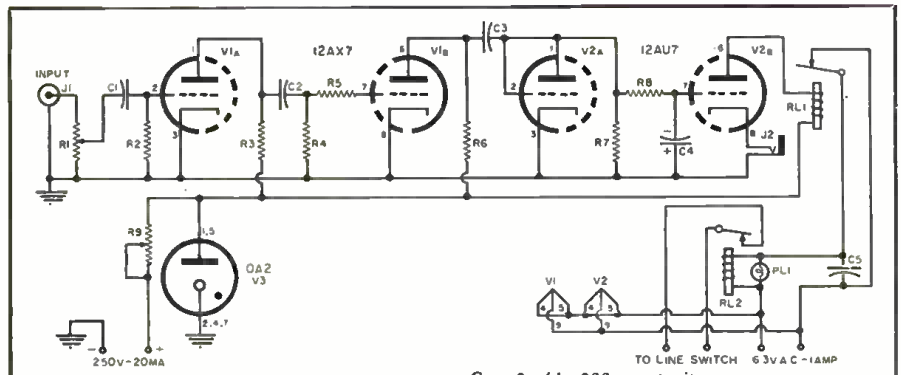
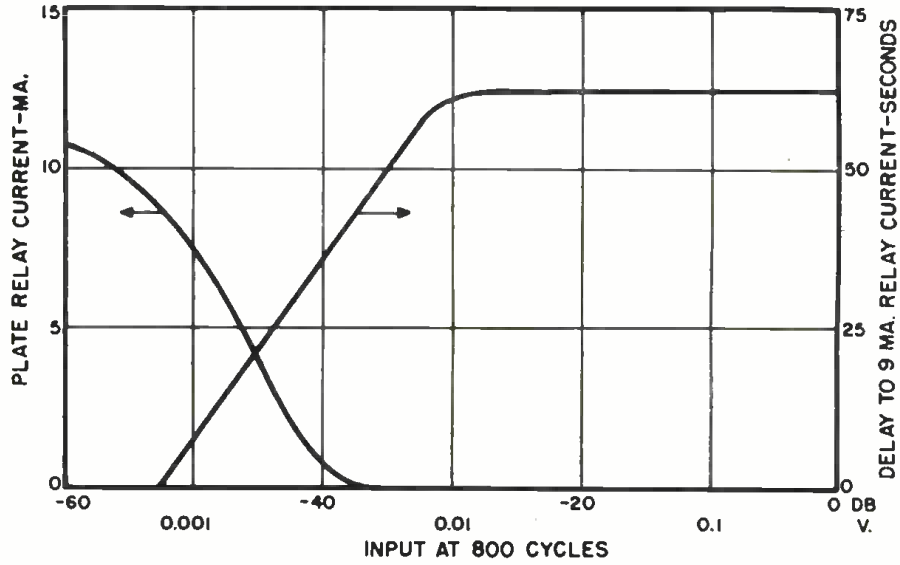


R_1—2 megohm audio taper pot
R_2, R_4, R_7—4.7 megohm, ½ w. res.
R_3, R_6—220,000 ohm, ½ w. res.
R_5, R_8—470,000 ohm, ½ w. res.
R_9—10,000 ohm, 10 w. wirewound res. (with adj. slider)
C_1—.001 μfd., 500 v. ceramic capacitor
C_2—.002 μfd., 500 v. ceramic capacitor
C_3—.01 μfd., 500 v. ceramic capacitor
C_4—4 μfd., 50 v. oil-filled capacitor (see text)
C_5—.2 μfd., 200 v. capacitor
J_1—Phono jack
J_2—Single-circuit, closed-circuit jack
RL_1—S.p.d.t. plate circuit relay, 2500 ohms, 6-9 ma.
RL_2—S.p.s.t. medium-duty relay, 6.3 volts a.c.
PL_1—6.3 v. pilot light
V_1—12AX7 tube
V_2—12AU7 tube (6BF6 can be used with socket changes)
V_3—0A2 tube

Fig. 1. Complete schematic. Several component variations are possible. See text.

Fig. 2. Sensitivity and time delay characteristics of the "automatic shut-off."



USING THE CADMIUM SULFIDE PHOTOCELL

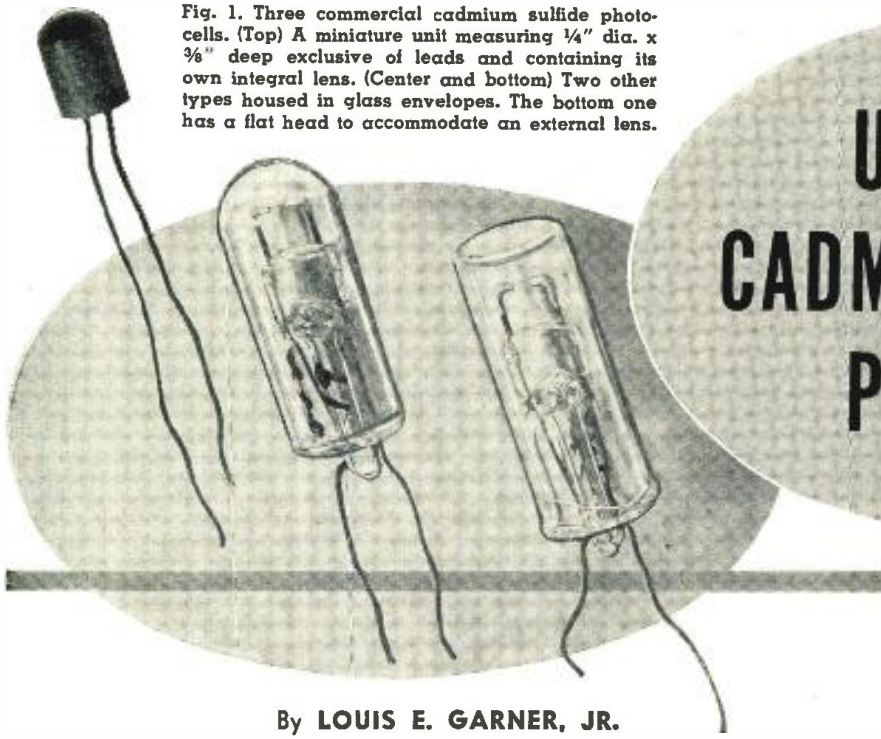


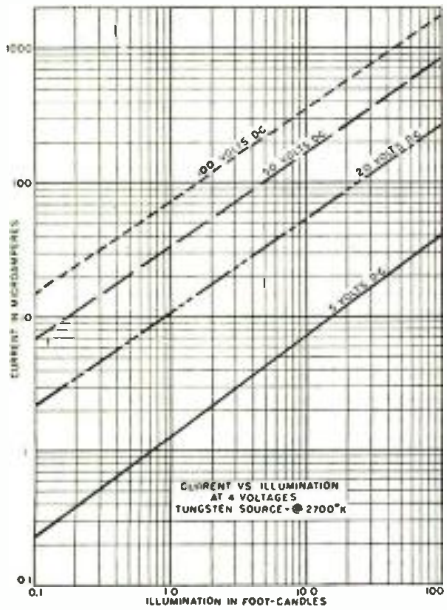
Fig. 1. Three commercial cadmium sulfide photocells. (Top) A miniature unit measuring ¼" dia. x ⅜" deep exclusive of leads and containing its own integral lens. (Center and bottom) Two other types housed in glass envelopes. The bottom one has a flat head to accommodate an external lens.

By **LOUIS E. GARNER, JR.**

Where only moderate sensitivity is required, the use of the new cadmium sulfide photocells offers real economy.

PHOTOELECTRIC circuits, as a group, are employed in many of the most widely used industrial electronic controls. Generally speaking, photoelectric control circuits are designed to perform some function as a result of a change in intensity or an interruption in a reflected or transmitted light beam. In most cases, this function is the opening or closing of an electromagnetic relay which, in turn, controls the operation of another piece of equipment, such as an alarm signal, an electric motor, a solenoid, an electromagnetic counter, or a timer.

Fig. 2. Graph of output current vs illumination for typical CdS photocells with different values of applied d. c. voltage. Courtesy Standard Electronics Div., Hupp Corp.



On the surface, the basic problem of operating a relay by interrupting or changing the intensity of a light beam appears to be a simple one. And in some cases it is. But, unfortunately, due to the characteristics of available light-sensitive devices, a good many of the practical circuits employed in the past have been relatively complicated and expensive. Often, the basic light-sensitive device (photocell or phototube) has been used in conjunction with one or more stages of amplification, employing either vacuum or gas-filled amplifier tubes. The use of such amplifiers adds several complications; not only are a number of additional components required by the stage(s) itself, but both high (plate) and low (filament) voltage power sources may be needed.

An "ideal" photoelectric control circuit would probably be one requiring no external power source and only a single relay and photocell, but with the operational features of good response speed, moderate to high sensitivity, low cost, ruggedness, durability, compact construction, and long life. Not quite "ideal," but still excellent, would be a circuit having most of the desired operational characteristics and requiring but a single power source, with a minimum of additional components. With such specifications, circuits requiring very expensive phototubes, complicated power supplies, or delicate "ultra-sensitive" relays, even though simple otherwise, might be ruled out.

A circuit with specifications closely approaching the "ideal" could probably be designed around a phototransistor. But, unfortunately, at this writing phototransistors are fairly expensive and, in addition, are not readily available to the average experimenter and circuit designer. Where only moderate sensitivity is required, a better solution, at this time, is to use the new cadmium sulfide (CdS) photocells. Readily available at a cost competitive with conventional phototubes, the CdS photocell is sufficiently sensitive to permit its operation in most applications without requiring an amplifier stage. Where moderate light intensities are available, a relay circuit may be designed around a simple d.c. power source, a high resistance relay, and the CdS photocell itself. Using standard-sized, commercially-available components, a complete circuit, including an a.c. power supply, may be assembled in a case hardly larger than a package of king-sized cigarettes—and with space to spare!

The Cadmium Sulfide Photocell

Three typical commercial cadmium sulfide photocells are shown in Fig. 1. The smallest cell (a *Standard Electronics Div. of Hupp Corp.* type CdS-3) measures only ¼" in diameter by ⅜" deep (exclusive of leads), yet incorporates an integral lens. In spite of its small size, when used in an appropriate circuit, this unit can deliver as much as 1.5 to 5 milliamperes when exposed to from 50 to 100 footcandles illumination. The other two photocells shown are similar to each other except for their glass envelopes. The lower unit has a flat head to accommodate an external lens.

Cadmium sulfide, as used in the photocells, is photoconductive. Thus, when the cell is dark, its resistance is quite high and, when illuminated, its resistance drops. Although the photoelectric properties of cadmium sulfide have been known for some time, practical considerations have, in the past, limited its use in photocells. Chief among these limitations has been its speed of response. But new techniques

have permitted a reduction in response time to the point where some of these units have a response time as short as 5 milliseconds in practical circuits. This is ample for the majority of counting and control applications.

The curves given in Fig. 2 show the current output of typical cadmium sulfide photocells *versus* illumination at four different values of applied d.c. voltages. As can be seen, even with moderate d.c. voltages, CdS photocells have a comparatively high output, capable of operating many standard relay types directly. At low light levels, CdS photocells have a quite linear response, with highly linear resistance changes being obtained from 1 footcandle to 0.0001 footcandle and lower. The CdS photocell is therefore well suited to the design of instruments for measuring minute changes in light intensity with good accuracy. With greater illumination, a less linear response may be obtained, but since high light levels are generally used primarily for "on-off" control and counting applications, linearity of response is less important.

The spectral response peak occurs at approximately 5200 angstrom units in the visible light range. Among other things, CdS photocells are quite sensitive to x-rays.

The general characteristics of typical commercial CdS photocells are given in Table 1. These specifications do not apply to a specific cell but, rather, are typical of a group.

The particular photocell used by the author is only one of many types of such cells available. Such things as impedance, speed of response, sensitivity, etc. can be varied to meet the requirements of the user.

Of particular interest is the minute size of the sensitive area (only two square millimeters!). Since the point sensitivity of the much larger sensitive surfaces of conventional phototubes is frequently non-uniform, difficulties may be encountered in applications requiring a small, sharply focused beam of light. In a conventional phototube, a pin-point light beam striking only one part of the sensitized surface may give a different response than when striking another part. With the small sensitive area of the CdS photocell the entire area will be covered by the light, even with quite small beams, insuring a consistently uniform response.

An Experimental Circuit

The schematic diagram of the experimental photocell relay shown in the photographs is given in Fig. 4, while an interior view of the model is shown in Fig. 3. All major components are identified. The parts needed to assemble a duplicate unit are specified in the parts list. With the exception of the type CdS-3 photocell, all parts are standard and should be available through regular parts distributors. At the present writing, the photocell itself is not available except on order directly to the manufacturer. However, the author has contacted the

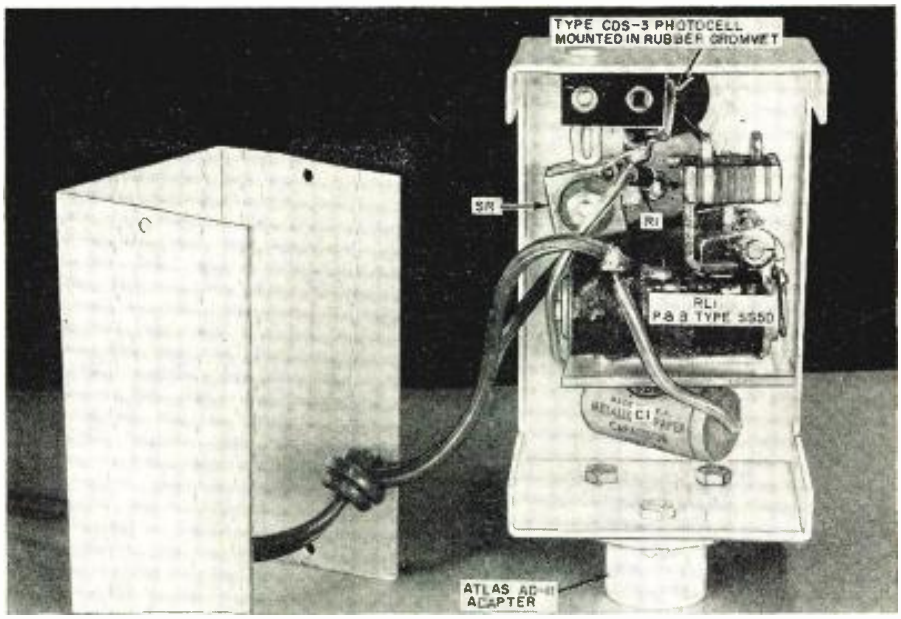


Fig. 3. Interior view of the author's experimental photoelectric relay.

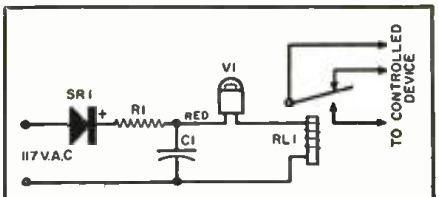
Max. dissipation	150 milliwatts
Max. voltage	400 volts (peak)
Dark resistance	10,000 megohms (nominal)
Sensitive area	2mm²
Sensitivity	1 to 10 amps. per lumen
Operating temp.	—50°C to +100°C (variations from —50°C to +75°C cause less than a two to one change in cell resistance).

Table 1. General characteristics of typical commercially-available CdS photocells.

manufacturer and has been assured of his willingness to supply single lot orders.

The CdS photocell (V_1) and a sensitive high resistance relay (RL_1) are connected in series across a d.c. power source. In operation, light striking the photocell reduces its resistance and permits sufficient current to flow through the relay to effect its closure.

(*Continued on page* 158)



R1—5600 ohm, ½ w. carbon res.

C1—2 μfd., 200 v. metallized paper tub. capacitor

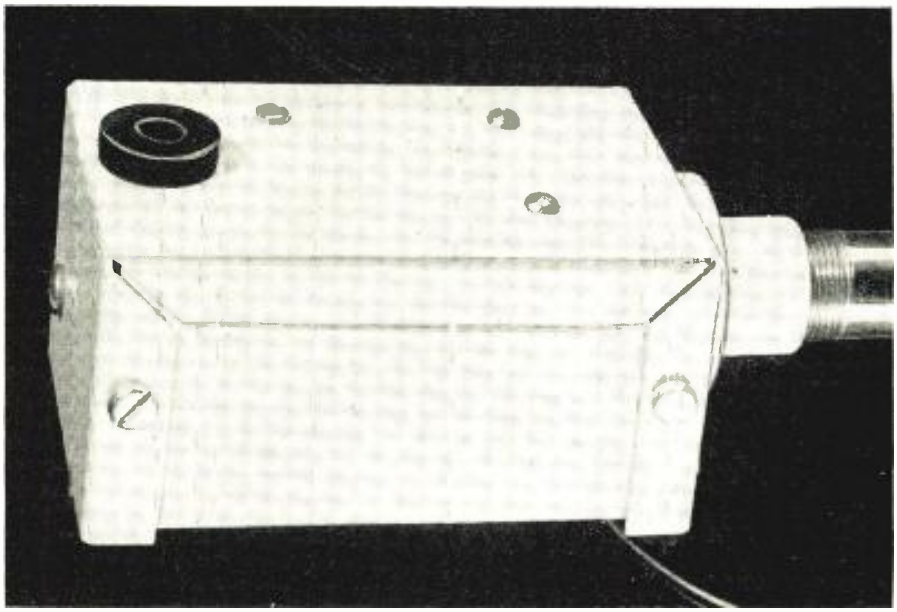
SR1—20 ma. selenium rectifier (Radio Receptor Type 8Y1)

RL1—Sensitive d.c. relay, s.p.d.t., 1 ma., 10,000 ohm coil (Potter & Brumfield super-sensitive Type SS5D)

V1—Cadmium sulfide photocell (Standard Electronics Div. of Hupp Corp. Type CdS-3). Note that while this component is not yet available as a distributor item, the manufacturer will fill single-lot orders. Write Mr. Neil H. Sanders in care of the company, P.O. Box 513, Carlisle, Pa.

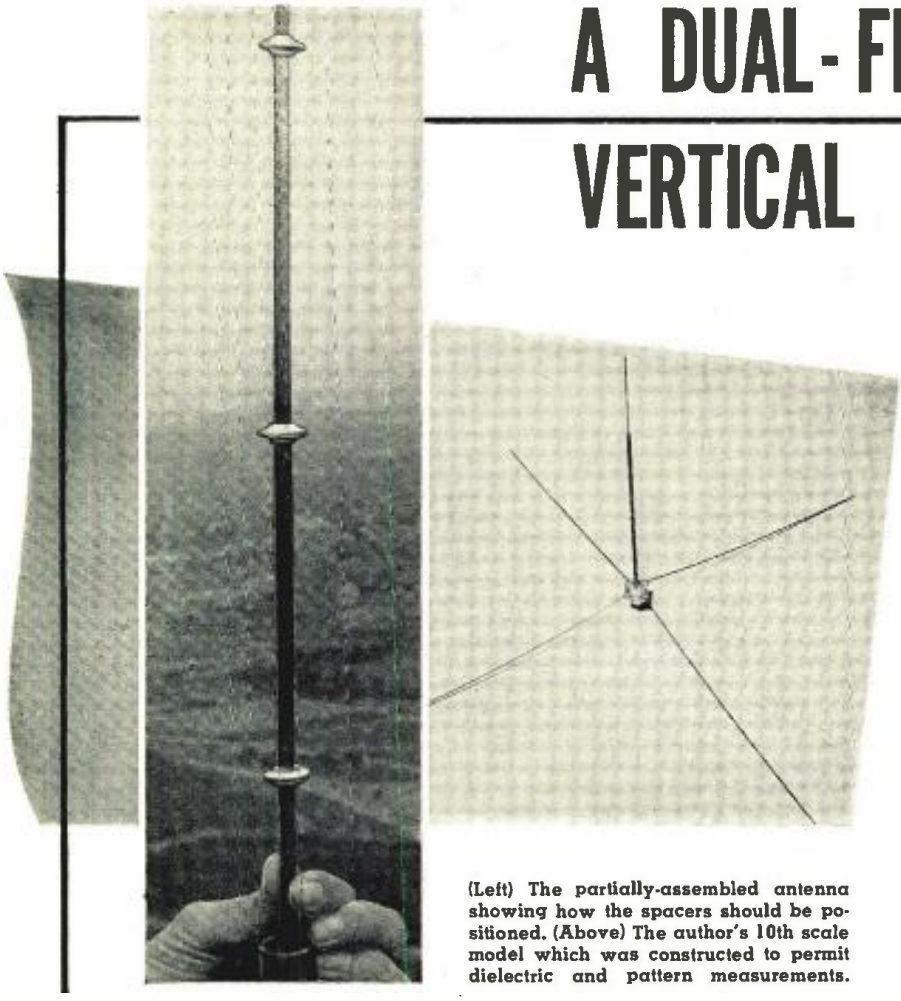
Fig. 4. Schematic of photoelectric relay.

Fig. 5. The experimental photoelectric relay mounted on a standard microphone stand. Other mounting techniques may be used, if preferred.



A DUAL-FREQUENCY VERTICAL RADIATOR

By
WILLIAM H. HARRISON, W6ULD
Mount Lee Laboratory
Stanford Research Institute



(Left) The partially-assembled antenna showing how the spacers should be positioned. (Above) The author's 10th scale model which was constructed to permit dielectric and pattern measurements.

An unusual antenna system designed for dual-frequency operation by means of a coaxial choke which also serves as a portion of radiator. It works on any two ham bands.

MANY times it would be convenient to be able to operate an antenna on two bands by merely changing the transmitter frequency. The antenna to be described is a vertical stub mounted in a ground plane, matching a 50-ohm line over two separate frequency bands —10 and 15 meters. The same idea may be applied to other frequencies for operation on other bands, if desired. The operating frequencies do not have to be harmonically related and may be considerably removed from one another.

There appear to be at least two types of hams who read antenna articles (the XYL says we're all alike). First, the person who is primarily an operator and is interested mainly in the information concerning the physical dimensions and components required to make it function properly; second, the ham who not only likes to operate but also wishes to know exactly how the system functions so he can apply the idea to some pet scheme he has been nourishing.

With this in mind, the construction and adjustment of the antenna system will be described, after which the theory of operation will be outlined. The constructor should have some means of checking the standing-wave ratio on the transmission line so that he will know when the antenna is properly tuned.

Fig. 4 shows the general arrangement of the antenna system, the basic concept being quite simple. The 15-meter antenna is placed inside the 10-meter antenna and the two are connected together at the bottom (feed point). When the antenna operates on 10 meters the lower portion of the vertical stub is used and when operating on 15 it utilizes the entire length of the antenna. A complete explanation of what takes place will follow the construction details.

A piece of ⅞-inch copper water tubing is used as the outer conductor and ¼-inch tubing is utilized as the center conductor. Other diameters and types of tubing may be used with equal success, however it is desirable to maintain a ratio of 2 to 1 or greater between the outside dimension of the inner conductor and the inside dimension of the outer conductor. These ratios will have little effect on the dielectric spacer dimensions other than their diameter. Care should be exercised to assure a good electrical connection between the two conductors at the base of the antenna. The short, used in the antenna described, is made of brass and soldered to insure low-loss operation. The complete antenna is held in place by two insulators secured to the supporting mast.

The antenna system is mounted above the roof and the guy wires which hold it in place are also used as the ground radials. The four radials, equally spaced, are tilted down about 20 degrees from horizontal because it is convenient to do so and it also improves the match between the antenna and transmission line. The ground plane radials are 11½ feet which is a quarter wavelength at 15 meters. This length does not impair 10-meter operation or harm the radiation pattern. The results are shown in the impedance curves and radiation patterns.

Note from the picture of the disassembled antenna that the center conductor inside the 10-meter antenna is held in position by dielectric spacers or beads. In addition to holding the center conductor in the proper position, they also reduce the wave velocity to the desired value. It is necessary to resonate this internal portion of the antenna (10 meters) and this is accomplished by the use of spacers placed inside the tubing as shown in Fig. 4. The top spacer, longer than the others, is inserted and adjusted until the desired resonant frequency is obtained.

The standing-wave indicator is placed in the transmission line (10-meter signal feeding the indicator) and the top spacer is adjusted for minimum standing wave. This may be done by noting the standing wave, then making a small change in the position of the dielectric, then once again noting the standing wave. Each time the adjustment is made stand clear of the antenna while reading the meter since your movements may affect the reading. Once the choke is tuned the antenna is ready to operate on the two bands.

Various types of dielectric material may be used as long as the dielectric constant is taken into consideration. The antenna was originally constructed using dielectric beads listed in the *Andrew Corporation* catalogue as type 737-103, made for their ⅞-inch diameter semi-flexible coaxial cable. These are shown in Fig. 4 and also in the picture of the partially assembled antenna. If you prefer to make up your own spacers, sample dimensions are included in Fig. 4. Other dielectrics, lengths, and spacings may be used with the aid of the formula given in Fig. 3. These homemade spacers (marked "see text" in Fig. 4) can be made of either polystyrene or "Rexolite." The computed values were checked on the tenth-scale model (used for pattern measurements) and found to be accurate. Polystyrene rod is available in most major cities and if not available in your locality, can be purchased through any of the radio mail order houses for about $1.50 per foot. Exercise caution when machining polystyrene as excessive heat will cause it to become gummy.

The theory of operation will be illustrated by showing how portions of an antenna may be disconnected by means of lumped parallel resonant circuits.[1] With reference to Fig. 5, the length a_1 is made equal to half wavelength at the highest frequency of operation. Parallel resonant circuits L_1C_1 and $L_1'C_1'$ are then added at the ends of this section, these circuits being resonant at the frequency for which a_1 is a half wavelength. Operation at the next lower frequency is then obtained by adding sections b and b', so the equivalent electrical length of section a_2, when the reactance introduced by the resonant circuits is taken into account, corresponds to the half wavelength resonance for the next lower frequency used. These added sections are inoperative for the frequency for which a_1 is in half-wave resonance since they are isolated by the high impedance of the parallel resonant circuits. Thus one obtains two resonant frequencies corresponding to the two desired frequencies of transmission.

The system just described adapts itself to wire type of antennas, especially at the lower frequencies where the antenna is quite long. However with the vertical type of antenna the coaxial equivalent of the parallel resonant circuit, the coaxial choke, lends itself well both electrically and physically. It is superior because the losses in the choke are less than in the regular parallel resonant circuit. The coaxial choke is a quarter wavelength transmission line, with one end shorted, that is, the inner and outer conductors are connected together at one end. At the end opposite the short, the impedance between the inner and outer conductors is very high. This is exactly the same condition that takes place across the terminals of a parallel resonant circuit. This is illustrated in Fig. 1B. If the coaxial choke is slightly longer or shorter than a quarter wavelength

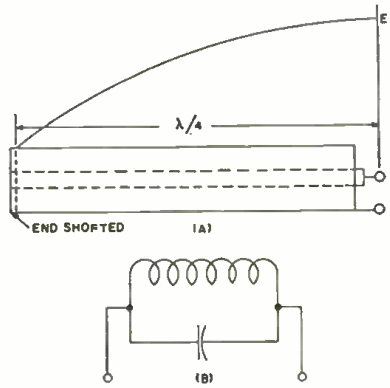


Fig. 1. (A) A shorted quarter-wave coaxial section, and (B) its equivalent as a parallel resonant circuit. Refer to article.

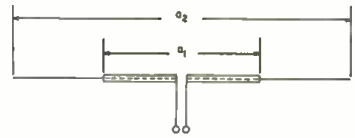


Fig. 2. The coaxial equivalent of the antenna shown in the diagram of Fig. 5.

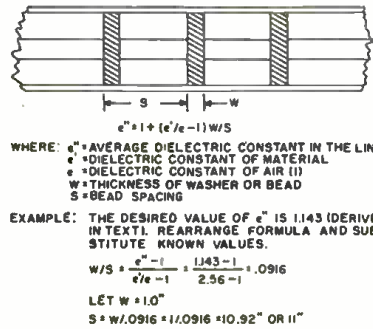


Fig. 3. Effect of dielectric spacers.

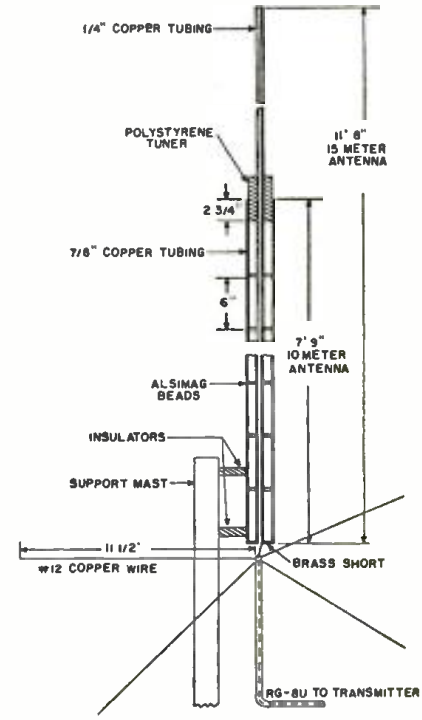


Fig. 4. Sectionalized view of 10 and 15 meter antenna showing bead spacing and general layout. If 1" homemade spacers are used, they are spaced 11 inches apart. See text for details on how the spacers can be home-constructed.

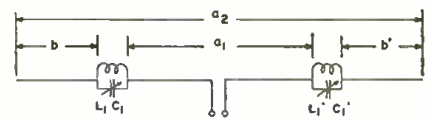


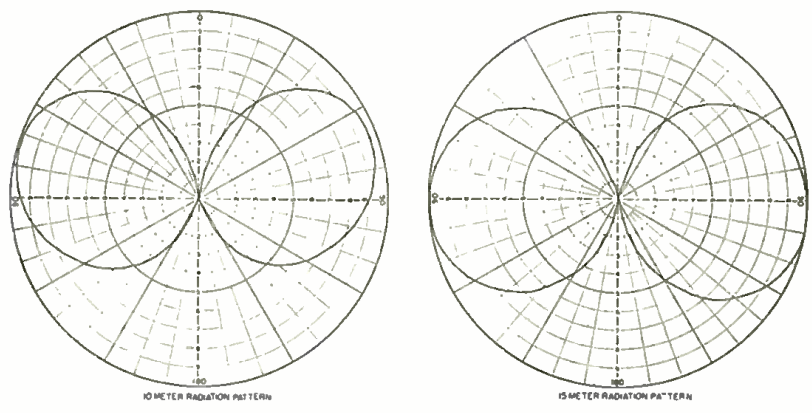
Fig. 5. Multi-frequency antenna system.

it no longer presents a high impedance at the output terminals and will not disconnect the remaining portion of the antenna. The same would be true if the lumped parallel circuit were not resonant. The parallel resonant circuits in the antenna shown in Fig. 1B may therefore be replaced by the coaxial chokes shown in Fig. 2. It would operate exactly the same in either case.

In the design of an antenna system using the coaxial choke we must first consider the proper length of the outer conductor since that surface must act as a radiator while the inside surface acts as a portion of the coaxial choke. Impedance measurements were made on the outer conductor with the center conductor removed. The system was resonant at approximately .23 wavelength. The proper length of the radiator (10 meters in this case) is determined by its length/diameter ratio.

The antenna now operates properly on 10 meters as a conventional stub

Radiation patterns of the dual-frequency antenna on the 10 and 15 meter bands.



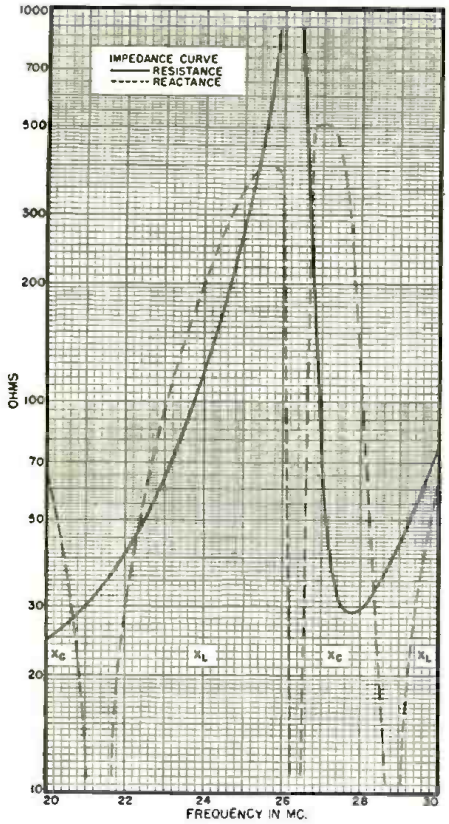


Fig. 6. Impedance tests made between 10 and 15 meters. Other bands can be used.

in a ground plane. The next step is to insert the center conductor and resonate the choke. When the coaxial choke is resonant, the impedance at the base of the antenna will be the same as it was prior to insertion of the center conductor. As mentioned before, the length of the quarter wave line is fixed at .23 wavelength and it will therefore be necessary to reduce the wave velocity inside the coaxial choke to produce resonance at the same frequency. The wave velocity in a coaxial choke is determined by the insulation dielectric constant between the inner and outer conductors. In the case of lines with air insulation, the distance corresponding to the wavelength will be only slightly less than the wavelength of a radio wave of the same frequency traveling in space. With other than air insulation, the wavelength is reduced to a value equal to $1/\sqrt{e}$, where e is the dielectric constant of the insulation. For example, in computing the wave velocity for a section of RG-8U (polyethylene insulation—dielectric constant of 2.26), we obtain

$$1/\sqrt{2.26} = 1/1.5 = .667$$

velocity of propagation, which agrees with the value given for RG-8U.

It can be seen from these figures that we would not want to support the inner conductor of the coaxial choke with solid polyethylene as the propagation in the choke would be delayed excessively. It would be resonant at a much lower frequency than desired. The velocity of propagation in a coaxial line where the inner conductor is held in position by beads or dielectric washers, will fall somewhere between free space velocity and the wave velocity obtained with a line completely filled with the dielectric material. This is desirable since it is necessary to support the center conductor and also reduce the velocity of propagation to 92% (4 x .23, the dimension of the outer conductor).

The effect of the dielectric spacers can be obtained by computing the average dielectric constant in the line as shown in Fig. 3. Since the desired wave velocity is known (92%) we can compute the average dielectric constant necessary to produce such a velocity. It is desirable to be able to vary the wave velocity, therefore the line was designed for a slightly higher velocity and the large top spacer used to reduce it to the exact value. 93.5% was chosen and is obtained with an average dielectric constant of $(1/.935)^2 = 1.143$. A spacer width of 1.0" was selected and with the aid of the formula shown in Fig. 3, the necessary spacing of the dielectric material was secured.

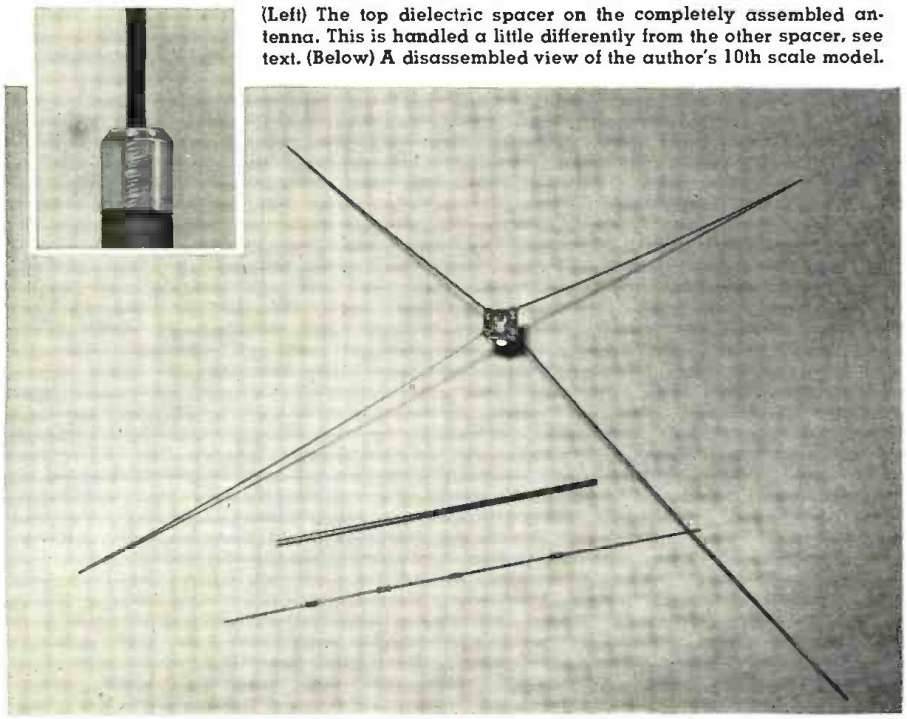
Two antennas were constructed using the coaxial choke utilizing different types of spacers. One made use of an "Alsimag" bead which has a dielectric constant of 6.00 and the other of polystyrene spacers which have a dielectric constant of 2.56. The "Alsimag" beads were made for ⅞-inch transmission line using an inner conductor of .25 inch. Data obtained from the manufacturer indicated that 6 inch spacing of the beads would produce a wave velocity of 93.5% which is quite close to the desired velocity. The velocity was further reduced by means of a polystyrene plug inserted, to various depths, into the top of the coaxial choke. As mentioned previously, the impedance of the antenna was measured on 10 meters prior to inserting the center conductor. After the center conductor was inserted (along with the spacers) the polystyrene plug was positioned above the coaxial choke and the depth of insertion increased until the impedance of the antenna returned to the proper value, the impedance obtained prior to insertion of the center conductor.

The frequency of measurement was then adjusted to the middle of the 15-meter band and the top portion of the center conductor adjusted to resonate the over-all length of the antenna. After this was done, a complete set of impedance measurements was made between 10 and 15 meters; these are shown in the graph of Fig. 6.

The second antenna, one tenth the size of the first, was constructed to check other dielectric materials in the choke and to make radiation patterns of the antenna system. The one-tenth scale model was tuned exactly as described by insertion of the top spacer until the impedance returned to its normal value. The spacers are made of polystyrene ($e = 2.56$). Patterns taken with the model indicate free space operation of the system, that is, the stub and ground plane are remote from ground.

There are a number of combinations of lengths that may be used to make an antenna system that will operate on several other bands. For instance, the coaxial choke can be operated on 10 meters and the length of the inner conductor can be extended to resonate on 20 meters. Additional combinations could be used, namely extending the choke for 20 meters and the center section for 40-meter operation. The idea may also be applied to the higher frequencies, such as the 2- and 6-meter bands.

(Left) The top dielectric spacer on the completely assembled antenna. This is handled a little differently from the other spacer, see text. (Below) A disassembled view of the author's 10th scale model.



REFERENCE

1. "Multi-Frequency Tuned Antenna System," Electronics, August 1940.

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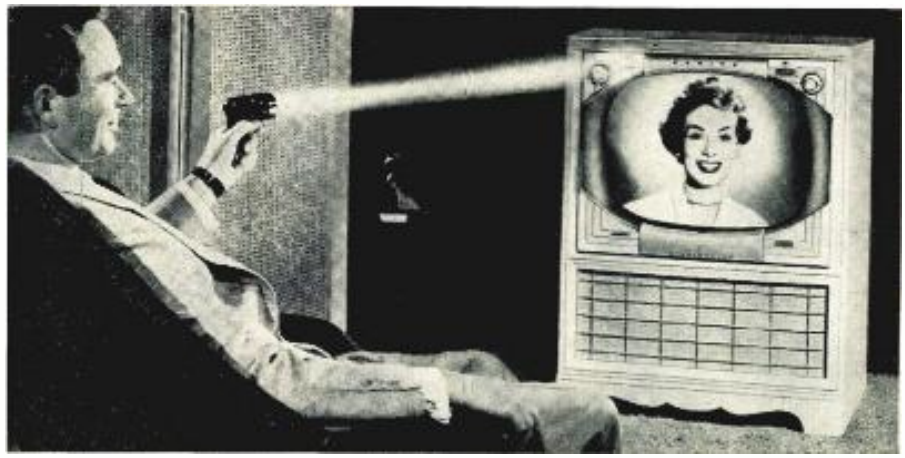


The light beam from the "flash gun" of the viewer is shown aimed at the counter-clockwise channel selector of the new Zenith "Flash-matic" remote control TV set.

Flash Beam—new addition to Zenith's TV Line

Here is a new idea in remote control for TV receivers, using a light beam for tuning and for power switching.

ZENITH RADIO CORPORATION has announced and demonstrated a television set that uses a flash beam from a small pistol-shaped device to turn a television set on or off, change channels, or cut out the sound of long-winded commercials.

The ray does all the work; no dangling wires or connecting cords are required. All the viewer has to do is beam the ray across the room at a small window on each of the corners of the set. A light beam shining on the lower left-hand corner will turn the set off. Channels are switched through the upper two windows; the one in the left corner selects the channels in a counter-clockwise direction; the upper right corner window changes channels clockwise. A beam striking the lower right hand window effectively cuts out commercials. Another touch of the flash gun brings the sound on again when the commercial is finished and the program returns.

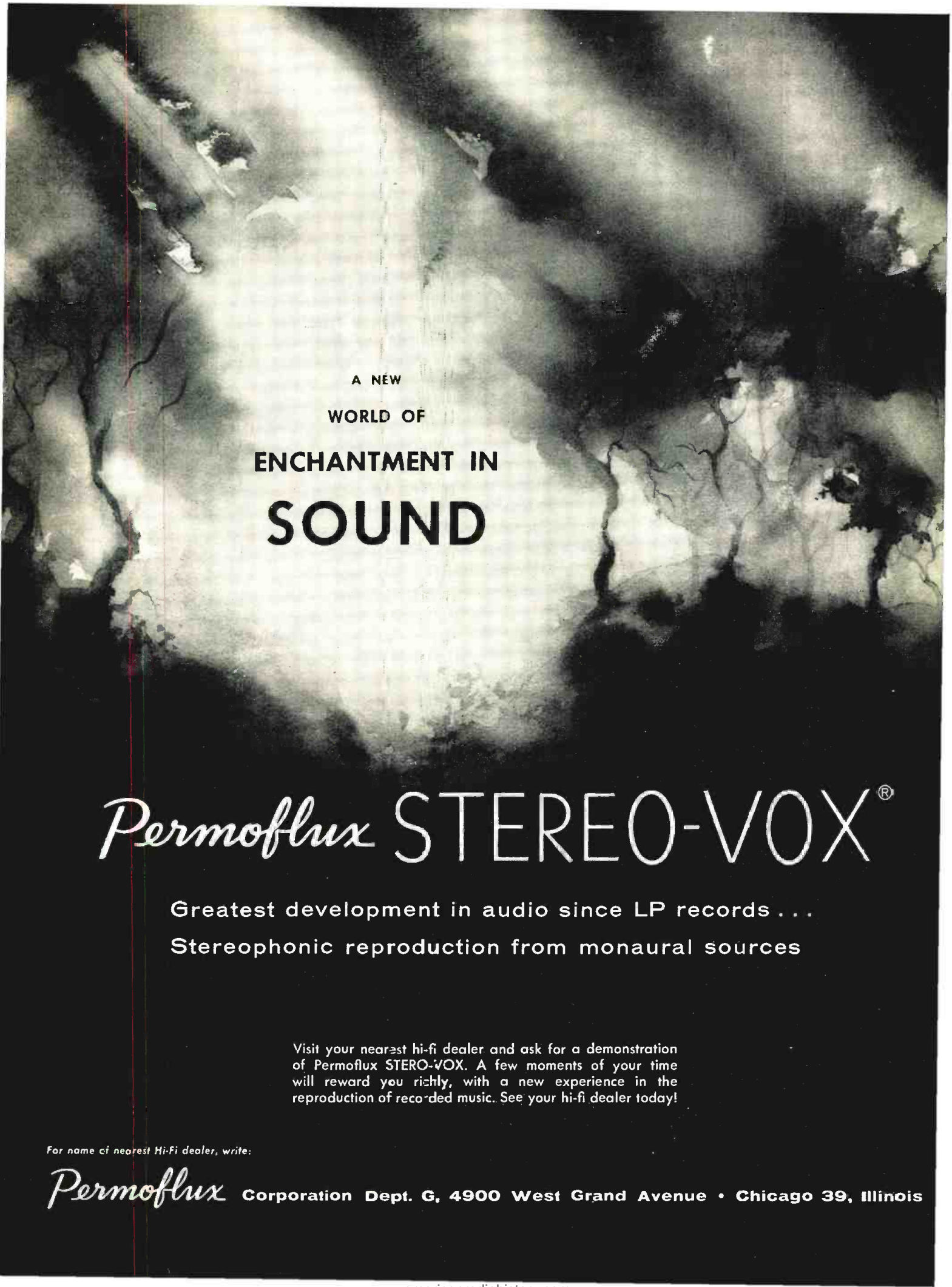
Activators in the circuit are four cadmium-sulfide photocells. These are semiconductors that are extremely sensitive to light and respond by producing wide changes in their internal resistance. With no light, a photocell may have as high as 100 megohms resistance; when strongly energized by light, the resistance may drop to as low as 25,000 ohms.

Each cell is connected in the grid circuit of a special control tube. One cell triggers a 2D21 thyratron tube and the current flowing in the plate circuit will activate a solenoid that turns the power input to the receiver on or off. A second photocell triggers another thyratron and its plate circuit solenoid mutes the sound from the speaker. The remaining two photocells operate separate triode sections of a 6BX7GT tube. Individual plate circuit relays control the 117 volts a.c. applied to a tuner motor for clockwise or counter-clockwise rotation.

In each instance, the photocell, through its resistance changes, controls the grid bias on its associated tube. High resistance means cut-off bias; low resistance permits the tube to conduct. In the case of the two thyratrons, each tube would continue to conduct until the plate voltage was removed or made negative and the grid was returned to cut-off. However, the plate voltage is a.c. and the tube will stop conducting every time the a.c. swings negative.

Light level adjustments are made when a set is installed in the home. Adjustments must be below the point where the room light will actuate the unit. In some cases bright room light, or sunshine entering the room, may cause erratic operation. To prevent this, it may be necessary to darken the room. If it is desired to operate a set in the conventional manner, the photocell system can be inactivated by a back panel switch.

Incidentally, there is nothing mysterious about the flash gun furnished with the receiver. Any good household flashlight can be used if the brightness and focus are OK. —30—



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By JOHN T. FRYE

SOME OFF-TRAIL INTERESTS

MAC stood in the front door of the service shop, his face wearing a look of puzzled amazement as he looked blankly at the office girl, Miss Perkins. From behind the closed door of the service department there issued a bellowing sound that was half voice-tone and half screeching whistle. It was going "Whooooo whooooo whoo-whooooo" in a very good imitation of the whistle of a steam locomotive.

In reply to Mac's questioning look Miss Perkins twirled a forefinger significantly in the vicinity of her right temple. "He's been carrying on like that for the past ten minutes," she announced.

Mac walked across the room and cautiously pushed open the service department door with his foot. Inside, his assistant, Barney, was revealed standing in the middle of the floor with his lips tightly pursed in front of the microphone held in his hand. The mike was plugged into the shop's portable p.a. system; and a large horn-type speaker connected to the amplifier was set up directly in front of the screen of a large console TV set.

Taking all this in at a glance, Mac immediately began to move his right arm back and forth in a rhythmic motion while he moved forward on shuffling feet, saying all the while, "Chuga-chuga-chuga-chuga-chuga." Still carried along by this peculiar gait, he described a small circle and then backed up to Barney, who was watching the actions of his employer with pop-eyed amazement.

"I know you're the *Wabash* 'Cannon Ball'," Mac said soothingly; "and I'm a *Pennsylvania* J-1 locomotive. I've just received orders for us to double-head to push a coal train over the hump; so couple up and let's get going."

"You flipped your lid?" Barney demanded. "Don't you think we're a little old to be playing train—especially you?"

"*I* have flipped *my lid!*" Mac exclaimed indignantly. "Who's been making like a train whistle for the past ten minutes? I was just trying to humor you and coax you outside so we could throw the net over you."

"Oh *that*," Barney dismissed the subject with a nonchalant wave of his hand. "It has a perfectly logical explanation. Last night I was talking to George Harmony who does servicing for *TV Sales & Service* on Market Street. He was telling me an interesting thing. You know the safety shield in front of the picture tube on the sets they handle is made of a special glass that breaks into smooth-edged pieces when fractured. Possibly you recall that Tucker intended to make the windshield of his car out of this stuff. Anyway, George reports that in the past few months they have had seven of these shields mysteriously disintegrate for no apparent reason whatever. Last week, though, a man came in with a possible clue. He was watching his set when suddenly a locomotive—he lives close to the tracks—gave out with a piercing whistle. Right while he was watching, a bunch of cracks fanned out across the shield and then it slithered down on to the rug in the form of a couple of handfuls of little round glass pebbles. What's more, three of the other shield failures were in houses not more than half a block from railroad tracks!"

"So?" Mac questioned, pretending to be unimpressed.

"So we're convinced these shields that are moulded in a curved form shatter when the train whistle vibrates them at their resonant frequency. In the cases where the sets were not near the tracks, possibly just the right note from the speaker did the business for the shields. I was experimenting to see if I could whistle the right note into the mike and cause the shield on that TV set—it is the make *TV Sales & Service* sells—to fracture."

"Well you fracture me!" Mac exclaimed grimly. "Just what were you going to tell the owner of that set if you were successful?"

"Holy cow! I never thought of that," Barney admitted with a crestfallen air. "I was so interested in seeing if I could break the glass with a sound of the right pitch that I never thought of anything else. Even though the manufacturer has replaced the shields at no charge, it would still take some time to get a new one. Maybe it's a good thing I wasn't successful."

"Maybe you're right," Mac said darkly.

"Hey, Mac," Barney said brightly, eager to change the subject, "I see you got out that TV set the boy built up from a kit. Was it as tough as you thought it was going to be?"

"Just about as I figured it. You remember I refused to take the set at first. I knew it would be altogether different from an ordinary service job. When the usual set comes in for repair you can safely assume it was properly wired and working satisfactorily when it left the factory and that its present trouble is caused by a component or wiring failure. In this kit set, though, you could not assume anything like that. Wires might be improperly connected; components might be in the wrong places; bad parts might have been unknowingly wired in.

"I felt that charging the boy at our regular rates for this kind of a job might make it tough on him and that possibly he could get a part-time technician with a lot of time and no overhead to take on the job more reasonably. He didn't do this, however. Instead he took it to one of the best-known shops in town. They kept the set for a month and then told him it was hopeless. They reported it would not align properly, that there were some spurious pips on the display of the sync signals, and that the sync circuits were improperly designed. The only way the set could be made to work, they reported, would be to make drastic changes in the circuit and the layout of the receiver.

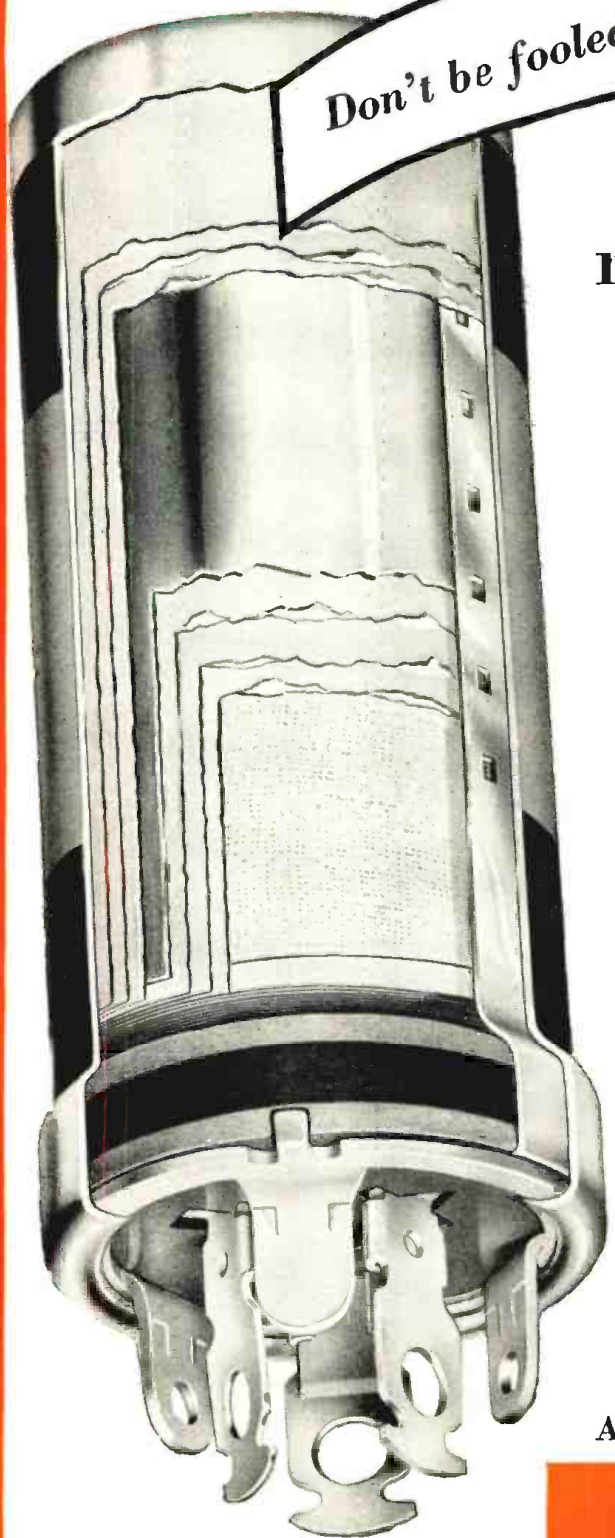
"When he hit me up again to take it on, I didn't have the heart to refuse. I felt sorry for the kid, who was getting pretty desperate. He was taking a radio and TV course, and his father felt the boy should know all there was to know about television right away. The boy had put together a v.t.v.m. kit with good success and had mistakenly concluded assembling a TV receiver kit would be just as easy. On the boy's recommendation, the father had bought the kit—and it was no small sum, for the set is a thirty-tube job with all the trimmings—and now he was making life miserable for the lad. I was confident in my own mind that the kit was properly engineered, for the people who make it have a good reputation."

"It was a darned neat job of wiring," Barney observed.

"You're right. When I aligned the i.f. circuit, I could not see a thing wrong, for the proper curve came out exceptionally well on the scope. There was, though, absolutely no sync control of the picture, which ran both vertically and horizontally. While both oscillators were apparently free-running, they responded easily to the action of the vertical and horizontal hold

(*Continued on page* 174)

Don't be fooled by OUTSIDE similarity . . .



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There are other features, too . . . and many you can't see, such as the hospital-like sanitation maintained in the Mallory plant to guard against impurities which could shorten capacitor life. Add all these up, and you'll appreciate why FP capacitors are the *standard of performance* for replacement and for use in original equipment.

Order your stock of FP capacitors today, from your nearby Mallory distributor. They lead the field, yet cost no more.

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New Bendix TV Circuit

THE new *Bendix* T19 chassis contains an interesting circuit design called the "Picture Pulse Pilot." In this circuit, a dual-purpose miniature tube combines the functions of an a.g.c.-controlled i.f. amplifier and a triode sync separator without performance degradation of either function.

In the past, because of the pin limitations of existing tubes, a pentode-triode employed either a cathode common to both sections or an internal connection between the suppressor grid and cathode in the pentode section.

To overcome the inherent limitations by either of these connections, *Bendix,* with the cooperation of the *Sylvania Electric Products Inc.,* developed the 5BE8 pentode-triode. (Patent application for this concept has been made.) In the 5BE8, the suppressor grid of the pentode is tied internally to the cathode of the triode section.

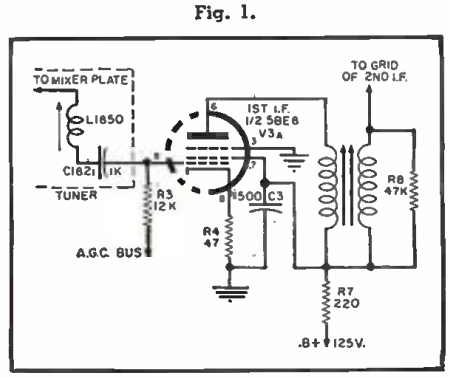
In Fig. 1, V_{3A} is the 1st video i.f. amplifier with a.g.c. applied to its grid. To compensate for changes in input loading and capacity with plate current, the unbypassed resistor, R_4, is used in series with the V_{3A} cathode. If the suppressor grid were tied to the cathode, undesired feedback would result from a.c. voltage on this grid.

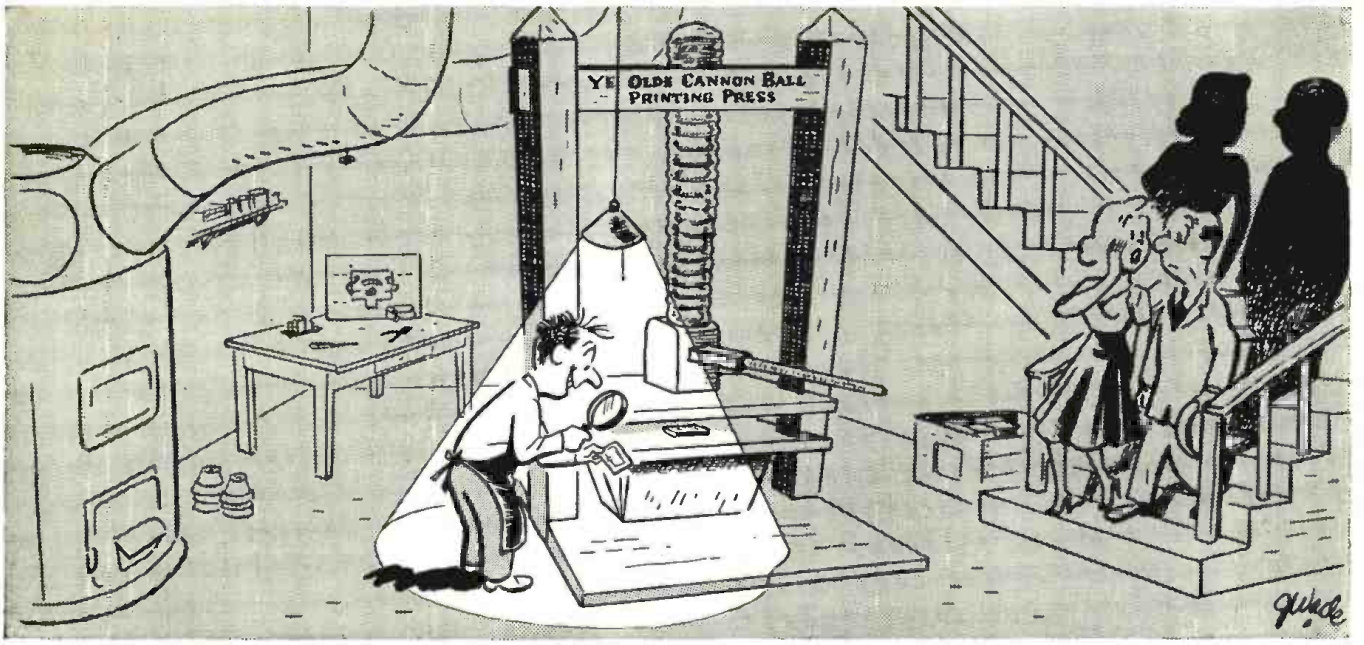
In the 5BE8, however, the suppressor is tied internally to the *triode* cathode. In the circuit, the sync separator application of the triode section calls for a grounded cathode. Therefore, the pentode suppressor grid is also grounded and the feedback effects are avoided.

The remainder of the i.f. circuitry associated with V_{3A} is conventional. A series-tuned coupling coil, L_{1850}, is used between the mixer plate and first i.f. grid to minimize oscillator signal coupling to the grid. R_3 is the grid loading resistor whose value is selected to give the desired circuit bandwidth. The output tuned circuit is a bifilar wound coil. R_5 serves as the loading resistor for the output circuit.

The circuitry associated with V_{3B} performs the function of separating the synchronizing information from the composite video signal. (See Fig. 2). The composite signal is coupled from the video amplifier plate to the grid of

Fig. 1.





"Fred's really gone on those printed circuits!"

You'd have to look hard and long to find anything that even faintly resembles the satisfaction and money-saving that can be yours with a "Surprise" Trade-In allowance on used (factory-built) test and communication equipment. Put us to the test. Get your trade-in deal working today. Wire, write, phone or use handy coupon below.

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AMECO LOW PASS FILTERS

Supresses radiation of all frequencies above 40 MC, thereby removing a major cause of TVI. Uses constant K circuit, designed for use with 52 to 72 ohm coaxial cable. Will handle up to 200 watts of RF power. Complete with bracket, RCA type phono connectors and instructions.

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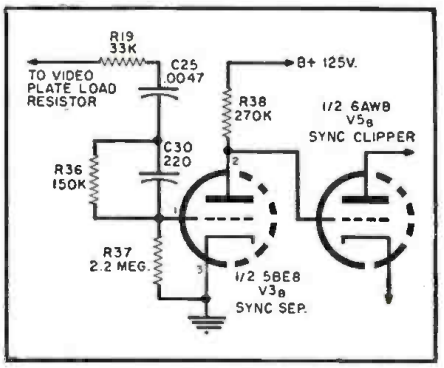


Fig. 2.

V_{3B} through R_{19}, C_{25}, R_{36}, and C_{30}. C_{30} and R_{36} provide an additional time constant to obtain a high degree of sync circuit immunity against impulse noise. The plate of V_{3B} is directly connected to the grid of the sync clipper. As a result of this, the grid loading of V_{5B} provides a lower d.c. plate voltage on V_{3B} to clip the sync more effectively in the plate circuit. In addition, the parallel impedance of R_{38} with the grid loading of V_{5B} is chosen to give the desired circuit bandwidth. —30—

SOLAR BATTERY USE

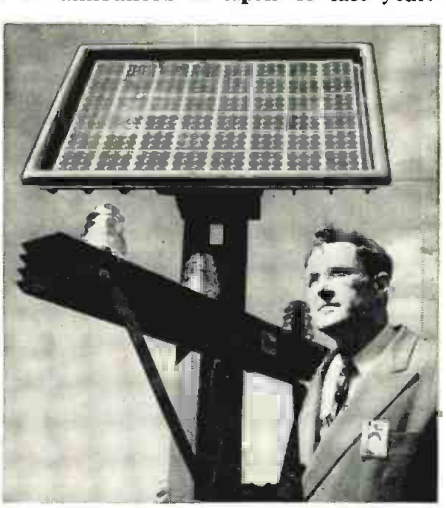
AN EXPERIMENTAL solar battery is being tested by Bell Telephone Laboratories at Americus, Georgia as a source of power for the terminal equipment on rural telephone lines.

The heart of the solar battery, shown below, is the specially prepared silicon disc which converts sunlight into electricity. The model shown contains 432 discs, arranged in 48 units of 9 discs each.

During daylight hours the solar battery is used to power the terminal equipment directly while, at the same time, it charges a storage battery for the nighttime operation of the equipment or for periods of lowered sun intensity.

Flexible features of the mounting allow the face of the solar battery to be tilted to the most favorable angle for maximum sun exposure in any latitude.

The Bell solar battery, the first successful device to convert sunlight directly and efficiently into useful amounts of electricity, was invented by a three-man team of Bell Labs' scientists and was first announced in April of last year.



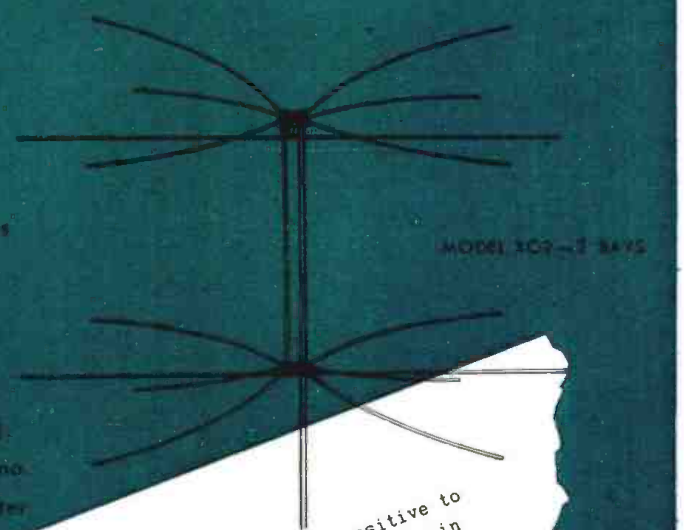
EXPO

Have you ever seen or heard of the Exponential Antenna? You have not, for until now it was unknown to the engineering world.

WHAT IS EXPO?

EXPO, the exponential antenna, represents an historical technical advance that eliminates the crippling frequency limitations of all known antennas by the use of exponentially curved elements.

The ultimate in antenna design! One antenna for all 82 channels with gain progressively increasing with increase of frequency. This principle, recently discovered* is the basic answer to the limited bandwidth problem. There is no need for multiple antenna installations or other expedients to gain slightly wider bandwidth operation.



Here is an antenna that is insensitive to frequency variations -- except that gain increases as you go higher in the spectrum, reaching astounding gains in the upper VHF and throughout the UHF regions. Where wide bandwidth operation is necessary as in T.V., EXPO ushers in a new era in antenna design, wiping out the frequency restrictions of straight element antennas.

EXPO comes in 1, 2 and 4 bays in the standard and deluxe models. The standard models use a single parasitic reflector while the deluxe models employ a screen-type reflector for areas in which the ultimate in back attenuation and increased forward gain is desired.

Higher gains
– one antenna
– one transmission line
– one installation.
That is EXPO.

Servicemen will appreciate the ease and speed of installing EXPO: occupies less space — pleasing appearance — supreme performance. Its performance sells it for you.

Will you be among the first to see it perform? Consult your distributor, or for further information, write:

HOLLOWAY ELECTRONICS CORP.
Fort Lauderdale, Florida

*Patent applied for.

Within the Industry

(*Continued from page 36*)

handle the sale of its resistors on a nationwide basis. The new firm, **WELWYN INTERNATIONAL, INC.** has offices at 3355 Edgecliff Terrace, Cleveland 11, Ohio . . . **CONSOLIDATED DIESEL ELECTRIC CORP.** of Stamford, Conn. has acquired control of **INSTRUMENTS FOR SERVICE, INC.** of Freeport, Long Island. It will be operated as a separate corporation by the parent firm.

* * *

L. M. BURCHETT has been named manager of *Allied Radio Corporation's* stores in the Chicago area. He was formerly personnel training director of the company.

He will take over supervision of the Chicago store sales in *Allied's* new modern building at 100 N. Western Avenue, and also of the new store for the sale and demonstration of high-fidelity equipment at 602 Davis Street in Evanston.

Before joining *Allied,* Mr. Burchett was associated with the *R. H. Macy Company* in Kansas City, Missouri.

* * *

JERROLD ELECTRONICS CORPORATION has broken ground for a new engineering laboratory which will be built on a six acre plot at Byberry Road and the Pennsylvania Turnpike just outside Philadelphia. The lab will be a one-story cinder block building of about 5700 square feet. It is expected to be completed some time this fall . . . **JAMES VIBRAPOWR CO.** is building a new one-story factory building at 4060 N. Rockwell Street in Chicago which will triple its present manufacturing space . . . **BAUME ELECTRONIC SALES CO.** has moved into new and larger quarters at 44 Cranberry Lane, Bethpage, Long Island, New York . . . **MOTOROLA INC.** has broken ground for a new one and one-half million dollar transistor manufacturing facility in Phoenix, Arizona. The entire building will be devoted to the research, development, and production of transistors and other semi-conductor devices . . . **ASTRON CORPORATION** is adding 20,000 square feet of manufacturing space to its plant at 255 Grant Avenue, East Newark, New Jersey . . . **POLYTRONIC RESEARCH, INC.** has moved from Wheaton, Maryland into a new building at 7660 Woodbury Drive, Silver Spring, Md. . . . **WESTINGHOUSE ELECTRIC CORPORATION** is building a new multi-million dollar plant at Youngwood, Pa. Completion is planned for the end of 1956. The new "automatic" facility will employ between 400 and 500 persons and will be devoted to the manufacture of semiconductor devices of all types . . . The radio division of **BENDIX AVIATION CORPORATION** is building a new $2,000,000 engineering laboratory at Towson, Maryland. It will be completed by July of next year . . . **LAMBDA ELECTRONICS CORP.** has opened a new plant at 11-11 131 Street, College Point 56, N. Y. which will be devoted to the manufacture of regulated and unregulated d.c. power supplies . . . **TECHNICAL APPLIANCE CORPORATION** has made a fourth addition to its plant at Sherburne, N. Y. The company now has 70,000 square feet of manufacturing space on a single floor for the fabrication of its line of antennas . . . **NIAGARA-CONCORD CORP.** has acquired two large buildings at 45 and 47 Warren Street in New York City. The buildings will give **CONCORD** 35,000 square feet of sales, office, and warehouse space. In addition, a new store will be constructed in the same location . . . Two subsidiary offices of the **RADIO-ELECTRONICS-TELEVISION MANUFACTURERS ASSOCIATION** have moved to new locations. The West Coast office is now located in the Hollywood Professional Building at 7046 Hollywood Blvd., Hollywood 28, California, while the Statistical Department has been moved to the Sheraton Bldg., 711 14th Street, N.W., in Washington, D. C. . . . **LINK RADIO CORP.** has acquired a new, modern plant at 110 Jericho Turnpike, New Hyde Park, New York with all engineering, manufacturing, and testing facilities located on one floor. The executive offices will be located on the second floor of the two-story building.

* * *

PETER JANIS is the new chief engineer of *Amperex Electronic Corporation* of Hicksville, Long Island, N. Y.

He joined the company from *Sylvania Electric Products Inc.* where he was active in the early war development of klystrons, hydrogen thyratrons, magnetrons, and photosensitive devices. Later he was in charge of microwave and special purpose tube development activities and more recently was involved in the design, development, and production of traveling-wave tubes of various types.

Prior to his connection with *Sylvania,* he worked at *RCA* on the development of special purpose tubes. He is a senior member of the IRE and a registered professional engineer.

* * *

THE SIXTH NATIONAL CONFERENCE ON STANDARDS will be held October 24-26 in Washington, D. C. at the Sheraton-Park Hotel.

The National Bureau of Standards and the American Standards Association are co-sponsoring the event. The Program Committee, under the chairmanship of Dr. A. T. McPherson, associate director of NBS, has assembled a group of outstanding speakers who will focus on the conference theme of cooperation between industries and government departments and agencies in the field of standardization. —30—

Heathkits

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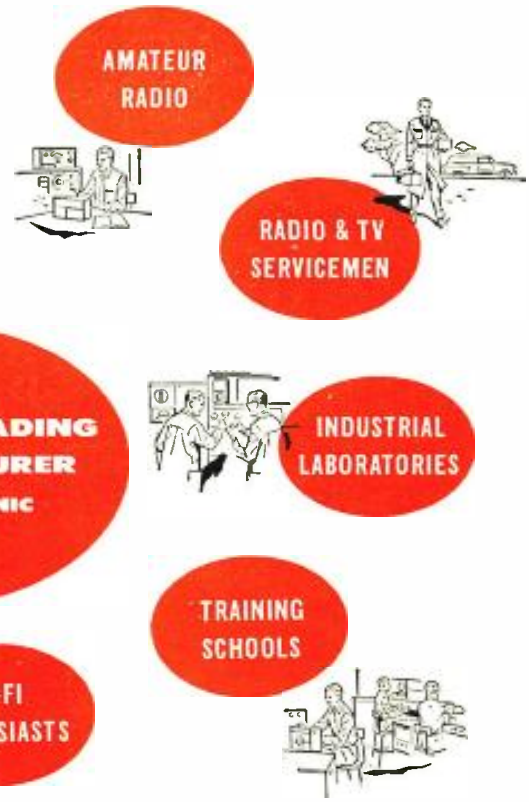
more than 65 top-quality models to choose from, including such outstanding kit designs as . . . .



V-7A VACUUM TUBE VOLTMETER: Easily the world's largest selling VTVM. Features peak-to-peak scales—etched metal circuit board—1% precision resistors—full wave rectifier and AC input circuit—reads rms and peak-to-peak AC, DC, and ohms.

O-10 LABORATORY TYPE OSCILLOSCOPE: The world's largest selling oscilloscope kit, and the most successful oscilloscope in history. Designed especially for color and black-and-white TV service work. Its 5 megacycle bandwidth and new 500 Kc sweep generator readily qualify it for laboratory applications. Features easy-to-assemble etched metal circuit board construction.

WA-P2 HIGH FIDELITY PREAMPLIFIER: This is the world's largest selling hi fi preamplifier kit. Features complete equalization, 5 separate switch-selected inputs with individual pre-set level controls, beautiful modern appearance, high-quality components.

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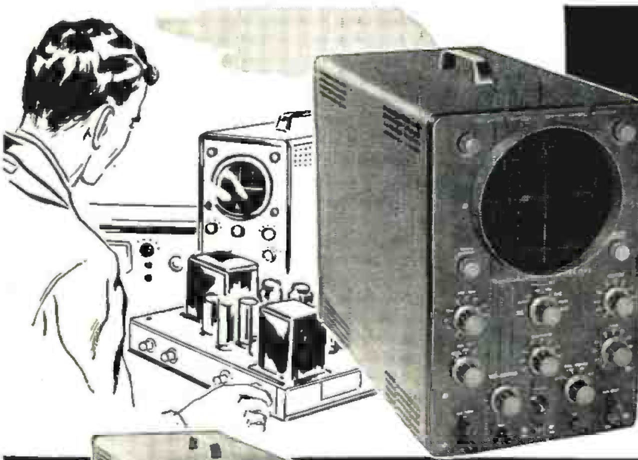

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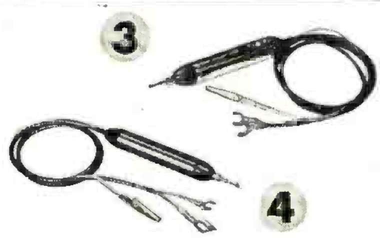

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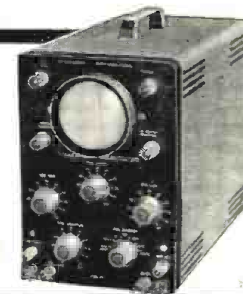

❶ *Heathkit* ETCHED CIRCUIT COLOR-TV 5″ OSCILLOSCOPE KIT

This deluxe quality oscilloscope has proven itself through thousands of operating hours in service shops and laboratories. Features the best in components—and the best in circuit design.

Features amplifier response to 5 Mc for color TV work, and employs the radically new sweep circuit to provide stable operation up to 500,000 cps. In addition, etched metal, pre-wired circuit boards cut assembly time almost in half, and permit a level of circuit stability never before achieved in an oscilloscope of this type.

Vertical amplifiers flat within +2 db −5 db from 2 cps to 5 Mc, down only 1½ db at 3.58 Mc. Vertical sensitivity is 0.025 volts, (rms) per inch at 1 Kc. 11 tube circuit employs a 5UP1 CRT.

Plastic molded capacitors used for coupling and bypass—preformed and cabled wiring harness provided.

Features built-in peak-to-peak calibrating source—retrace blanking amplifier—push-pull amplifiers and step-attenuated input.

MODEL O-10
$69.50
Shpg. Wt. 21 Lbs.

❷ *Heathkit* ETCHED CIRCUIT 5″ OSCILLOSCOPE KIT

This is a general purpose oscilloscope for the more usual applications in the service shop or lab, yet is comparable to scopes costing many dollars more.

Features full size 5″ CRT (5BP1), built-in peak-to-peak voltage calibration—3 step input attenuator—phasing control—push-pull deflection amplifiers—and etched metal pre-wired circuit boards.

Vertical channel flat within ±3 db from 2 cps to 200 Kc, with 0.09 V. rms/inch, peak-to-peak sensitivity at 1 Kc. Sweep circuit from 20 cps to 100,000 cps. A scope you will be proud to own and use.

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$49.50
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❸ *Heathkit* LOW CAPACITY PROBE KIT

Scope investigation of circuits encountered in TV requires the use of special low capacity probe to prevent loss of gain, circuit loading, or distortion. This probe features a variable capacitor to provide correct instrument impedance matching. Also the ratio of attenuation can be controlled.

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❹ *Heathkit* ETCHED CIRCUIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your Oscilloscope by observing modulation envelope of R.F. or I.F. carriers found in TV and radio receivers. Functions like AM detector to pass only modulation of signal and not signal itself. Applied voltage limits are 30 V. RMS and 500 V. DC.

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$3.50
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❺ *Heathkit* ETCHED CIRCUIT 3″ OSCILLOSCOPE KIT

This compact little oscilloscope measures only 9½″ H. x 6½″ W. x 11¾″ D., and weighs only 11 lbs! Easily employed for home service calls, for work in the field or is just the ticket for use in the ham shack or home workshop. Incorporates many of the features of the Model OM-1, but yet is smaller in physical size for portability.

Employing etched circuit boards, the Model OL-1 features vertical response within ± 3 db from 2 cps to 200 Kc. Vertical sensitivity is 0.25 V. RMS/inch peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for r.f. connection to deflection plates for modulation monitoring, and incorporates many features not expected at this price level. 8-tube circuit features a type 3GP1 Cathode Ray Tube.

MODEL OL-1
$29.50
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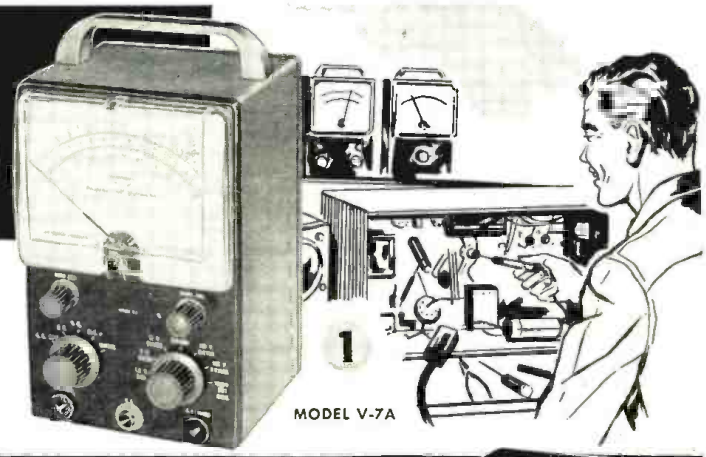
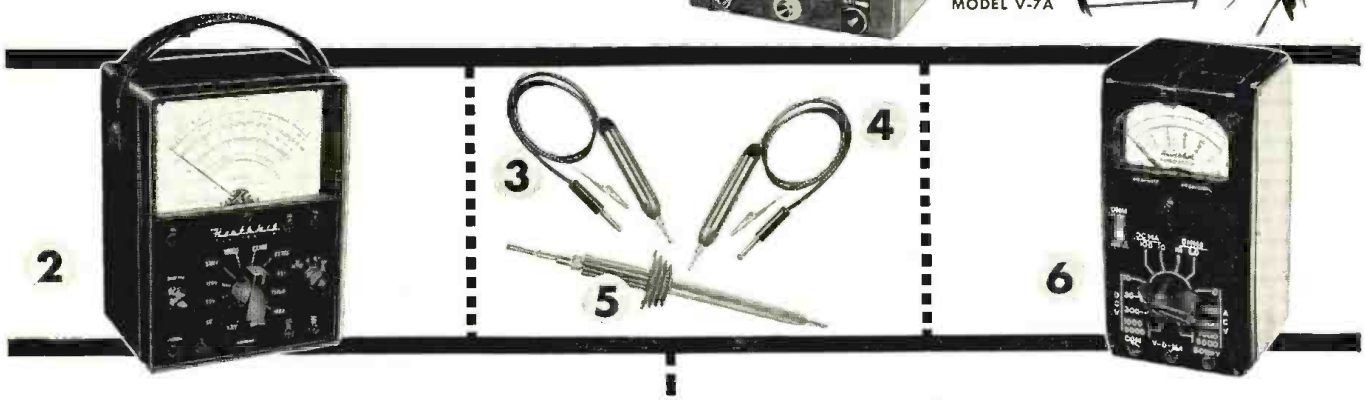


DESIGNED FOR YOU: *Heath Company test equipment is designed for the maximum in convenience. Besides being functional, Heathkits represent the very latest in modern physical appearance, and incorporate all the latest circuit design features for comprehensive test coverage.*



1 *Heathkit* ETCHED CIRCUIT VACUUM TUBE VOLTMETER KIT

Besides measuring AC (rms), DC and resistance, the modern-design V-7A incorporates peak-to-peak measurement for FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, and 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Also a db scale is provided. A polarity reversing switch provided for DC measurements, and zero center operation within range of front panel controls. Employs a 200 μa meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit board for fast, easy assembly and reliable operation is 50% thicker for more rugged physical construction. 1% precision resistors for utmost accuracy.

MODEL V-7A
$24.50
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2 *Heathkit* 20,000 OHMS/VOLT MULTIMETER KIT

The MM-1 is a portable instrument for outside servicing, for field testing, or for quick portability in the service shop. Combines attractive physical appearance with functional design. 20,000 ohms/v. DC, and 5000 ohms/v. AC. AC and DC voltage ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts. Direct current ranges are 0-150 μa., 15 ma., 150 ma., 500 ma., and 15 amperes. Resistance ranges are X1, X100, X10,000 providing center scale readings of 15, 1500 and 150,000 ohms. DB ranges cover −10 db to +65 db.

Features a 4½" 50 μa. meter. Provides polarity reversal on DC measurements. 1% precision resistors used in multiplier circuits. Not affected by RF fields.

MODEL MM-1
$29.50
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3 *Heathkit* ETCHED CIRCUIT RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 Mc with ± 10% accuracy. Uses etched circuits for increased circuit stability and ease of assembly.

NO. 309-C
$3.50
Shpg. Wt. 1 Lb.

4 *Heathkit* ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scale of any 11 megohm VTVM with this new probe, employing etched circuit for stability and low loss. Readings made directly from VTVM scales, from 5 Kc to 5 Mc. Not required for Heathkit Model V-7A VTVM.

NO. 338-C
$5.50
Shpg. Wt. 2 Lbs.

5 *Heathkit* 30,000 VOLT D.C. HIGH VOLTAGE PROBE KIT

For TV service work or similar application for measurement of high DC voltage. Precision multiplier resistor mounted inside plastic probe. Multiplication factor of 100 on the ranges of Heathkit 11 megohm VTVM.

NO. 336
$4.50
Shpg. Wt. 2 Lbs.

6 *Heathkit* HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Measures direct current at 0-10 ma. and 0-100 ma. Provides ohmmeter ranges of 0-3000 (30 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Features a 400 μa. meter for sensitivity of 1000 ohms/volt. Because of its size, the M-1 is a very handy portable instrument that will fit in your coat pocket, tool box, glove compartment, or desk drawer. Makes a fine standby unit in the service shop when the main instruments are in use, or is ideal for the hobbyist or beginner. An unusual dollar value.

MODEL M-1
$14.50
Shpg. Wt. 3 Lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

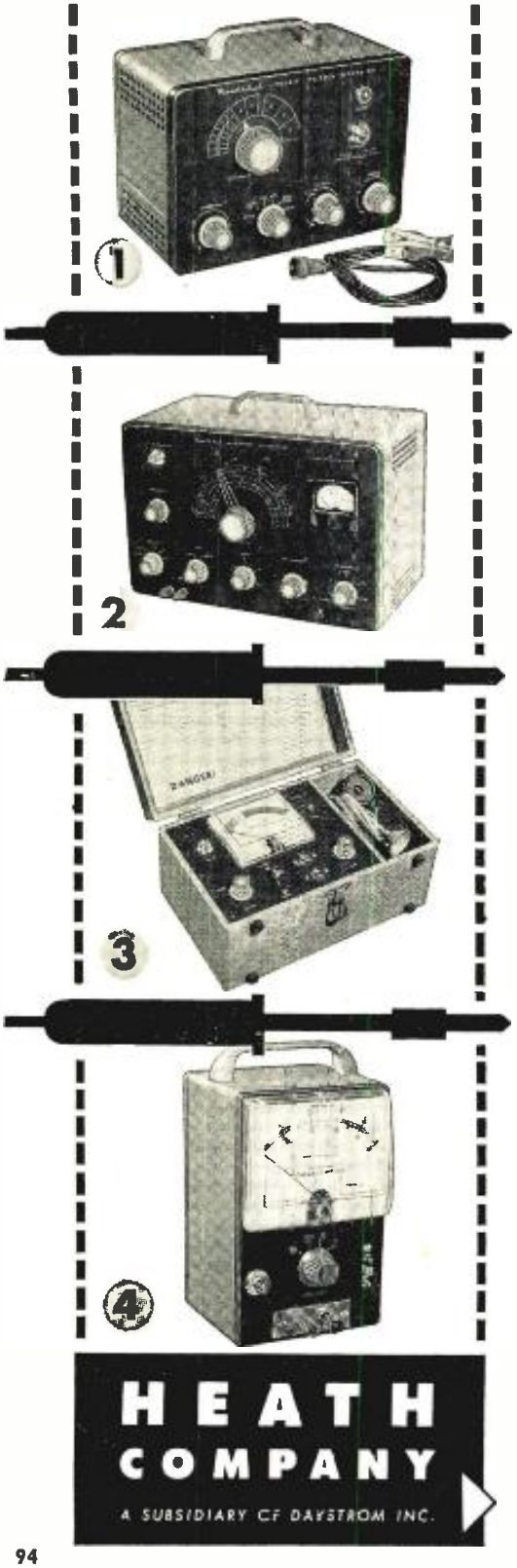
Heathkit TV ALIGNMENT GENERATOR KIT

The Model TS-4 features a controllable inductor for all-electronic sweep, improved oscillator and automatic gain circuitry, high RF output, center sweep operation, and improved linearity. It sets a new high standard for sweep generator operation, and is absolutely essential for the up-to-date service shop doing FM, black-and-white TV, and color TV work.

Voltage regulation and effective AGC action insure flat output over a wide frequency range. Electronic sweep insures complete absence of mechanical vibration. Sweep deviation controllable from 0 up to 40 Mc, depending upon base frequency. Effective two-way blanking.

Fundamental output from 3.6 Mc to 220 Mc in 4 bands. Crystal marker provides markers at 4.5 Mc and multiples thereof. Crystal included with kit. Variable marker covers from 19 Mc to 60 Mc on fundamentals, and up to 180 Mc on harmonics. Provision for external marker.

MODEL TS-4
$49.50
Shpg. Wt. 16 Lbs.



1 Heathkit LINEARITY PATTERN GENERATOR KIT

The new-design Model LP-1 produces vertical or horizontal bar patterns, a cross-hatch pattern, or white dots on the screen of the TV set under test. No internal connections required. Special clip is attached to the TV antenna terminals. Instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern presentation is a *must* for color convergence adjustments on color TV sets.

Extended operating range covers all television channels from 2 to 13. Produces 6 to 12 vertical bars or 4 to 7 horizontal bars.

MODEL LP-1
$22.50
Shpg. Wt. 7 Lbs.

2 Heathkit LABORATORY GENERATOR KIT

The Heathkit Model LG-1 Laboratory Generator is a high-accuracy signal source for applications where metered performance is essential It covers from 100 Kc to 30 Mc on fundamentals in 5 bands. Modulation is at 400 cycles, and modulation is variable from 0-50%. RF output from 100,000 μv. to 1 μv. 200 μa. meter reads the RF output in microvolts, or percentage of modulation. Fixed step and variable output attenuation provided.

Features voltage regulation, and double copper plated shielding for stability. Provision for external modulation. Coaxial output cable (50 ohms).

MODEL LG-1
$39.50
Shpg. Wt. 16 Lbs.

3 Heathkit CATHODE RAY TUBE CHECKER KIT

This new-design instrument holds the key to rapid and complete picture tube testing, either in the set, on the work-bench, or in the carton. Tests for shorts, leakage, and emission. Features Shadowgraph test (a spot of light on the screen) to indicate whether the tube is capable of functioning.

The Model CC-1 tests all electromagnetic deflection picture tubes normally encountered in television servicing. Supplies all-operating voltages to the tube under test, and indicates the condition of the tube on a large "GOOD-BAD" scale. Features spring loaded test switches for operator protection.

The CC-1 is housed in an attractive portable case and is light in weight – ideal for outside service calls.

MODEL CC-1
$22.50
Shpg. Wt. 10 Lbs.

4 Heathkit DIRECT READING CAPACITY METER KIT

Not only is this instrument popular in the service shop, but it has found extensive application in industrial situations. Ideal for quality control work, production line checking, or for matching pairs.

Features direct reading linear scales from 100 mmf to .1 mfd full scale. Necessary only to connect a capacitor of unknown value to the insulated binding posts, select the correct range, and read the meter. The CM-1 is not susceptible to hand capacity, and has a residual capacity of less than 1 mmf.

MODEL CM-1
$29.50
Shpg. Wt. 7 Lbs.

HEATH COMPANY
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BENTON HARBOR 15, MICHIGAN

Heathkit SIGNAL GENERATOR KIT

MODEL SG-8 **$19.50**
Shpg. Wt. 8 Lbs.

This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument. High quality components and outstanding performance.

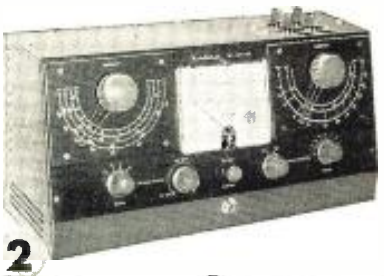
The SG-8 covers 160 Kc to 110 Mc on fundamentals in 5 bands, and calibrated harmonics extend its usefulness up to 220 Mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 uv. Output controlled by both a continuously variable and a fixed step attenuator. Also, audio output may be obtained for amplifier testing. Don't let the low price deceive you. This is a professional type service instrument to fulfill the signal source requirements in the service lab.

1 Heathkit . . . IMPEDANCE BRIDGE KIT

The IB-2 features built-in adjustable phase shift oscillator and amplifier, and has panel provisions for external generator. Measures resistance, capacitance, inductance, dissipation factors of condensers, and storage factor of inductance.

D, Q, and DQ functions combined in one control. ½% resistors and ½% silver-mica capacitors especially selected for this instrument. A 100-0-100 microammeter provides null indications. Two-section CRL dial provides 10 separate "units" with an accuracy of .5%. Fractions of units read on variable control.

MODEL IB-2
$59.50
Shpg. Wt. 12 Lbs.



2 Heathkit "Q" METER KIT

The Heathkit Model QM-1 will measure the Q of inductances and the RF resistance and distributed capacity of coils. Employs a 4½" 50 microampere meter for direct indication. Will test at frequencies of 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ± 3 mmf. Indispensible for coil winding and determining unknown condenser values. A worthwhile addition to your laboratory at an outstandingly low price. Useful for checking wave traps, chokes, peaking coils, etc. Laboratory facilities are now available to the service shop and home lab.

MODEL QM-1
$44.50
Shpg. Wt. 14 Lbs.

3 Heathkit 6–12 VOLT BATTERY ELIMINATOR KIT

This modern battery eliminator will supply 6 or 12 volt output for ordinary automobile radios as well as 12 volts for the new models in the latest model cars. Output voltage is variable from 0-8 volts DC, or 0-16 volts DC. Will deliver up to 15 amperes at 6 volts, or up to 7 amperes at 12 volts. Two 10,000 microfarad filter capacitors insure smooth DC output. Two panel meters monitor output voltage and current. Will double as a battery charger. Definitely required for automobile radio service work.

MODEL BE-4
$31.50
Shpg. Wt. 17 Lbs.

4 Heathkit DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1 to 99,999 ohms in 1 ohm steps. Indispensible around service shop laboratory, ham shack, or home workshop. Well worth the extremely low Heathkit price.

MODEL DR-1
$19.50
Shpg. Wt. 4 Lbs.

5 Heathkit VIBRATOR TESTER KIT

Tests vibrators for proper starting and indicates the quality of the output on a large "GOOD-BAD" scale. Checks both interrupter and self-rectifier types in 5 different sockets. Operates from any battery eliminator delivering variable voltage from 4 to 6 volts DC at 4 amps. Ideal companion to the Model BE-4.

MODEL VT-1
$14.50
Shpg. Wt. 6 Lbs.

6 Heathkit DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

MODEL DC-1
$16.50
Shpg. Wt. 3 Lbs.

BENTON HARBOR 15, MICHIGAN

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

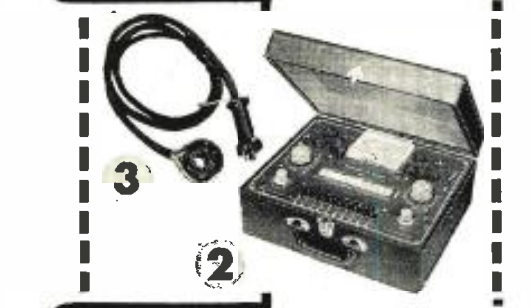
Heathkit TUBE CHECKER KIT

1 The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
$29.50
Shpg. Wt. 12 Lbs.



2 Heathkit **PORTABLE TUBE CHECKER KIT**

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
$34.50
Shpg. Wt. 15 Lbs.

3 Heathkit **TV PICTURE TUBE TEST ADAPTER**

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. (Not a kit.)

MODEL 355
$4.50
Shpg. Wt. 1 Lb.

4 Heathkit . . .

CONDENSER CHECKER KIT

Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again, all values are read directly on the calibrated scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
$19.50
Shpg. Wt. 7 Lbs.

5 Heathkit VISUAL-AURAL

SIGNAL TRACER KIT

This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
$23.50
Shpg. Wt. 9 Lbs.

HEATH COMPANY
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BENTON HARBOR 15, MICHIGAN

MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

Heathkit HARMONIC DISTORTION METER KIT

1 Heathkit AUDIO ANALYZER KIT

This instrument consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units. High or low impedance IM measurements made with built-in 6KC and 60 cps generators. VTVM ranges are .01, to 300 volts in 10 steps. Wattmeter ranges are .15 mw. to 150 w. in 7 steps. IM scales are 1% to 100% in 5 steps.

MODEL AA-1
$59.50
Shpg. Wt. 13 Lbs.

2 Heathkit AUDIO GENERATOR KIT

This new Heathkit Model features step-tuning from 10 cps to 100 Kc with three rotary switches that provide two significant figures and multiplier. Less than .1% distortion. Frequency accurate to within ± 5%.

Output monitored on a large 4½" meter that reads voltage or db. Both variable and step-type attenuation provided. Meter reads zero-to-maximum at each attenuator position. Output ranges (and therefore meter ranges) are 0-.003, .01, .03, .1, .3, 1, 3, 10 volts. Step-tuning provides rapid positive selection of the desired frequency, and allows accurate return to any given frequency.

MODEL AG-9
$34.50
Shpg. Wt. 8 Lbs.

3 Heathkit AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

The Model AO-1 features sine wave or square wave coverage from 20-20,000 cps in 3 ranges. It is an instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high level output across the entire frequency range, low distortion and low impedance output. Features a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces an excellent sine wave for audio testing, or will produce good, clean, square waves with a rise time of only 2 microseconds.

MODEL AO-1
$24.50
Shpg. Wt. 10 Lbs.

4 Heathkit RESISTANCE SUBSTITUTION BOX KIT...

Provides switch selection of 36 RTMA 1 watt standard 1% resistors ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work, and essential in the developmental laboratory.

MODEL RS-1
$5.50
Shpg. Wt. 2 Lbs.

5 Heathkit AC VACUUM TUBE VOLTMETER KIT...

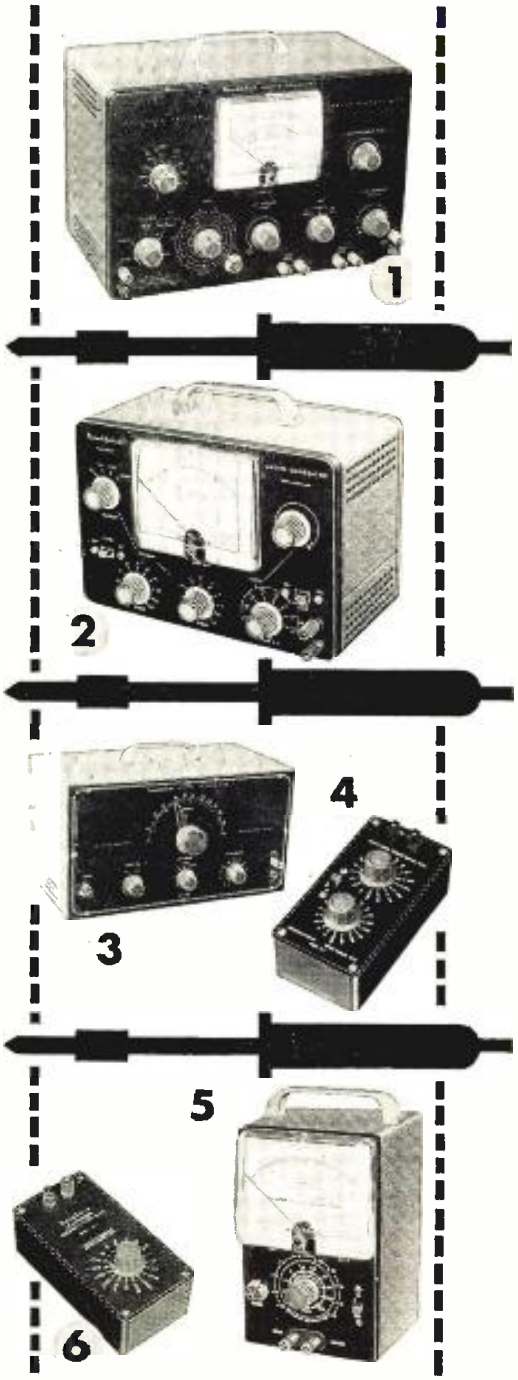
The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency response is substantially flat from 10 cps to 50 Kc. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 v. RMS. Total db range −52 to + 52 db. Input impedance 1 megohm at 1 Kc.

MODEL AV-2
$29.50
Shpg. Wt. 5 Lbs.

6 Heathkit CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1
$5.50
Shpg. Wt. 2 Lbs.



HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN

HEATHKIT HAM GEAR

for high quality at moderate cost

MODEL DX-100

DOLLAR VALUE: *You get more for your Heathkit dollar because your labor is used to build the kit instead of paying for someone else's. Also, the middleman's margin of profit is eliminated when you deal directly with the manufacturer.*

1 *Heathkit* DX-100 PHONE & CW TRANSMITTER KIT

The reception given this amateur transmitter has been tremendous. Reports from radio amateurs using the DX-100 are enthusiastic in praising its performance and the high quality of the components used in its assembly. Actual "on the air" results reflect the careful design that went into its development.

The DX-100 features a built-in VFO, modulator, and power supplies, and is completely bandswitching for phone or CW operation on 160, 80, 40, 20, 15, 11, and 10 meters. All parts necessary for construction are supplied in the kit, including tubes, cabinet, and detailed step-by-step instructions. Easy to build, and a genuine pleasure to operate.

Employs push-pull 1625's modulating parallel 6146's for RF output in excess of 100 watts on phone and 120 watts on CW. May be excited from the built-in VFO or from crystals (crystals not included with kit). Features five-point TVI suppression: (1) pi network interstage coupling to reduce harmonic transfer to the final stage; (2) pi network output coupling; (3) extensive shielding; (4) all incoming and outgoing circuits filtered; (5) inter-locking cabinet seams to eliminate radiation except through the coaxial output connector. Pi network output coupling will match 50 to 600 ohm non-reactive load. Illuminated VFO dial and meter face. Remote control socket provided.

The chassis is made of extra-strong #16 gauge copper-plated steel. It employs potted transformers, ceramic switch and variable capacitor insulation, solid silver loading switch terminals, and high-grade well-rated components throughout. Features a pre-formed wiring harness, and all coils are pre-wound.

High-gain speech amplifier for dynamic or crystal microphones, and restricted speech range for increased intelligence. Plenty of audio power reserve. Measures 20⅞" W. x 13¾" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
$189.50
Shpg. Wt. 120 Lbs.

Shipped Motor Freight Unless Otherwise Specified
$50.00 Deposit Required on C.O.D. Orders

2 *Heathkit* VFO KIT

The Model VF-1 covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10-volt average RF output on fundamentals. Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from plug on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters. Measures: 7" H. x 6½" W. x 7" D.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.

3 *Heathkit* CW AMATEUR TRANSMITTER KIT

The Model AT-1 is an ideal novice transmitter, and may be used to excite a higher power rig later on.

This CW transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11, and 10 meters. Features single-knob bandswitching, and panel meter indicates grid or plate current for the final amplifier. Designed for crystal operation or external VFO. Crystal not included in kit. Incorporates such features as key click filter, line filter, copper-plated chassis, pre-wound coils, 52 ohm coaxial output, and high quality components throughout. Instruction book simplifies assembly. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 35 watts plate power input.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

4 *Heathkit* . . . ANTENNA COUPLER KIT

The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

MODEL AC-1
$14.50
Shpg. Wt. 4 Lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

"AMATEUR-ENGINEERED"

Equipment For The Ham

MODERN DESIGN: *You can be sure of getting all the latest and most desirable design features when you buy Heathkits. Advanced-design is a minimum standard for new Heathkit models.*

1 MODEL AR-3

2

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1 *Heathkit* COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

The new Model AR-3 features improved IF and RF performance, along with better image rejection on all bands. Completely new chassis layout for easier assembly, even for the beginner

Covers 550 Kc to 30 Mc in four bands. Provides sharp tuning and good sensitivity over the entire range. Features a transformer-type power supply—electrical bandspread—separate RF and AF gain controls—antenna trimmer—noise limiter—AGC—BFO—headphone jacks—5½" PM speaker and illuminated tuning dial.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part No. 91-10, shipping weight 5 lbs. $4.50.

MODEL AR-3
$27.95
Shpg. Wt. 12 Lbs.
(Less Cabinet)

2 *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

Operates with any receiver having an IF frequency between 450 and 460 Kc. Will not function with AC-DC type receivers. Requires 6.3 volts AC at 300 ma. and 150 to 250 VDC at 2 ma. Derives operating power from your receiver. Uses a 12AX7 tube, and special High-Q shielded coils. Simple to connect with the cable and plugs supplied. Measures only 4-11/16"H.x7⅜"W.x4⅛"D. A really valuable addition to the receiving equipment in your ham shack.

MODEL QF-1
$9.95
Shpg. Wt. 3 Lbs.

3 *Heathkit* VARIABLE VOLTAGE REGULATED POWER SUPPY KIT

Provides well filtered DC output, variable from zero to 500 volts at no load and *regulated* for stability. Will supply up to 10 ma. at 450 VDC, and up to 130 ma. at 200 VDC. Voltage or current monitored on front panel meter. Also provides 6.3 VAC at 4A. for filament. Filament voltage isolated from B+, and both isolated from ground. Invaluable around the ham shack for supplying operating potentials to experimental circuits. Use in all types of research and development laboratories as a temporary power supply, and to determine design requirements for ultimate power supply.

MODEL PS-3
$35.50
Shpg. Wt. 17 lbs.

4 *Heathkit* ANTENNA IMPEDANCE METER KIT

Use in conjunction with a signal source for measuring antenna impedance, line matching, adjustment of beam and mobile antennas, etc. Will double as a phone monitor or relative field strength indicator. 100 μa. meter employed. Covers the range from 0-600 ohms. An instrument of many uses for the amateur.

MODEL AM-1
$14.50
Shpg. Wt. 2 lb.

5 *Heathkit* GRID DIP METER KIT

This is an extremely valuable tool for accomplishing literally hundreds of jobs on all types of equipment. Covering from 2 Mc to 250 Mc, the GD-1B is compact and can be operated with one hand. Uses a 500 μa. meter for indication, with a sensitivity control and headphone jack. Includes prewound coils and rack. Indispensable instrument for hams, engineers, or servicemen.

MODEL GD-1B
$19.50
Shpg. Wt. 4 lbs.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

Heathkits
PROVIDE THE "CONSTRUCTIVE" APPROACH TO HIGH-FIDELITY

EASY TO BUILD: *The assembly instructions supplied with Heathkits are so complete and detailed that anyone can assemble the kits without difficulty. Plenty of pictorial diagrams and step-by-step instructions. Information on resistor color codes, soldering, use of tools, etc. Build-it-yourself with confidence!*

1

1 Heathkit ADVANCED-DESIGN HIGH FIDELITY AMPLIFIER KIT

The 25 Watt Model W-5 is one of the most outstanding high fidelity amplifiers available today—at any price. Incorporates the very latest design features to achieve true "presence" for the super-critical listener.

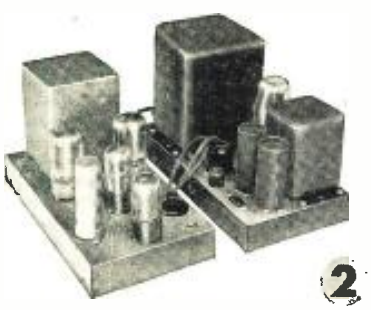
Features a new-design Peerless output transformer, and KT66 output tubes handle power peaks up to 42 watts. The unique "tweeter-saver" suppresses high frequency oscillation. A new type balancing circuit results in closer "dynamic" balance between output tubes. Features improved phase shift characteristics and frequency response, with reduced IM and harmonic distortion. Color styling harmonizes with the Heathkit WA-P2 Preamplifier and the FM-3 Tuner.

Frequency response—within ± 1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts, using 60 and 3,000 cps. Output impedance 4, 8, or 16 ohms. Hum and noise—99 db below rated output. Uses two 12AU7's, two KT66's and a 5R4GY.

KIT COMBINATIONS:

W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual. Shpg. Wt. 31 lbs. Express only. **$59.75**

W-5 Combination Amplifier Kit: Consists of W-5M Amplifier Kit listed above *plus* Heathkit Model WA-P2 Preamplifier Kit. Complete with all necessary parts, tubes, and construction manuals. Shpg. Wt. 38 lbs. Express only. **$79.50**



2

2 Heathkit DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output transformer, and has a frequency response within ± 1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—88 db below 20 watts. Uses two 6SN7's, two 5881's, and a 5V4G.

KIT COMBINATIONS:

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 29 lbs., Express only. **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 37 lbs., Express only. **$69.50**

3

3 Heathkit SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson type amplifier ever offered in kit form, and yet it retains all the usual features of the Williamson type circuit. Main amplifier and power supply combined on one chassis, and uses a new-design Chicago output transformer. Frequency response—within ± 1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output, 2.7% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—95 db below 20 watts. Uses two 6SN7's, two 5881's, and one 5V4G.

Instructions are so complete that the kit may be assembled successfully even by a beginner in electronics.

KIT COMBINATIONS:

W-4AM: Consists of main amplifier and power supply for single chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 28 lbs. Express only. **$39.75**

W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 35 lbs. Express only. **$59.50**

HEATH COMPANY
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BENTON HARBOR 15, MICHIGAN

ATTRACTIVELY STYLED: *Heathkit high fidelity instruments are not only functional, but are most attractive in physical design. Such units as the preamplifier and the W-5 main amplifier are designed for beauty as well as performance. They blend with any room decor and are the kind of instruments you will be proud to own.*

enjoy....

THE VERY BEST IN AUDIO WITH "BUILD-IT-YOURSELF"

HEATHKITS

1 *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT

This outstanding preamplifier is designed specifically for use with the Heathkit Williamson type amplifiers. It completely fulfills the requirements for remote control, compensation and preamplification, and exceeds even the most rigorous specifications for high fidelity performance.

Features five separate switch-selected input channels (2 low level and 3 high level), each with its own input control. Full record equalization with four-position turnover control and four-position rolloff control.

Output jack for tape recorder – separate bass control with 18 db boost and 12 db cut at 50 cps. – treble control offering 15 db boost and 20 db cut at 15,000 cps – special hum control to insure minimum hum level – and many other desirable features. Overall frequency response (with controls set to "flat" position) is within 1 db from 25 cps to 30,000 cps. Will do justice to the finest available program sources. Beautiful satin-gold fiinish.

Power requirements from the Heathkit Williamson type high fidelity amplifier – 6.3 VAC at 1 amp., and 300 VDC at 10 Ma. Uses two 12AX7's and one 12AU7.

MODEL WA-P2
$19.75
Shpg. Wt. 7 Lbs.

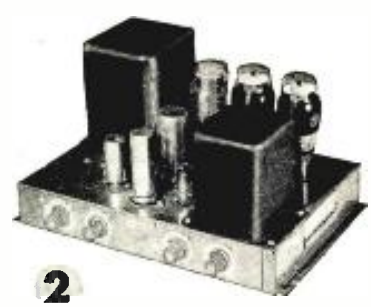
1

2 *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT

This Heathkit Model offers you the least expensive route to high fidelity performance. Frequency response is ± 1 db from 20-20,000 cps. Features full 20 watt output using push-pull 6L6's, and incorporates separate bass and treble tone controls. Preamplifier and main amplifier are built on the same chassis. Four switch-selected compensated inputs and separate bass and treble tone controls provide all necessary functions at minimum investment. Features miniature tube types for low hum and noise.

Uses 12AX7, two 12AU7's, two 6L6G's and a 5V4G. A most interesting "build-it-yourself" project, and an excellent hi-fi amplifier for home use. Well suited, also, for public address applications because of its high power output and high quality audio reproduction. Another Heathkit "best-buy" for you!

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.



2

3 *Heathkit* 7-WATT AMPLIFIER KIT

The redesigned Model A-7D features a new type output transformer for tapped screen operation, and provides improved sensitivity, reduced distortion, and increased power output.

The full 7-watt output of the Model A-7D is more than adequate for normal home installations. Frequency characteristics are ± 1½ db from 20 to 20,000 cps. Potted output and power transformers employed. Push-pull output – detailed construction manual – top quality parts – high quality audio without great expense. Output transformer tapped at 4, 8, and 16 ohms. Bass and treble tone controls provided on the front chassis apron.

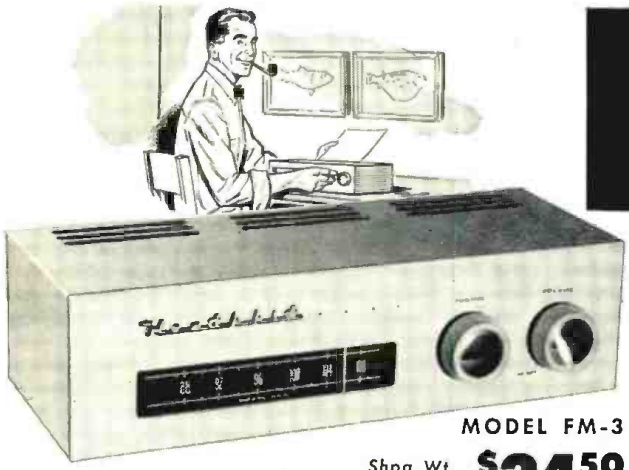
MODEL A-7D
$16.95
Shpg. Wt. 10 Lbs.

3

Model A-7E: Provides a preamplifier stage with two switch-selected inputs and RIAA compensation for variable reluctance or low level cartridges. Preamplifier built on same chassis as main amplifier. Model A-7E. Shipping weight 10 lbs. $18.50.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM INC.

BENTON HARBOR 15, MICHIGAN



MODEL FM-3

Shpg. Wt. 7 lbs. **$24.50** (with cabinet)

Brand New HEATHKIT HIGH-FIDELITY FM TUNER KIT

Features

- *Brand New, Modern FM Circuit Using Latest Type Miniature Tubes.*
- *Low-Noise Cascode RF Stage—Two IF's—Ratio Detector —Stage of Audio.*
- *Extremely Good Sensitivity and Band-Pass for Outstanding Performance.*
- *Strikingly Attractive Satin-Gold Finish to Match Heathkit Model WA-P2 Preamplifier.*
- *Compact Physical Dimensions for Most Pleasing Appearance and Increased Circuit Efficiency.*

The new Heathkit Model FM-3 features tremendous circuit improvements and brand new physical design. Sensitivity is better than 10 μv. for 20 db of quieting, and it employs a completely modern tube line-up for high gain and stable operation. Incorporates its own power supply, and has provision for low-level or high-level output at low impedance.

The attractive Model FM-3 matches the WA-P2 Preamplifier in color, styling, and physical size.

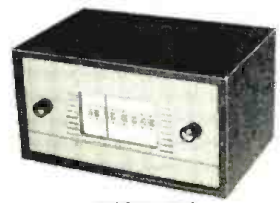
Incorporates automatic gain control, a highly stabilized oscillator, and illuminated tuning dial. Educational treatment of construction manual simplifies assembly for the newcomer to electronics. *IF* and *ratio* transformers are *pre-aligned*, and the front-end tuning unit is pre-assembled and aligned. Uses 6BQ7A as a cascode type RF stage, 6U8 oscillator-mixer, two 6CB6's as IF amplifiers, a 6AL5 ratio detector, a 6C4 audio amplifier, and 6X4 rectifier.

HEATHKIT BROADCAST-BAND RECEIVER KIT

Build your own radio receiver with confidence, even if you are a beginner. Complete instructions supplied.

Features transformer-type power supply, high-gain miniature tubes, built-in antenna, 5½" speaker, and planetary tuning from 550 Kc to 1500 Kc. Adaptable for use as AM Tuner and phono amplifier. Educational treatment of the construction manual helps the beginner learn about radio circuits and parts as he builds.

CABINET: Fabric covered plywood cabinet with aluminum panel as shown. Part 91-9, Shpg. Wt. 5 lbs., $4.50.



MODEL BR-2

$17.50 *Less Cabinet*

Shpg. Wt. 10 lbs.

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- ☐ Express
- ☐ Freight
- ☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE

NOTE: ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

Enclosed find ( ) check ( ) money order for_____. Please ship C.O.D. ( ) postage enclosed for_____pounds.

On Express orders do not include transportation charges— they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS include postage for weight shown. ORDERS FROM CANADA and APO's must include full remittance.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 15, MICHIGAN**

What's New in Radio

NEW HAM GEAR

The Hallicrafters Company, Chicago, Illinois has unveiled four new units in its communications line.

Among the items now in production is the Model HT-31 linear amplifier which will put the equivalent "talk power" of a one kilowatt conventional AM transmitter on the operating desk. In one package, it is a full bandswitch power amplifier covering 80 to 10

meters which offers easy drive, high stability, and extreme versatility, according to the company.

Power input is from 500 to 510 watts, power output is 330 watts peak envelope power on 80 with slightly less on 10 meters and drive power of 10 watts p.e.p. maximum on the lowest frequency. The circuit uses two 811-A zero bias triodes in parallel. The input system is designed to be fed from a 50-70 ohm unbalanced line and requires a maximum of 10 watts drive on 80 meters. The grid tank circuit is balanced to provide all-band neutralization while the output tank circuit is a continuously variable pi-network which provides a high degree of harmonic suppression. Two 866-A rectifiers complete the tube complement.

"TUBE-SAVER"

Wuerth Enterprises, 7819 Farnsworth Street, Philadelphia 15, Pa. has come out with a new device which is designed to protect tube filaments and cathodes from the destructive high surge of power when the set is switched on.

Known as the "Tube-Saver," the

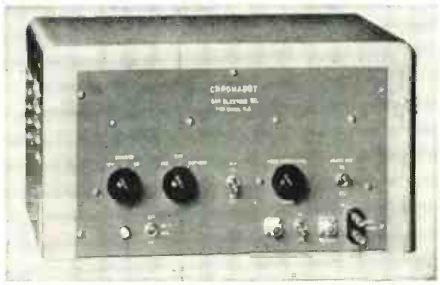
new device provides a thermal cushion against power surges and thus increases tube life. The unit is small and compact, measuring 5½" x 2½" x 3½", and can be mounted out of sight in back of the set. Completely automatic, the device works equally well on old or new sets, 150 to 400 watts, 117 volts a.c. or d.c. It can be easily attached by simply plugging it in.

COLOR BAR DOT GENERATOR

Kay Electric Company of 14 Maple Avenue, Pine Brook, N. J. is now offering a new combination color bar-dot generator, the "ChromaDot."

The new test instrument has vertical sync and requires only one connection to the r.f. antenna or video amplifier. It is designed to be used either on the production line or by service technicians. It provides color bars and dots at video and at specified r.f. frequencies.

The color bar generator has a horizontal sync pulse signal. When a switch is depressed it provides a vertical sync pulse and varying pedestals throughout each frame to test linearity of color receiver circuits. The dot section provides signals which contain horizontal pulse, dot pulses, and ver-



tical sync, so that a stationary locked pattern is displayed without auxiliary signals.

For full details and complete specifications, write the company direct.

PI-NETWORK INDUCTOR

A new, compact 1 kilowatt pi-network tank coil with full bandswitching is now being marketed by *Barker & Williams, Inc.,* 237 Fairfield Ave., Upper Darby, Pa.

The new inductor provides efficient operation from 80 through 10 meters for high power pi-network final amplifiers. Designed for class C or linear operation using triodes or tetrodes in conventional or grounded-grid circuits, the new Model 850 permits instant selection of the desired operating band through a positive-acting, high-current r.f. switch. Stepped section coil windings, of extra heavy conductor at the higher frequencies, provide ample current carrying capacity and minimum "*Q*" of 300 across the entire operating range.

Full details will be provided by your

local electronic parts distributor or the company will forward a copy of Bulletin 850 upon request.

"RAINBOW GENERATOR"

A color television pattern generator, the Model 150 "Rainbow Generator," has just been introduced by *Winston Electronics, Inc.*, 4312 Main Street, Philadelphia, Pa.

The new unit will produce from one to eight visible rainbows of color on the face of a color TV kinescope. Individ-

ual colors making up the rainbow may be identified for use in testing and aligning color television receivers. This instrument can be used both as a color TV demonstrator for a sales department and as a servicing tool for color TV alignment and troubleshooting.

The Model 150 measures 4" wide, 5" high, and 7" long. It is equipped with a chrome handle for portability.

SIGNAL GENERATOR

Triplett Electrical Instrument Co., Bluffton, Ohio is now offering a new signal generator which covers the range from 160 kc. to 110 mc. without skips.

The Model 3432-A's r.f. circuits are double shielded with copper steel shields and a cathode follower output provides good stability by acting as a buffer to the oscillator.

Jacks are provided for either internal modulation or audio output and both are controlled by audio control to provide variable modulation or a.f. output. The instrument has a large, easily-read etched aluminum dial as well as a smooth planetary drive dial

for ease and accuracy in adjustment. The seven directly-calibrated 160 degree scales are readable at a glance.

GEIGER COUNTERS BY RCA

The Tube Division of *Radio Corporation of America*, Camden, N. J. has introduced six models of Geiger coun-

NEW ELECTRONIC MIRACLE

DEALERS: Contact your Favorite Distributor, some of which are listed here for your convenience . . .

IN CALIFORNIA —
- Deon's Electronics — Long Beach
- Dow Radio, Inc. — Pasadena
- Scott Radio Supply Co. Inc. — Long Beach

IN DISTRICT OF COLUMBIA —
- Silberne Radio & Electronics — Washington

IN FLORIDA —
- Certified Radio TV Supply — Fort Lauderdale

IN ILLINOIS —
- Allied Radio Corporation — Chicago
- The Lukko Sales Corporation — Chicago
- Nation Wide Radio — Chicago
- Stolz-Wicks, Inc. — Chicago
- Walker-Jimieson, Inc. — Chicago
- Melvin Electronics, Inc. — Oak Park

IN INDIANA —
- H. A. Williams Co. — Columbus
- Peerless Electric Supply Co. — Indianapolis
- Terre Haute Radio — Terre Haute

IN KANSAS —
- R & A Tube Company — Kansas City
- Radio Supply Company, Inc. — Wichita

IN KENTUCKY —
- Lexington Electronic Supply — Lexington
- Cooper-Louisville Company — Louisville

IN LOUISIANA —
- Koelemay Sales Company — Shreveport

IN MARYLAND —
- A. R. Spartana Co. — Baltimore

IN MICHIGAN —
- Purchase Radio Supply — Ann Arbor
- Electronic Supply Corp. — Battle Creek
- Falk Distr. Co. Inc. — Detroit
- Nor-West Tel. & Radio Sup. — Detroit
- West Side Radio Supply — Detroit
- Erickson's Electronic — Ferndale
- Shand Radio Specialties — Flint
- Saginaw Distributors, Inc. — Saginaw

IN NEW JERSEY —
- Continental Sales Co. Inc. — Newark
- Electronic Marketers, Inc. — Newark
- Krich-New Jersey, Inc. — Newark

IN NEW YORK —
- Bay Electronics Distributors — Bronx, N. Y.
- National Radio Distributors — Bronx, N. Y.
- Bay Electronic Distributors — Brooklyn
- Hy Grade Electronics, Inc. — Brooklyn
- National Radio Parts Distr. Co. — Brooklyn
- Bruno-New York, Inc. — New York
- Dorosin Distributing Corp. — New York
- Fischer Distr. Co., Inc. — New York
- Interocean Export Corp. — New York
- Slate and Company — New York
- Westchester Elec. Supply — New York

IN OHIO —
- Chambers Electronic Supply — Cincinnati
- Holub & Hogg — Cincinnati
- Lockie & Glenn, Inc. — Cincinnati
- Hughes Peters Co. Inc. — Columbus
- Whitehead Radio Company — Columbus
- Hutch & Son — Washington Court House
- Srepco, Inc. — Dayton

IN PENNSYLVANIA —
- A. G. Radio Parts Co. — Elkins Park
- Barnett Bros. Radio Co. — Philadelphia
- Electronic Parts Co. — Pittsburgh
- Zimmerman Wholesalers — Uniontown

IN WEST VIRGINIA —
- Tri-State Appliance Co. — Huntington

IN WISCONSIN —
- Marsh Radio Supply Co. — Milwaukee
- Seemuth Distributors, Inc. — Milwaukee

DISTRIBUTOR INQUIRIES INVITED

Rembrandt — FOR THE FINEST IN PICTURES — Indoor TV Antenna

Eliminates ROOF ANTENNAS IN METROPOLITAN AREAS

or YOUR MONEY BACK

Now — at last — an indoor antenna that outperforms or — at the very least — equals any roof antenna or master antenna system in the metropolitan area!

BASED ON RADAR

Up to ten times more powerful than all other indoor antennas, the "REMBRANDT" is based on a radical, new principle. It couples radar loops with resonant di-poles. This automatically brings in the clearest, sharpest, strongest signal on every channel — both in color and black-white. And in practically all locations the 9 position orientation switch completely eliminates ghosts. But don't take our word for it. The proof is in the picture. Make a side-by-side test of the "REMBRANDT" with any other indoor or outdoor antenna, regardless of cost. Compare its performance in your home, on your set. You and you alone be the judge.

MONEY BACK GUARANTEED

Completely ELIMINATES ALL GHOSTS PRACTICALLY EVERYWHERE

EBONY OR MAHAGONY **$14.95** COMPLETE

GOLD FINISH $5.00 EXTRA

UP TO **10** TIMES MORE *Powerful* THAN ALL OTHER INDOOR ANTENNAS

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ALL CHANNEL ANTENNA CORP.

47-39 49th STREET, WOODSIDE 77, N. Y. EXETER 2-1336

ters with ranges in sensitivity and price to meet the requirements of the non-professional and professional uranium prospector as well as the technician in medical and industrial laboratory work.

The Models WF-10A and WF-11A are designed for the weekend and vacationing prospector. Each model weighs only 5 pounds, including batteries and carrying strap, and measures only 8" x 7½" x 3½". Both of these units have meter, neon flasher, and headphone indication.

The Models WF-12A and WF-14A are equipped with external probes for examining openings in rock formations and test bores. The Models WF-15A and WF-16A are supersensitive units for more critical applications.

V.T.V.M. KIT

Heath Company, Benton Harbor, Michigan has come out with a vacuum-tube voltmeter in kit form, the Model V-7.

Designed for FM and TV servicing as well as laboratory work, the new instrument incorporates seven a.c. and d.c. voltage ranges; seven peak-to-peak a.c. voltage ranges, and seven ohmmeter ranges. A decibel scale is also provided. Zero-center operation is within the range of the front panel controls. The instrument incorporates a 4½" meter, 1% precision resistors,

and an a.c. power supply. The use of printed circuit boards cuts assembly time to a few hours.

For full details, including price, write the company direct.

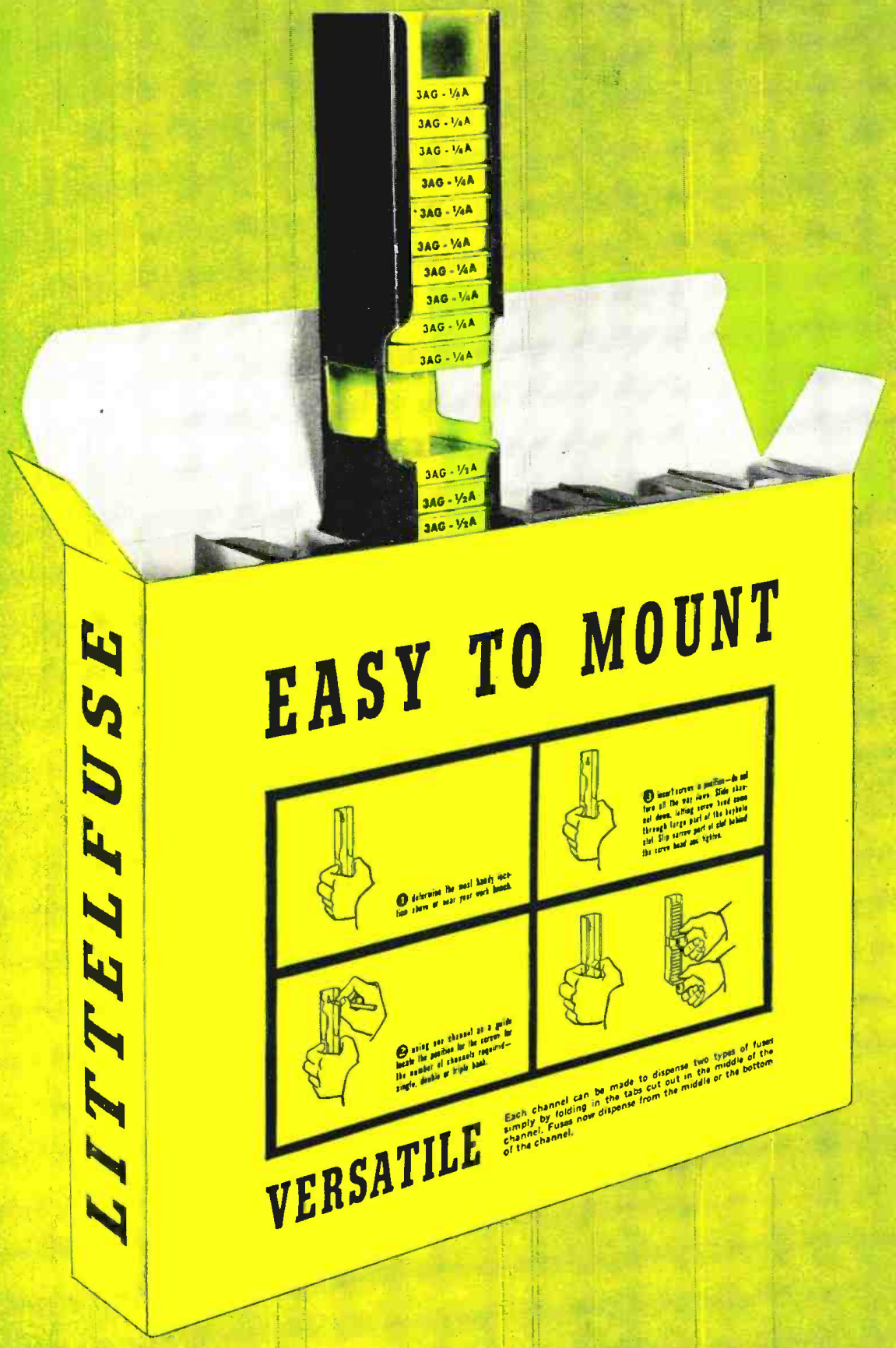
TELEVISION KIT

Transvision, Inc., New Rochelle, N. Y. has introduced a new television kit for home assembly which is so designed that color may be added at a later date.

The Model El has been engineered so that a layman can assemble the unit as easily as the more experienced electronic experimenter. Each part in the kit is individually packaged and marked with a number so that the layman can identify the component and follow the step-by-step instructions.

Eight different types of kits are available in 17", 21", 24", and 27" picture tube sizes. Remote control is available as an optional feature. The kit is broken down into nine packages. Each package is a complete circuit

(*Continued on page* 164)



LITTELFUSE To serve you . . . to increase your profits . . .

again streamlines your fuse service operation with a program that makes sure you have the right fuse at your fingertips at all times—time saved, effort saved build up your service profits.

ASK YOUR JOBBER about the Littelfuse Single Channel Fuse "Stocker" Package: 10 single (double dispensing) fuse

BURTON BROWNE ADVERTISING

Picture-Tube Rejuvenators

CRT tester of Authorized Manufacturing Co., also called "Rejuvindicator."

"Multiphase Rejuvenator" by Central Electronics.

"Beamer" manufactured by Raytronic Labs., Inc.

TV service dealers find that the legitimate use of these instruments creates good will and tube sales.

ALTHOUGH cathode-ray tube rejuvenators have been on the market for three years or more, they are still regarded by many service technicians and others who handle picture tubes with suspicion. This, to a large measure, is due to a misunderstanding of their function and of why CRT's go bad.

The greatest single cause of picture tube inoperation is low emission. Of course, open heaters and grids, shorted elements, broken stems, and other mechanical defects will also put CRT's out of business but, about 90% of defective picture tubes suffer from low emission which may or may not be accompanied by excessive gas content. These are the tubes which can be most successfully rejuvenated. Why do tubes lose emission?

In general two different types of coating are used with cathodes in picture tubes. Most tubes use an oxide coating (barium oxide, etc.) on the cathode because of its great activity, as far as emission is concerned, when heated. After prolonged use, the top layer of oxide loses all or almost all of its available electrons, forming a film of inert material over the cathode which prevents the electrons of the material beneath from getting through. Thus, there is insufficient emission to light up the tube face.

Some tubes use a metallic coating, like barium, on the cathode, which may absorb some of the excess gases in the tube (if such exist) to form an inert film over the cathode surface. Again, the result is loss of emission. Contamination will also occur in tubes using oxide-coated cathodes if excess gases are present in the tube, causing loss of emission to occur sooner than it would normally.

To rejuvenate or reactivate a cathode-ray tube whose only defect is low or no cathode emission, the layer of inert material must be removed. This is done in most rejuvenators by heating the cathode to an above-normal operating temperature while, at the same time, making the control grid positive with respect to the cathode. This process is allowed to proceed until an emission test indicates that there is a sufficient amount of emission in the tube.

Tests have indicated that after a picture tube has been reactivated in this manner, at least 85% will give satisfactory service for 6 months or more. In most cases where tubes are rejuvenated, the customer is given a 90-day guarantee.

Open and Shorted Elements

In addition to the reactivation of the cathode-emitting surface, most rejuvenators also have provisions for the testing of cathode-ray tubes to detect open elements and shorts between elements. Where such defects are present, they may sometimes be repaired although not always permanently.

If there are some foreign particles between two elements, shorting them together, the particles may be burned out by the application of a high voltage between the elements. This most commercial rejuvenators furnishes for just such purposes. This high voltage may also be used in an attempt to weld an open element together. This is done by applying the high voltage between the open element and the cathode and tapping the neck of the picture tube lightly so as to bring the two severed parts of the open element together temporarily. When they touch, a weld may take place. However, while these welds will take place occasionally, tests have shown that they are seldom effective for more than a few days.

Finally, based upon the belief that a CRT with an excessive amount of gas will not give lasting service after reactivation, many rejuvenators incorporate some type of test for gas content. These range from an actual meter measurement of the amount of gas in a CRT to the observation of the color of the glow in the CRT while its heater is on.

Commercial Rejuvenators

Most of the commercially available cathode-ray tube rejuvenators use similar circuits to accomplish their main functions. Thus, neon tubes are used almost universally to indicate shorts and open circuits, and for cathode reactivation (or "sweeping," as it is sometimes called), the heater voltage to the picture tube is increased about 100% while a positive voltage is placed

on the control grid (first anode). The size of this positive voltage varies with the instrument, as does its character.

The "Rejuvindicator," manufactured by *Authorized Manufacturing Company* of Brooklyn, N. Y., applies no more than 7 volts positive to the control grid to insure that the grid is in no way damaged during the rejuvenation process. In addition, this instrument indicates when the rejuvenation has been completed and provisions are included for properly aging the new cathode coating.

The "Multiphase Rejuvenator," manufactured by *Central Electronics, Inc.* of Chicago, Illinois, places a high positive voltage on the control grid of the CRT and the normal 6.3 volts on the heater. Provisions are included for increasing the heater voltage for tubes which react too slowly to rejuvenation. This instrument actually meters cathode emission during the reactivation period. During reactivation, cathode emission will rise until a critical point is reached, after which activity will fall if the process is continued. The metering circuit in this instrument indicates to the operator when this critical point is reached so that he will stop the rejuvenation process.

It was mentioned previously that CRT's with an excessive amount of gas will not be successfully rejuvenated. To determine whether a picture tube can be reactivated or not, the "Beamer" and "Junior Beamer" produced by the *Raytronics Laboratories, Inc.* of Cincinnati, Ohio, incorporate a critical gas content test which actually records the ion current in a cathode-ray tube. The ion current depends upon the amount of gas in the tube. Picture tube manufacturers contend that a CRT with an ion current of less than one microampere should have long life if all other parts are good. The "Beamer" gas content detector is capable of measuring down to .0026 microampere of ion current. In addition to this feature, the "Beamers" also contain mutual transconductance, emission, leakage, shorts, and continuity test facilities, and are capable of performing a large number of CRT repairs.

The "Cathode Rejuvenator-Tester" manufactured by the *B&K Manufacturing Company* of Chicago, Illinois, like many of the other instruments in its price range, uses a simplified method for determining the probable useful life of a rejuvenated tube. The method consists simply of noting the emission fall-off rate of the CRT when the heater is switched off. If the meter needle falls to zero rapidly, there is either a considerable amount of gas in the tube or else not much emitting material left. In either case, the tube will not last very long.

A combination of a.c. and d.c. voltages are used by the "Ren-O-Lyzer," manufactured by the *U.S. Electronic Research and Development Corp.* of Detroit, Michigan, to reactivate low-emission cathodes. A similar voltage is used for the various element welding operations of the test instrument.

Transvision, Inc. of New Rochelle, N.Y., has three units available for repairing CRT's. One, the "Sparker," is used to eliminate low and high resistance shorts by burning out the leakage path through the application of about 15,000 volts of r.f. The "Tester Reactivator" tests picture tubes for emission, shorts, and leakage, and reactivates low emission cathodes. The third instrument is a combination of the first two and is called the "Tester-Reactivator-Sparker."

The Business Aspect

Although the process of rejuvenating tubes was known long before TV picture tubes came into existence, it was never practiced on a wide scale. It just isn't economically advisable to reactivate a tube which could be replaced for about $2.50. However, the case is different with picture tubes. The cost of rejuvenation is nominal when compared to the replacement cost of a picture tube.

Unfortunately, the fact is that the effects of rejuvenation are never certain. In the review of commercially available rejuvenators, it was indicated that most of the instruments attempt some sort of "life test," based either upon the amount of gas present in the tube or on the emission characteristics of the tube elements. Where effective, these tests will dissuade a technician from attempting to reactivate a tube which will probably go bad again shortly afterwards. However, statistics have shown that even after tests, some rejuvenations will not hold. Most dealers and technicians guarantee their rejuvenations for 90 days. Many go one step further, and inform the customer that the service charge for a rejuvenation is applicable towards the cost of a new picture tube when it becomes necessary. This gives the technician or dealer an inroad on the sale of a new picture tube to that customer and, at the same time, saves the customer money by extending the life of his present picture tube.

One typical service shop charges the customer $5 for rejuvenation of tubes up to 15", and $7 for larger size tubes. Their experience has shown that about 90% of the tubes suffering from low emission can be restored to give 6 months additional service on the average. Some have lasted a good deal longer.

Some TV receiver distributors have been using rejuvenators on tubes still under warranty when returned to them by service dealers. Also, many dealers are rejuvenating tubes in TV receivers that they obtain as trade-ins for new models. These are then sold at reduced prices. These tubes, of course, are covered by a guarantee.

Service technicians and dealers are cautioned to inform their customers in every case where rejuvenation is used. Rejuvenation has become an accepted method of prolonging the life of a picture tube. However, whenever it is used, the customer should know that it is only a temporary method and a new tube will be required eventually. There is a big field for legitimate rejuvenation—do not sell it under false pretenses. —30—

B&K Mfg. Co. rejuvenator-tester.

U. S. Electronic Research and Development Corp.'s "Jiffy Ren-O-Lyzer."

CRT rejuvenator and tester manufactured by Transvision, Inc.

OUTLOOK GOOD FOR ELECTRONICS INDUSTRY

THE Electronics Division, Business and Defense Services Administration, U. S. Department of Commerce reports that production of electronic products in 1955 is expected to reach $6.2 billion.

The products included in this estimate comprise radio and television receivers, broadcasting and radio communications equipment, tubes and electronic components, and military equipment such as radar, sonar, and guided missile electronic systems.

The number of black-and-white TV receivers produced in the first half of 1955 was near-record level—3¾ million units. Although the average unit price has declined because savings resulting from improved production techniques have been passed on to the consumer, the total value of factory production for the year is expected to exceed one billion dollars.

Production of color television receivers is not expected to become a major factor in the total production of TV receivers this year, although increased sales are anticipated during the Fall season.

The present outlook is that total factory sales of color TV receivers in 1955 will reach at least $15 million and that a substantial increase in production will take place in 1956.

Production of radio receivers of all types continues at a high level, according to the report. —30—

DO-IT-YOURSELF HI-FI SHOP

VIC RONDEL of 3612 Coral Way, Miami, Florida has capitalized on the current vogue for "do-it-yourself" high fidelity by setting up complete woodworking and electronic facilities for the hi-fi enthusiast who wants to build or service his own components, cabinets, or speaker baffles.

Technical advice is furnished, along with rental of the various items of service and test equipment, to those who are not too sure of their grasp of audio principles. Thus, the audiophile can tackle any project secure in the knowledge that a helping hand is available for the rough spots.

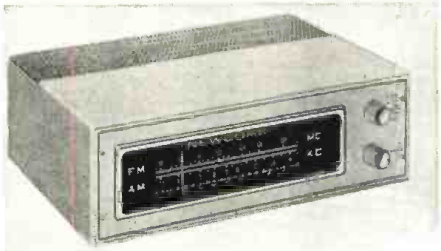
While this idea has been applied to various hobby projects before, its use in audio construction is unique. —30—

New Hi-Fi-Audio Equipment

NEWCOMB FM-AM TUNERS

Newcomb Audio Products Co., Inc., 6824 Lexington Ave., Hollywood 38, California has added two new FM-AM tuners to its audio line.

Housed in decorator-designed satin-gold finish cabinets, the new tuners can be used "as is" without additional cabinetry. The "Compact 100" unit shown is a self-powered, two-knob



model designed to be used with any high-fidelity amplifier having its own controls. It features a new multiplex output jack to permit adaptation for reception of the newest system of binaural broadcasts. FM response is ±1 db from 20 to 20,000 cps, with sensitivity of 5 μv. for 30 db of quieting.

The deluxe "Compact 200" features a 2 μv. FM sensitivity for 30 db of quieting, a new FM detector system with triple limiting action to provide lower distortion, better adjacent channel rejection, and more effective limiting on weak as well as strong signals. This tuner has a response of ± ½ db from 20 to 20,000 cps with distortion of less than .2% at 5 volts. A cathode-follower allows placement up to 200 feet from the amplifier.

HI-FI COMPONENTS

Sargent-Rayment Co., 1401 Middle Harbor Road, Oakland 20, California has added two new components to its line of high-fidelity equipment.

The new items are the Model SR-707 AM-FM tuner and the SR-14B ampli-

fier. The tuner features a dual concentric volume control, reluctance preamp provisions, a separate FM jack in the rear for future multiplex binaural broadcasting, mid-frequency variation when the treble and bass controls are rotated from maximum attenuation to maximum accentuation of less than 1

db, and a special 10 kc. whistle filter. The tuner uses ten tubes and a germanium diode.

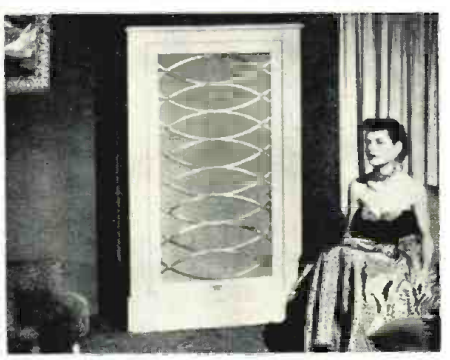
The SR-14B amplifier is a 14-watt "Ultra-Linear" circuit. Distortion is .2% at 10 watts and less than 1% at 14 watts. Frequency response is 40 to 12,000 cps. Hum and noise level is better than 86 db below rated output. Output impedances of 4-8 and 16 ohms are provided. A volume control is incorporated to eliminate the possibility of blasting. The circuit uses five tubes and measures 12½" long, 4" wide, and 6½" high.

E-V "PATRICIAN IV"

Electro-Voice, Inc. of Buchanan, Michigan has announced the development of a new, advanced-design "Patrician IV" high-fidelity four-way speaker system.

Tailored to the corner of the room, the speaker system with its folded horn and other special *E-V* features, conserves the spatial requirements of high fidelity. With its unique, separate 4-way system, intermodulation and transient distortion is minimized while the full range of audio frequencies is handled smoothly and efficiently. Three special controls permit proper balance to room acoustics.

The "Patrician IV" is available in hand-rubbed blonde or mahogany finishes. It comes complete with the 4-way system installed. The cabinet measures 62 inches high, 39 inches wide, and 29⅛ inches deep.



Complete information on this speaker system is provided in the company's Bulletin 220 which is available on request.

P.A. MICROPHONE

A new, advanced-type Model 664 "Variable D" cardioid dynamic microphone especially for p.a., recording, communications, and similar applications has been announced by *Electro-Voice, Inc.* of Buchanan, Michigan.

The Model 664 provides a uniform cardioid polar pattern at all frequencies, gives high front-to-back discrimination, and smooth wide-range response without close-talking boominess. The unit effectively cuts ambient noise, feedback, and reverberation and gives distinct, natural reproduction of voice and music.

Response is uniform at all frequencies from 60 to 13,000 cps. Output level is —55 db. Both 150 ohm and high impedances are provided with the im-

pedance changeable by means of a slight alteration in the connector cable.

For complete details on the Model 664, write the company direct.

BATTERY TAPE RECORDER

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y. has designed a new, self-contained tape re-

corder which is housed in a weather-tight aluminum case to assure complete protection against rain, spray, sleet, dust, fungus, sand, and other hazards.

A vu meter is incorporated in this recorder to act as a recording level indicator, output level indicator, and "A" and "B" battery meter. It also simplifies the correct setting of recording and playback levels to compensate for battery voltage changes.

Measuring only 7½" x 9" x 14", the new "Weathertite VU Magnemite" weighs only 19 pounds. It is currently available in one-, two-, three-, and four-speed models utilizing consecutive speeds from $^{15}/_{16}$ ips to 15 ips. The recorder uses inexpensive batteries and incorporates a spring motor. Complete specifications are available from the manufacturer.

V-M CONSOLE

V-M Corporation, Benton Harbor, Michigan is currently offering a com-

bined phono and speaker system housed in a console-type cabinet.

The Model 565 "Fidelis" console is available in both blonde and mahogany finishes. The dual bass-reflex, heavy-duty extended range speaker system (one 12" woofer and one 4" tweeter)

provide proper dispersion of all frequencies from 40 to above 15,000 cps. A powerful push-pull amplifier provides 500% reserve power over that needed in the average living room. The company's exclusive "tone-o-matic" control affords equal hearing loudness over the entire audio spectrum.

An auxiliary input permits playing AM or AM-FM radio, TV tuner, or tape recorder through the speaker system. Cabinet space is provided for housing a hi-fi tuner. An auxiliary output with 8 ohms impedance is provided for the connection of external speakers, if desired.

WOW AND FLUTTER METER

A new wow and flutter meter expressly designed to meet the recently-adopted IRE-SMPTE-ASA standards on sound recording and reproducing methods for determining flutter content has just been announced by the *Donner Scientific Company,* 2829 7th Street, Berkeley, California.

The instrument is especially useful to engineering laboratories, broadcast stations, motion picture studios and theaters, recording equipment manufacturers, and service shops. Applications include measurement of both

high- and low-frequency variations in the speed of phonograph turntables or other mechanical, optical, or magnetic recording and reproducing equipment.

Accuracy of the readings obtained is not affected by errors in center frequency of the 3 kc. test signal within the ±5% tuning range of the discriminator. A 3 kc. test signal is available from the input terminals for use in making recordings.

A descriptive bulletin on this new equipment is available without charge upon request.

AUDIO INPUT TRANSFORMER

Fairchild Recording Equipment Company, 154th Street and 7th Avenue, Whitestone, N. Y. is in production on its new Model 235 high-fidelity audio input transformer which has been specifically designed for use with the firm's Series 220 moving coil cartridge.

The Model 235 is recommended for use with amplifier systems that require extra gain or where it is desirable to operate at a particular volume control setting. Designed for installations in strong a.c. fields, the Model 235 has a Mumetal case which results in hum-free operation in even the most difficult installations.

Each transformer has a built-in

standard phono jack to accept the cartridge output and a 30-inch secondary lead with a standard phono plug

to feed directly into the preamplifier. No wiring of any type is required.

1-INCH MICROPHONE

Shure Brothers, 225 W. Huron Street, Chicago 10, Illinois is currently introducing a new series of small, 1-inch, controlled-reluctance microphones designed especially for applications where size and weight are factors and portability is extremely important.

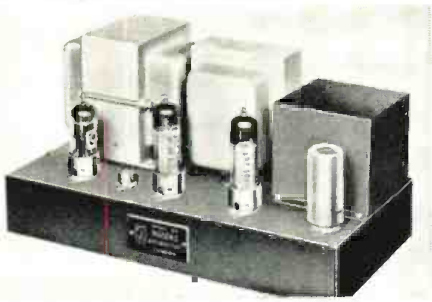
The MC Series, furnished in both round and rectangular shapes, is ideal for small, compact equipment, using either transistors or vacuum tubes. The units are rugged and immune to mechanical shock and varying conditions of heat and humidity.

The new microphones are available to both original equipment manufacturers and to the replacement market.

BRITISH AMPLIFIER

The Electronics Division of *Ercona Corp.,* 551 Fifth Ave., New York, N. Y. is handling the U.S. distribution of a 15-watt high-fidelity amplifier made by *Rogers Development Co.* of England.

The amplifier features *Partridge* transformers and an improved *Williamson* circuit. Frequency response is 20 to 30,000 cps, ±.25 db. Distortion is .12% at 10 watts while hum and noise is —85 db below 10 watts.



Power consumption is 60 watts and the equipment will operate on 110-117-125 volts, 50 or 60 cps. Over-all dimensions are 11" x 6" x 6". A specification sheet on this unit is available from the U.S. distributor on request.

MAGNETIC CARTRIDGE

A Danish-built, 8-pole magnetic cartridge has been placed on the American market by *Fenton Company,* 15 Moore Street, New York 4, New York.

The *B&O* "Lo-Z" cartridge has an

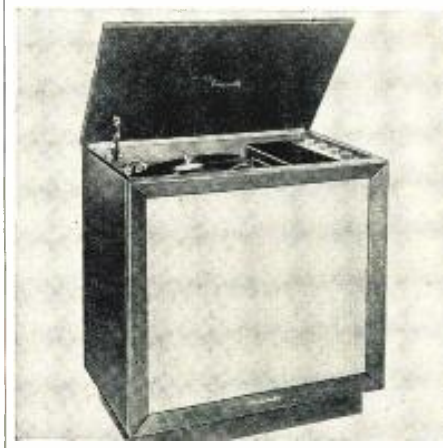
easily interchangeable armature. It features small mass and negligible inertia, freedom from resonance over the entire audible range, high compliance, and low record wear. Frequency response is flat from 20 to 16,000 cps ±2 db, then gradually rising to over 20,000 cps. The cartridge itself snaps into spring-loaded mounting hardware made to American standards. Four models are available: a single or dual stylus with sapphire tips and single or dual stylus with diamond tips.

The U.S. distributor will furnish complete details on these newly-released units on request.

PILOT CONSOLE PHONO

Pilot Radio Corporation, 37-06 Thirty-sixth Street, Long Island City 1, N. Y. has unveiled a new console phonograph which has been designated as the Model PT-1030.

The ensemble consists of the company's AA-903 10-watt amplifier with preamplifier, 5-position equalizer and tone controls; a speaker system comprised of a completely baffled, 3-way, four-speaker system with individual level setting controls for the bass and



mid-range speakers; and a *Garrard* RC-80 three-speed record changer with a *G-E* dual sapphire magnetic pickup. The entire system is housed in a mahogany or limed oak cabinet which is equipped with ready-roll casters for easy moving about the living room or to any room in the house.

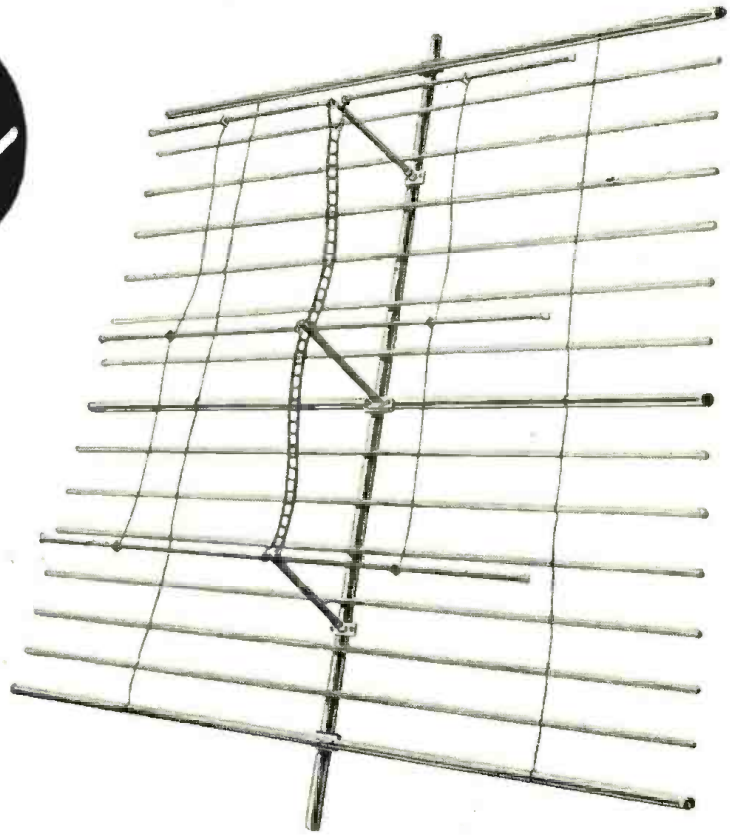
STEPHENS SPEAKER SYSTEM

Stephens Manufacturing Corporation, 8538 Warner Drive, Culver City, California is now offering a moderately-priced, two-way speaker system to the audio trade.

The new system features the company's 120LX 12" low-frequency driver, a 214 high-frequency driver with multicellular horn, and associated network. The use of an exponential, multicellular horn on the tweeter assures even wide-angle dispersement of highs. Impedance for the system is the usual 8 ohms.

Recommended enclosures for the new system are the company's Columbian #620 or the Coronado #622. Both are rear-horn loaded. They are available in walnut, blonde, and mahogany finishes. —30—

New! Revolutionary!



- ★ The GENERAL has a closely spaced screen (7 inches) to minimize pick up off the rear. With more and more stations coming on the air, on the same channel, this is a major problem of today and tomorrow.
- ★ The GENERAL is completely pre-assembled. By simply tightening three wing nuts, the antenna is ready to mount.
- ★ The GENERAL is light in weight with low wind resistance. Not only easy to put up, but easy to KEEP up.
- ★ The GENERAL is packed in a small carton. This makes the antenna more economical to ship, store, and handle.
- ★ The GENERAL sells for less than comparable products. This gives YOU a better mark up and faster moving merchandise.

Some Exclusive Territories Available To Aggressive Jobbers.

★The GENERAL is low enough in price to use in the most competitive market and is recommended for all locations.

The GENERAL combines 6 dipoles in a phased collinear array for super gain on channels 7 to 13 and features an interpolated dipole arrangement on channels 2 through 6 for a small physical size, high gain array on these channels. The GENERAL has peak gains of over 15 D.B. and is recommended for use in the most difficult reception areas.

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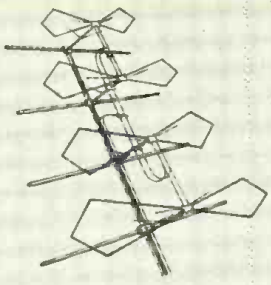

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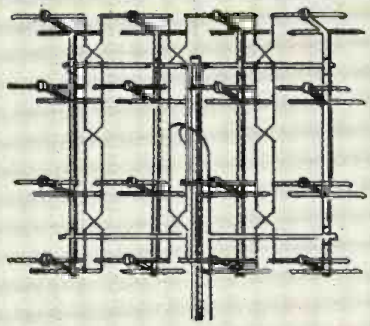

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The Pyramid model CRA-1 capacitor and resistor analyzer.

Quick-Check Capacitor Testers

You can now check capacitors without first removing them from the circuit by using the testers described here.

Sprague "Kwik-Test" capacitor checker.

THE trend in modern receivers is definitely towards printed circuits. And if you have ever had to remove or insert parts in such circuits, you know that it is not only time consuming but also fraught with numerous pitfalls, not the least of which is burning a hole through the base upon which the printed circuitry is embossed.

Two instruments have been developed recently which help to ease the technician's job in this respect. Both are capacitor checkers and both enable a technician to check capacitors for shorts, opens, and intermittents while the capacitor is still fully connected in its circuit. This avoids the need for first unsoldering the capacitor (at least one end of it) before a suitable test can be made. It also reduces the time lost unsoldering and checking capacitors that turn out to be good after all.

One instrument is the *Pyramid* Model CRA-1 capacitor-resistor analyzer. See photo. It contains a "quick check" circuit which will locate most shorted, open, and intermittent capacitors, as well as electrolytic units with high r.f. impedance (the latter a common cause of unwanted feedback and oscillations) without disturbing the wiring or unsoldering leads. The test can also be made even if inductors or resistors are in parallel with the capacitor. The only apparent limitation appears to exist in those cases where a capacitor is shunted by a resistor of 25 ohms or less, or by a low-impedance inductor; in these instances the meter may indicate a short even though the capacitor is good.

A simplified diagram of the *Pyramid* "quick check" circuit is shown in Fig. 1. The circuit consists of a balanced oscillator, a source of a.c. voltage, and an electron-ray indicator tube. The network is so arranged that it will not oscillate with the special "quick check" leads plugged into the instrument but with the test clips unconnected. (In Fig. 1, these leads would connect to the left-hand terminals marked "Blk" and "Red".) The wedge in the electron-ray indicator tube will be fully open. This is an indication of the absence of any internal r.f. voltage.

When the test clips are connected across a capacitor, one of three things will occur:

(1) The electron-ray indicator wedge will not deflect, revealing that the capacitor is open.

(2) The eye will fluctuate violently, as a result of the oscillator going in and out of oscillation. This is an indication that the capacitor is intermittent.

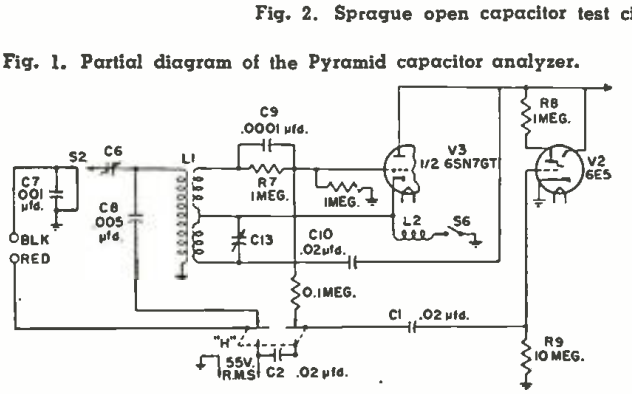
(3) The eye closes. This indicates that the capacitor is not open. It may, however, be shorted and additional checking is required to determine whether this is so.

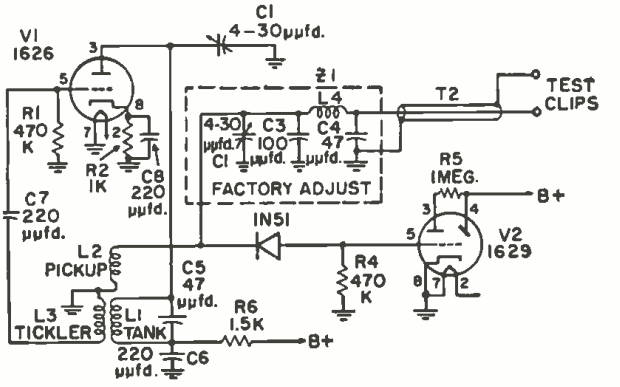
In the short test, the "H" switch (bottom of Fig. 1) is depressed. This places the capacitor under test across a source of a.c. voltage and connects the capacitor, in series with an internal .02 μfd. unit, across the electron-ray tube circuit. If the indicator wedge opens, the capacitor is short-circuited. (There are actually two switches for this test, with the value of the capacitor determining which switch is used. The principle, however, remains the same.)

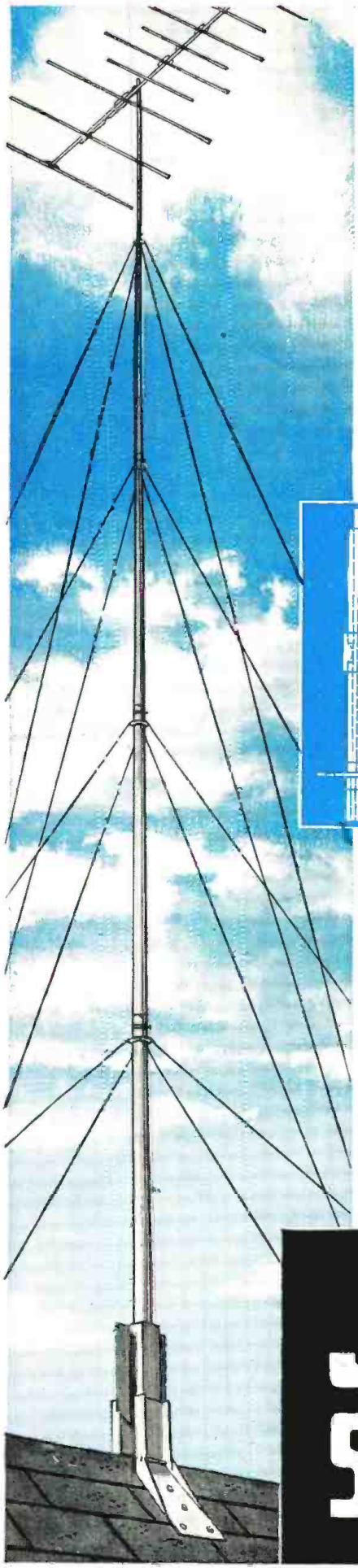
In addition to the "quick check" feature, the *Pyramid* analyzer will also perform those functions which any capacitor-resistor analyzer will do. This includes quantitative measurements of

Fig. 2. Sprague open capacitor test circuit.

Fig. 1. Partial diagram of the Pyramid capacitor analyzer.







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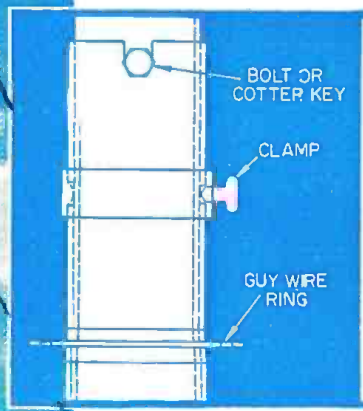

Only J&L Telescoping Perma-Tube offers:

- **Joint design which provides instant field assembly**
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No longer is it necessary to buy expensive, ready-made masts. Now you can "tailor-make" your own with standard 10-foot lengths of 16-gage J&L Perma-Tube—and save money.

It's available in cartons from your local distributor in five diameters. The largest base section OD is 2¼ inches and each telescoping section is ¼-inch smaller, the smallest section having an OD of 1¼ inches.

J&L Perma-Tube in the 1¼-inch size can be used interchangeably as a fitted-joint section for smaller masts or as the smallest and topmost piece of longer telescoping masts.

Corrosion-proof J&L Perma-Tube is treated with Vinsynite—then coated both inside and outside with a metallic vinyl resin base. It successfully passes ASTM's 500-hour-minimum salt spray test—which guarantees Perma-Tube's longer life on the job.

Sturdy J&L Perma-Tube is made of a special, high-strength, J&L-produced steel. A 10-foot section of 1¼-inch diameter by 16 gage can support a weight at its center point of 200 pounds with a minimum of deflection and permanent set.

Order these new telescoping sections along with your regular 1¼-inch J&L Perma-Tube. Hardware—cotter keys or bolts, clamps and guy rings—may also be secured from your local distributor. For more information write J&L direct.

J&L STEEL

Jones & Laughlin
STEEL CORPORATION — *Pittsburgh*

capacitance (from 10 $\mu\mu$fd. to 2000 μfd.), power factor (to 65 per-cent), capacitor leakage, insulation resistance, and ordinary resistance measurement (100 ohms to 25 megohms).

The second instrument designed to speed up servicing is the *Sprague* Model KT-1 "Kwik-Test" capacitor checker. See photo. This is a supplementary unit to the company's regular Model TO-4 capacitor-resistor analyzer. It checks capacitors in the circuit only for opens, shorts, and intermittents. Other tests, such as measuring leakage current or insulation resistance, must be made with the TO-4.

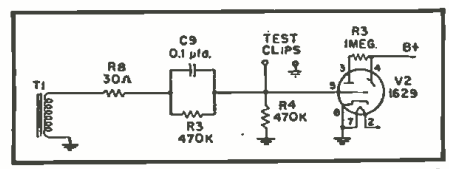
Fig. 3 shows the basic circuit of the short test. V_2 is an electron-ray indicator tube; T_1 is a winding on the power transformer. The test leads are connected to the points marked "Test Clips" and if they are shorted together, the voltage at the grid of the eye tube is zero. This causes a maximum opening. If the clips are open, the entire voltage appears at the grid of V_2 and the eye closes. Thus a shorted capacitor will cause the eye to remain open, while a normal capacitor will cause it either to close partially or completely, depending upon its reactance and the impedance of the circuit in parallel with it.

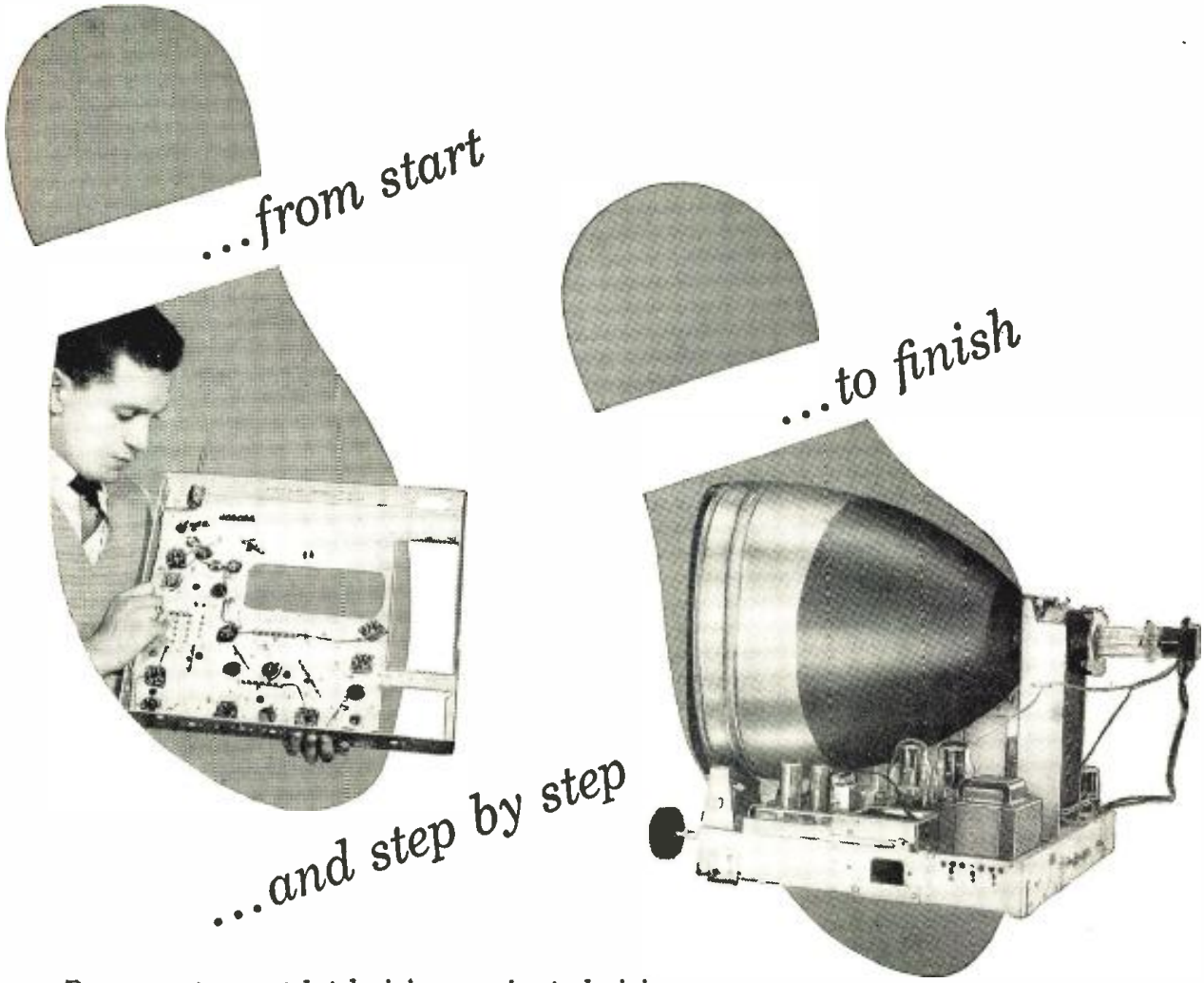
If the eye flutters during the test, the capacitor is intermittent.

Open capacitors are checked by the circuit shown in Fig. 2. Test cable T_2 and the network Z_1 constitute a quarter-wave transmission line operating at the frequency of approximately 20 mc. On such a line, any impedance connected across the output end is reflected to the sending end as a reciprocal. That is, if the output end is shorted, the input end "sees" an open circuit. In operation, if the test clips are open or are connected to an open capacitor, the sending end, L_2, "sees" a short circuit (zero voltage), which causes the eye to remain open. Any normal capacitance connected to the clips results in a voltage across L_2 which is rectified by the 1N51 crystal and then impressed upon the grid of V_2. This d.c. voltage causes the eye to close in proportion to its magnitude. A small capacitor will produce a small closure, a large capacitor will cause the eye to close completely.

Neither the open or short test will give correct results if the capacitor is in a parallel resonant circuit tuned to a frequency higher than 10 mc. Aside from this, however, there are surprisingly few limitations on the use of this instrument. Technicians who already have their basic complement of service equipment would do well to consider acquiring one of the "quick checkers" described. —30—

Fig. 3. Simplified diagram of the shorted capacitor test circuit of Sprague unit.





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Cathedral Sound in a Parish Church

By DR. JOHN J. STERN

EVERYBODY associates church music with the majestic reverberations of choir and organ in a cathedral. The mighty chords of the organ linger on, combine with the voices, and produce a feeling of space which creates an unforgettable musical and spiritual experience. Composers of religious music often seem to take these echo effects into account and incorporate them into their mental picture of how their music will sound in performance.

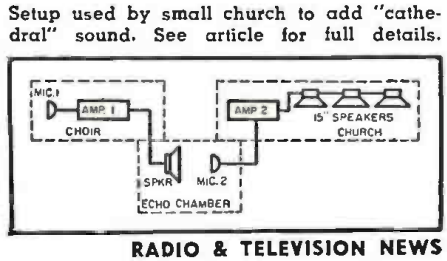
But what about the modest parish church, seating maybe 300 or 400, built without much consideration of reverberation and acoustics? It might have a fine little organ, a well-trained, enthusiastic choir of 10 or 12 voices—but how flat and dry this music usually sounds! How can an ambitious choir director improve his acoustic environment without rebuilding the church?

The answer is, of course, an electronic one: Why not try an echo chamber? A musical friend of mine, choir director in such an acoustically uncongenial church, experimented with the author in an attempt to enliven the sound in his church, which was particularly disappointing when the congregation represented, acoustically speaking, a sound-absorbing lining. We were fortunate in one respect: The church had three 15" speakers built into the ceiling, fed from a record player and a 20-watt power amplifier. The next step was to get two microphones and a second smaller amplifier, and to look for a room which could serve as an echo chamber. The ideal spot seemed to be the large, empty basement underneath the church itself.

The choir and organ are picked up by a crystal microphone which feeds into a 10-watt amplifier. Its output runs an eight-inch speaker in the basement, where the cavernous reverberations are picked up by a second microphone. This feeds into the main amplifier which is connected with the three 15" speakers in the ceiling.

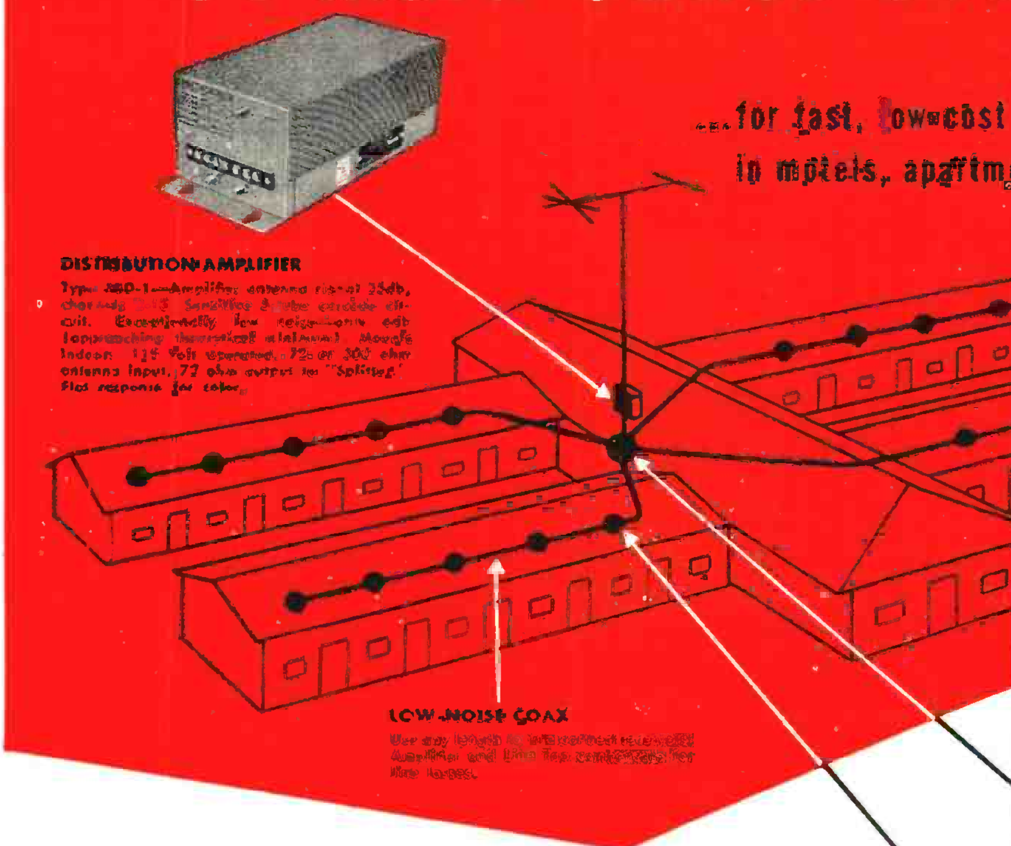
The effect is stunning. The amount of reverberation can be regulated by the organist who has the first amplifier near his manuals. Feedback may be a problem, but can be avoided by judicious placement of mike and choir. A lot of experimenting will be necessary, but the result is worth the time one spends on it. —30—

Setup used by small church to add "cathedral" sound. See article for full details.

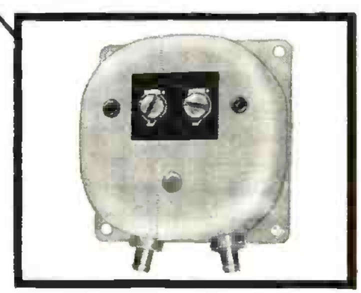


Jerrold

TV *Multi-Outlet* SYSTEM



LINE SPLITTER (if needed)
Type T1604—Equally divides amplifier output up to 4 ways. No tubes. Cannot overload.



LINE TAP IMPEDANCE MATCHER
One for each receiver. Compensates for line response tilt. Completely isolates receivers from each other. Matches 72 ohm feed line to 300 ohm set. No tubes.

Here's a TV *Multi-Outlet* distribution system that gives clean, snow-free reception to every receiver . . . with an increase in signal strength and with signal-to-noise ratio maintained in the bargain. A single *Multi-Outlet* Jerrold System can feed 20 receivers, and Jerrold Distribution Amplifiers can be grouped for larger installations. Reception at each receiver, on all channels, will be the best the antenna can provide in the area.

The complete Jerrold Distribution System designed for 24 hour operation is built to the same standards as larger Jerrold Community TV systems which serve as many as 5000 sets from a single antenna. Yet a Jerrold *Multi-Outlet* System costs less than half the price of ordinary installations using unsightly separate antennas for each receiver.

Investigate this profitable field now! Send for free catalog sheets describing all components.

INSTALLATION MADE EASY
Profusely-illustrated booklet tells all about distribution systems—theory, cost estimates, installation, etc. Free with each ABD-1 Amplifier. 25c separately. Write for your copy today.

JERROLD

JERROLD ELECTRONICS CORPORATION
2214 CHESTNUT STREET
PHILADELPHIA 3, PA.

Superior's new Model 670-A

SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new streamlined Model TC-55

TUBE TESTER

QUICKLY AND EFFICIENTLY TESTS RADIO AND TV TUBES INCLUDING: SEVEN PIN MINIATURES; EIGHT PIN SUBMINARS, OCTALS AND LOCTALS; NINE PIN NOVALS

YOU CAN'T INSERT A TUBE IN THE WRONG SOCKET.
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"FREE-POINT" ELEMENT SWITCHING SYSTEM.
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap."

CHECKS FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS.
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATIONS.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.
Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

About Testing Picture-Tubes...

Of course you can buy an "adapter" which theoretically will convert your standard Tube Tester into a picture-tube tester. Sounds fine—but—it simply doesn't work out that way!
We do not make nor do we recommend use of C.R.T. adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a make-shift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensable instrument.
Incidentally, the Model TV-40 is the only low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electric-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

C.R.T. TUBE TESTER

Tests *all* magnetically deflected tubes...in the set...out of the set...in the carton!!

SPECIFICATIONS:

- Tests *all* magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (*Ion trap need not be on tube*). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only

$15.85 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try any of the above instruments for 10 days before you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-158 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name .....

Address .....

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

☐ Model 670-A.....Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.

☐ Model TC-55.....Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 6 months.

☐ Model TV-40.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

The Model TV-50 GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A. M. Radio F. M. Radio Amplifiers Black and White TV Color TV

7 Signal Generators in One!

- R. F. Signal Generator for A.M.
- R. F. Signal Generator for F.M.
- Audio Frequency Generator
- Bar Generator
- Cross Hatch Generator
- Color Dot Pattern Generator
- Marker Generator

SPECIFICATIONS:

R. F. SIGNAL GENERATOR:

The Model TV-50 Genometer provides *complete* coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. Accuracy and stability are assured by use of permeability trimmed Hi-Q coils. R.F. is available *separately*, modulated by the fixed *400 cycle sine-wave* audio or modulated by the *variable* 300 cycle to 20,000 cycle variable audio. Provision has also been made for injection of any external modulating source.

VARIABLE AUDIO FREQUENCY GENERATOR:

In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. This service is used for checking distortion in amplifiers, measuring amplifier gain, trouble shooting hearing aids, etc.

BAR GENERATOR:

This feature of the Model TV-50 Genometer will permit you to throw an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. A Bar Generator is acknowledged to provide the quickest and most efficient way of adjusting TV linearity controls. The Model TV-50 employs a recently improved Bar Generator circuit which assures stable never-shifting vertical and horizontal bars.

CROSS HATCH GENERATOR:

The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines *interlaced* to provide a stable cross-hatch effect. This service is used primarily for correct ion trap positioning and for adjustment of linearity.

DOT PATTERN GENERATOR *(For Color TV)*

Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for *proper color convergence*. When all controls and circuits are in proper alignment, the resulting pattern will consist of a sharp white dot pattern on a black background. One or more circuit or control deviations will result in a dot pattern out of convergence, with the blue, red and green dots in overlapping dot patterns.

MARKER GENERATOR:

The Model TV-50 includes *all* the most frequently needed marker points. Because of the ever-changing and ever-increasing number of such points required, we decided against using crystal holders. We instead adjust each marker point against precise laboratory standards. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency.)

The Model TV-50 comes absolutely complete with shielded leads and operating instructions. Only .....

$47.50 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C. O. D.

Try it for 10 days before you buy. If completely satisfied *then* send $11.50 and pay balance at rate of $6.00 per month for 6 months. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-158, 3849 Tenth Ave., New York 34, N.Y.

Please rush one Model TV-50. I agree to pay $11.50 within 10 days and to pay $6.00 per month thereafter. It is understood there will be no finance, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

Address.....

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

Improving Amplifiers

(*Continued from page* 51)

It has been found that the energy of the disturbances is distributed uniformly throughout the entire frequency spectrum used for communications.

The amount of voltage that is developed by thermal agitation in conductors is computed from the following relationship:

$$E^2\ (r.m.s.) = 4KTR \times (f_2\text{-}f_1)$$

where: E = the r.m.s. value of the voltage generated across the resistance.

K = constant = 1.37×10^{-23} watt-second/degree.

T = the temperature of the conductor (it is expressed in absolute degrees, Kelvin, which is equal to 273 plus the temperature in degrees, centigrade).

R = the value of the resistance, in ohms.

$f_2\text{-}f_1$ = the bandwidth of the system, here actually from 30 to 15,000 cycles since this is the normal limit of audibility for most people.

Since the amount of noise generated is quite small, only that appearing in the first one or two stages of a system is important. Work which has been done on noise-evaluation in resistors[1] indicates that the amount of noise generated decreased with the wattage rating of the resistor. Thus, 1-watt resistors of a certain value produced less noise than ½-watt resistors and the latter were better than ¼-watt units. Furthermore, deposited film resistors and non-inductive wirewound resistors produced considerably less noise than composition resistors of the same rating. If these results are put to use in the first few stages of an amplifier, the noise reduction can be substantial.

The other main source of internal noise is in the tubes. We obtain a series of overlapping impulses due to the fact that the current flow from the cathode to the plate of a tube is not a continuous fluid but a moving congregation of separate particles, the electrons. This is known as the "shot effect." We obtain noise even when so-called steady current is flowing, because, at any single moment, more electrons are impinging on the plate than at some other moment. Over any time interval, the current is steady, but instantaneous fluctuations represent the noise component. Examination has revealed that the energy of the noise is distributed evenly throughout the frequency spectrum. In this respect it resembles the noise arising from thermal agitation.

With respect to tube noise, very little can be done. There are special low-noise tubes which have been designed for application in the low-level stages of audio amplifiers, but unless your system contains such a tube, it is ordinarily not suggested that a change be made, since this would require a redesign of the system. However, in the choice of amplifiers, it is well to keep this fact in mind. The best known low-noise tube is the 12AY7; this is a dual triode. Another is the *RCA* 5879, and the British Z729. The latter two are pentodes.

[1]Krebert, M. V.: "The Williamson Type Amplifier Brought Up To Date." Audio Engineering, August, 1952.

Circuit Balance

Two of the major advantages of push-pull output amplifiers are their practical elimination of second harmonic distortion and the greater permissible drive at the input providing a stronger output with less odd-harmonic distortion. These advantages, however, are possible only when both halves of the system are properly balanced and both are receiving the same amount of input signal. The greater the deviation from this balance, the less benefit we receive from the use of push-pull operation.

In checking for balance, there are a number of factors to keep in mind. First of all, the push-pull output stages themselves must be balanced and this is usually determined by measuring the cathode current through each tube.

Another item to check is the applied signal to each tube and whether or not these are equal. A good test frequency is in the range of 1000 to 2000 cycles. Any indication of unequal input signals means that the preceding phase inverter is unbalanced. It may be that both halves of the phase inverter (if two sections are used, as in the Williamson amplifier) are not functioning with equal vigor, or resistor values may have changed. Whatever the cause, it should be corrected.

At this point, many technicians might feel that the system was balanced. For the middle range of frequencies this might be true; but what about the low- and high-frequency ends of the band? At the low end, supposedly equal-valued coupling capacitors may differ considerably from each other and this would cause each push-pull tube to receive unequal amounts of signal. At the high end, the balance may be upset by stray shunting capacities. With signals of the proper frequencies, check response at both ends and only when equal signals are obtained at all frequencies can you be assured of receiving *all* the advantages of this form of operation.

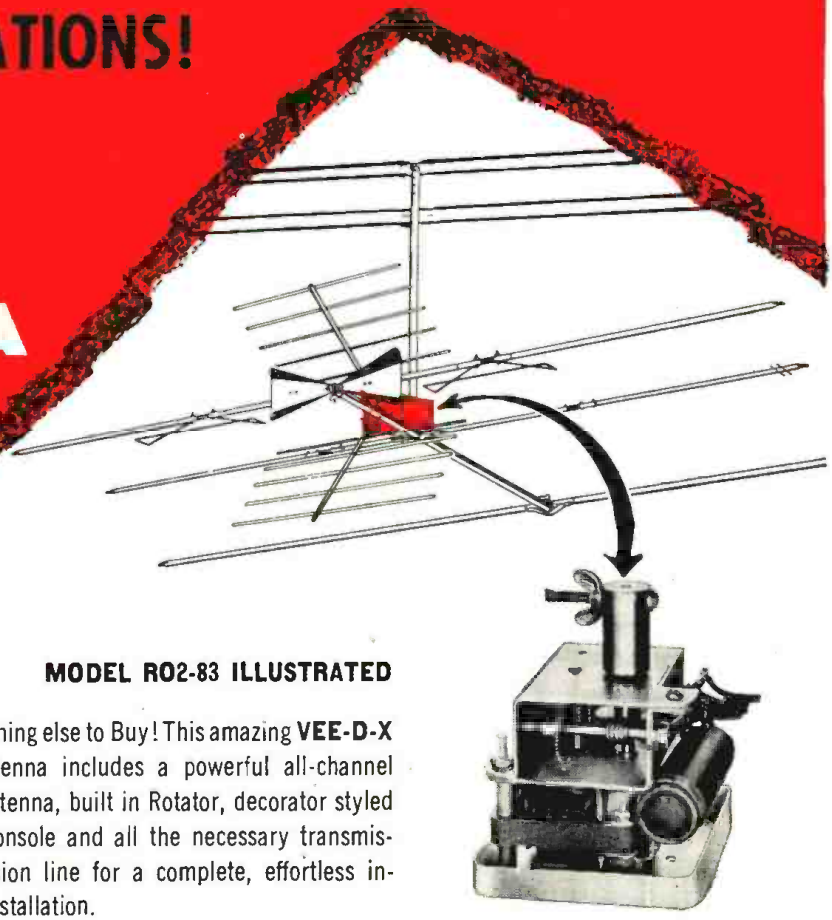
Stray capacitance is a function of parts layout and a better balance will be obtained if care is taken to make the system leading into the push-pull stages as physically symmetrical as possible. A little attention to details will pay off in cleaner sounding high notes. At the low-frequency end, check supposedly equal coupling capacitors and matched grid resistors to see whether they come within 5 per-cent of each other. If they do not, replace them with units that do.

Low-frequency response can also be improved by using larger filter ca-

a LOW COST ALL-CHANNEL ANTENNA & ROTOR for ATTIC INSTALLATIONS!

The

VEE-D-X ROTENNA



MODEL RO2-83 ILLUSTRATED

Nothing else to Buy! This amazing **VEE-D-X** Rotenna includes a powerful all-channel antenna, built in Rotator, decorator styled console and all the necessary transmission line for a complete, effortless installation.

- **Complete Kit—Antenna—Rotator—Console—50 ft. 300 ohm transmission line—50 ft. 4 wire rotator line—isolation network for UHF-VHF—4 dual-line stand off insulators—Aluminum Mast**
- **Rotenna requires only 56" of radial space to rotate.**
- **Rotating Speed 1½ R.P.M.**
- **Easy to stock**
- **Can be installed 365 days of the year.**

Compact enough to fit in all attics, this **VEE-D-X** Rotenna provides Better Picture Quality than the average outdoor antenna . . . without climbing on Rooftops . . . marring the appearance of the house.

Installed within minutes—never affected by Rain, Sleet, Snow or Windstorms. Compact Rotator unit has long life motor—rotates in either direction.

Beautifully designed control console operates with convenient downward pressure, available in Heather Green or Cordovan Mahogany.

MODEL RO2-83
ALL CHANNEL UHF-VHF
$34.95 COMPLETE

MODEL RO-2-13
ALL CHANNEL VHF
$29.95 COMPLETE

Write **NOW...**

LaPointe ELECTRONICS, INC.
ROCKVILLE, CONN.

Please send me specification sheets on RTN-1

☐ **RO2-83** ☐ **RO-2-13**

Name.....

Address.....

City..... State.....

pacitors in the decoupling networks between stages. Ten microfarads is a common value; raising these to 30 or 40 μfd. will serve to improve the low-frequency response.

The foregoing suggestions are put forth with the idea of helping technicians improve the quality of existing amplifiers. Basic design has, at no point, been altered; all that has been recommended is refinements. —30—

Special Effects Amplifier

(*Continued from page* 67)

tors. However, it should be noted that the linearly damped wavetrains of some of the percussive sounds only represent one of the many possibilities in envelope modulation. For example, two or more balanced modulators may be used to obtain different attack and decay rates for different frequencies, a situation frequently found in nature. Of course, an oscilloscope is very useful in experiments of this kind, as it permits a considerable degree of analysis of both waveforms and of modulation envelopes. A tape recorder may be used as a convenient method of examining particular sound patterns as a small endless loop of tape may be made which will play back continuously. Likewise, the tape recorder may be used instead of the audio oscillator as a signal source for modulation experiments.

Noise may also be used as a signal source, obtained either from a noise generator or from a record, and quite impressive electronic explosions can be obtained by triggering the balanced modulator. Pistols, rifles, machine guns, and other types of explosive sounds can be simulated by proper choice of time constants, repetition rates, and frequency bands of noise. An excellent device of this nature has been created by Hathaway for the *NBC* sound effects department.

So far we have considered relatively slow modulation rates, with modulation envelopes lasting as long as several seconds. Another class of effects may be achieved by modulating an incoming signal at rates of three cycles-per-second or higher. For example, speech or music may be modulated at the rate of three to thirty cycles-per-second with curious results. In a small room the amplitude variations are very noticeable, but may interfere surprisingly little with the intelligibility of speech, although providing effects that may vary from that of an overseas broadcast to someone about one-hundred-and-fifty years old. However, in larger areas, with live acoustics, the modulation component may be much less noticeable, and some actual benefit achieved in public address or sound re-enforcement work as the modulation component tends to reduce acoustic feedback. Similarly, poor acoustics may actually serve to "fill in" the holes produced by modulation, instead of producing cancellation or standing-wave patterns as they would in the

case of a conventional sound system.

Modulation rates above thirty cycles-per-second may be used to create interesting effects, but other than this seem to have little utility as they introduce a buzzy or raspy effect into the reproduction. Nevertheless, in the creation of musical tones this technique is of interest in generation of special qualities or timbres.

In conclusion, it might be noted that although the modulator circuit shown in this article represents a simple, compact device of considerable utility, it still is only a point of departure compared to the possible complexity of equipment that might be used. Similarly, only a few of the possible applications and effects obtainable have been mentioned. —30—

ELECTRONIC GEAR VS A-BOMB

IN ONE of the first reports regarding the "survival" of electronic equipment at the recently-held A-Bomb tests at Yucca Flats, Nevada, General Electric Company has revealed that on the whole commercially-built electronic gear proved to be remarkably rugged in the face of the destruction accompanying the explosion.

Thirty companies participated in the test at the request of the RETMA and FCDA. Approximately 150 products, covering all types of radio communication were tested. Various pieces of equipment were housed in residences in situations approximating placement under normal conditions. While the buildings were damaged by the blast, the electronic equipment showed remarkable durability.

While the full report of the FCDA-RETMA committee remains classified pending review by the Atomic Energy Commission, it is expected to be made available to the industry shortly.

Equipment taken from the test areas has been returned to participating manufacturers for further damage assessment. Based on preliminary conclusions, it is not expected that participating companies will plan any extensive changes in their current models. Minor alterations may be undertaken but it was indicated that most manufacturers will probably hold the line on present equipment because of the ruggedness shown at Yucca Flats.

Preliminary evaluation of gross damage after the nuclear explosion revealed nearly all items were operable or readily repairable. Damage was due almost wholly to falling structures. Radiation was not a problem and thermal damage was insignificant. No broken vacuum tubes or TV picture tubes were observed. A 250-watt AM broadcast transmitter did not return to the air three minutes after the blast as hoped for, but this was attributed to breakage of the wires carrying ordinary 60 cycle current into the building housing the transmitter. Three steel antenna towers were still standing after the blast.

For purposes of comparison, two distances were used—4700 feet from ground zero, where severe damage to surface structures was expected, and 10,500 feet where equipment damage proved to be much less severe because the effect of the explosion on housing structures was substantially less.

Based on these preliminary reports, the electronic equipment proved that it could "take it." —30—

COIL REPLACEMENTS

J. W. Miller Company, 5917 South Main Street, Los Angeles 3, California is currently offering copies of its new 64-page "TV Technician's Coil Replacement Guide" to the service industry.

The guide, which is designated as #156, contains more than 2000 different chassis and nearly 11,000 TV model numbers, cross-referenced for all of the set manufacturers' coil numbers with the *Miller* replacement.

The company has also announced publication of a new general catalogue, #56, which lists nearly 1000 different replacement items which are stocked by the company at all times. The items include r.f. chokes, line filters, AM coil kits, i.f. transformers, line filter chokes, industrial coils, and special i.f. windings.

Either or both of these publications is available upon written request to the manufacturer.

ANTENNA DATA

Winegard Company, 3000 Scotten Blvd., Burlington, Iowa, is offering new literature on its low-cost line of "Pixie" antennas.

The publication describes the antenna's new and exclusive "Dicon" element design. This new element combines the most desirable features of both the conical and folded dipole antennas into one element but eliminates the undesirable features of each.

At the present time there are three antennas in the "Pixie" line—all of which are described in detail in the data sheet.

CONNECTOR BULLETIN

A new bulletin describing the complete line of AN electrical connectors manufactured by the *Deutsch Company,* 7000 Avalon Blvd., Los Angeles, Calif., is now available to users in the electronic, aviation, instrument, radio, television, and allied industries.

The publication briefly describes the fields of application for this type of electrical connector and provides general information on performance requirements, size and capacity, basic parts, and the numbering system used.

When writing for a copy of this publication, please specify Bulletin PN-1.

DECADE BOX DATA

Telex, Inc., Telex Park, St. Paul 1, Minn., has published a new data sheet describing the features of its miniature decade resistance unit.

Designed for use in analogue-computing equipment and in circuit development and specialized electrical laboratories, the unit is approximately one-fifth the size of standard decade resistors, yet is available in maximum resistance values of 1 to 10 megohms. A photograph of the unit and complete product specifications are given in the literature.

STEPHENS CATALOGUE

The Stephens Manufacturing Corporation, 8538 Warner Drive, Culver City, Calif. is now offering a new and uniquely designed catalogue to the trade.

The catalogue is made up of five separate looseleaf sections placed in a cover which has folded ends that form a pocket. The first three sections are four pages each: two dealing with speaker enclosures, the third with coaxial and full-range loudspeakers and speaker systems. The last two are two-page sheets concerned with component loudspeakers, horns, networks, and theater installations. This design permits quick, ready reference to individual sections.

Copies are available without charge from the company.

CLAROSTAT CATALOGUE

Clarostat Mfg. Co., Inc., Dover, N. H., is currently offering copies of its latest catalogue to the industry.

Designated as No. 55, the new publication contains more pages, more items, and more listings of resistors, controls, and resistance devices than previous editions.

Notable features of the publication are handy assortments of wirewound resistors mounted on display cards, fuse-type resistors for TV, deposited carbon precision resistors, industrial type and precision controls for laboratory and other semi-critical applications, etc.

ERIE RESISTORS

Erie Resistor Corporation, Erie, Pa., has announced publication of its new catalogue "D-55" for distributors, service departments, laboratories, industrials, product engineers, and amateurs.

The new publication includes additions to the company's standard lines and two important new lines. The firm's "Teflon" electronic components include stand-off and feedthrough insulators, sockets, and spaghetti. Also shown are the electronic components of *Corning Glass Works,* including various types of capacitors and resistors which are available through *Erie* distributors.

Copies of the catalogue can be picked up at distributors or from Dept. S of the company.

WALCO NEEDLE CHART

Electrovox Co., Inc., 60 Franklin St., East Orange, N. J., has developed a new method of positive phonograph needle identification using the name of the phonograph manufacturer as the only reference.

Known as the "Walco Ident-I-Graf," the new chart will give positive needle identification in five to ten seconds. Designed as a simple 8" x 10" slide chart,

the "Ident-I-Graf" is constructed of heavy varnished cardboard and printed in two colors. For further ease of needle identification, the chart illustrates dozens of the most popular needle and cartridge types. The reverse side provides identification through cartridge manufacturer's data.

Complete information for obtaining this chart will be supplied by the manufacturer on request.

"HEADLINERS FOR HAMS"

The Tube Division of *Radio Corporation of America* has published a completely revised edition of its popular four-page folder, "Headliners for Hams".

The folder covers 45 popular *RCA* ham tube types—oscillators, amplifiers, frequency multipliers, voltage regulators, thyratrons, rectifiers, oscillograph types for test equipment, and camera tubes for use in amateur telecasting.

"Headliners for Hams" contains a tube line-up chart for amateur transmitters; operating conditions for class C amplifier and oscillator, modulator, and frequency-multiplier service; single-sideband tube data; and latest ham ratings on popular receiving-tube types.

Copies are available from local tube distributors or from the Commercial Engineering Department of the Tube Division, Harrison, N. J.

STANCOR TRANSFORMERS

A new 24-page catalogue of *Stancor* transformers for replacement and original equipment applications has just been published by the *Chicago Standard Transformer Corporation*, Addison and Elston, Chicago 18, Ill.

This new catalogue is a completely revised and expanded reference book, listing 543 transformers and related components. It contains detailed electrical and physical specifications for each unit, in an easy-to-read type. Illustrations of each transformer type appear on the same page as the transformer listing.

Copies of this catalogue are available without charge from the firm's distributors or from the company direct.

TWEETER-NETWORK DATA

The Distributor Division of *Permoflux Corp.*, 2835 N. Kedzie Ave., Chicago 18, Ill., is now offering copies of its Engineering Data Sheet No. JC-101.

The sheet covers schematic diagrams, response curves, complete specifications, and a detailed description of performance characteristics on the company's Model 32KTR super tweeter and the Model NK-60 crossover network.

Copies of the data sheet are available either from local distributors or from the company direct.

ULTRASONIC EQUIPMENT

Acoustica Associates, Inc., Shore Road, Glenwood Landing, L. I., N. Y., has published a bulletin describing its Model DR-400 ultrasonic cleaning equipment for production cleaning and

degreasing of precision products for the electronic, electrical, radio and TV, photographic, and instrument manufacturing industries.

An explanation of the unit's operation is given in the data sheet along with complete specifications on the DR-400.

TEKTRONIX SCOPES

A new 16-page booklet describing the company's line of oscilloscope and plug-in amplifiers has been issued by *Tektronix, Inc.*, P. O. Box 831, Portland 7, Ore.

Included in the publication are details on the Type 530 series oscilloscopes, Type 53 plug-in units, and Type 53/54 plug-in units. Complete descriptions and specifications are given in this lavishly-illustrated booklet. Copies are free on request.

POWER SUPPLIES

Kepco Laboratories, 131-38 Sanford Ave., Flushing 55. N. Y., has available a compact, fact-filled booklet covering its line of power supplies.

Twenty-four different models are pictured and described in detail with performance specifications presented in tabular form for quick and easy reference.

Copies of this booklet are available without charge from the manufacturer on request.

E-V CONDENSED CATALOGUE

A new condensed catalogue. No. 123, has been issued by *Electro-Voice, Inc.*, Buchanan, Mich.

The 14-page publication gives basic information on television, broadcast, p.a., recording, communications, and special purpose microphones and accessories as well as high-fidelity speakers, speaker systems, components and enclosures, and high-fidelity cartridges.

Details on the company's "Circlotron" amplifiers and CDP compound diffraction p.a. loudspeaker systems are also given along with information on replacement phono cartridges, FM boosters, etc.

WCEMA DIRECTORY

The 48-page 1955 product list and membership directory of the West Coast Electronic Manufacturers Association has just come off the press.

Over 190 member companies from San Diego to Seattle are listed in the directory, and all products manufactured by members are classified for easy reference.

Copies of the directory are available to purchasing agents and buyers. Requests should be made on company letterheads to Don Larson, WCEMA General Manager, 339 S. Robertson Blvd., Beverly Hills, Calif.

LAFAYETTE CATALOGUE

Lafayette Radio, 100 Sixth Ave., New York, N. Y., has released a 64-page catalogue, No. 6-55.

A wide assortment of radio, TV, and high-fidelity equipment is pictured and described in this flyer. The publication

lists amplifiers, TV boosters, microphones, record players, receivers, tape recorders, phono parts, speakers, antennas, hardware of all types, tools, TV accessories, tubes, resistors and capacitors, intercoms, p.a. systems, as well as various items of optical equipment.

Free copies of this catalogue are available on request.

PRINTED CIRCUIT DATA

International Resistance Company, 401 North Broad Street, Philadelphia 8, Pa. has issued a new bulletin covering its Type MCR molded printed electronic circuits.

Catalogue Data Bulletin M-1 provides comprehensive details on the types, construction, applications, dimensions, design service, leads and terminals, etc. of the circuits currently available in the line.

PANEL INSTRUMENTS

A data sheet on the company's line of 4½ inch custom panel instruments is currently available from *Phaostron Company*, 151 Pasadena Ave., South Pasadena, Calif.

Physical and electrical specifications on the line are included in tabulated form for easy reference. The instrument is illustrated full size to demonstrate the ease with which the meter scales can be read.

TRANSISTOR APPLICATIONS

A new book, entitled "Transistor Applications" has been published by *Raytheon Manufacturing Company* of 55 Chapel Street, Newton 58, Mass.

This 116-page illustrated manual gives constructional details on over 50 different types of transistorized equipment.

In addition to the articles, many of which originally appeared in this magazine, the booklet lists complete technical data on the company's low cost units and pertinent technical information for the 11 types of transistors now in the firm's line.

The booklets are 50 cents a copy and are available from *Raytheon* tube distributors or from Department P-7 of the company. —30—

A Raytheon foursome looks over advance copies of the company's new transistor booklet. From left to right are: Charles W. Martel, Norman B. Krim, Robert K. Dixon, and Herbert F. Starke. Messrs. Martel, Dixon, and Starke have articles in the new book.

Tape Recording

(*Continued from page* 59)

Frequency of the bias current is governed by two requirements: (1) It should be outside the audio range. (2) It should be several, preferably at least five, times as great as the highest audio frequency recorded in order to avoid beat effects between the bias frequency and harmonics of audio frequencies. Bias oscillators therefore operate in the range of 30 to 150 kc.

It is necessary that the resonant frequencies of the record and erase heads be in the neighborhood of the bias frequency or above it, otherwise, losses in bias and erase current would occur because low capacitive reactance of the heads at the bias frequency would act as a short circuit.

Current required by the erase head may be 10, 20, or more times as great as that required by the record head. Therefore it is necessary to limit the current to the record head by means of a resistor or capacitor. Optimum bias current varies with type of tape and speed of the recorder. The better machines enable bias to be readily varied and metered. Sometimes the vu meter of the record preamplifier is employed through a switching arrangement; a special scale on the meter is then used for reading bias current.

The bias oscillator should generate a sine wave with negligible harmonic distortion to keep noise at a minimum. Symmetry of the waveform is very important. An asymmetrical sine wave in effect contains a d.c. component which corresponds to the difference between the amplitudes of the positive and negative portions of the wave. As previously indicated, a d.c. component in recording results in noise. This noise is "developed" in the tape by a d.c. component in either the record or erase head. Moreover, asymmetry of current (as well as other causes, such as sudden cut-off of a large signal, accidental contact with magnetized tools, etc.) may produce a degree of magnetization of the record and erase heads. This results in a further d.c. component in recording and additional noise. For this reason users of professional machines frequently demagnetize the heads with an a.c. electromagnet which is slowly brought to the heads and slowly removed. (The same condition and cure applies to the playback head, which tends to become magnetized owing to the natural asymmetry of audio waveforms.)

The bias oscillator is usually located within the unit which contains the record and playback preamplifiers. In some instances it may be located in the transport mechanism or in a separate unit.

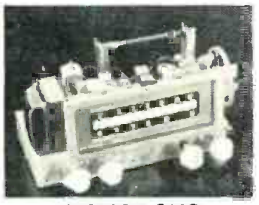
Next month's article will cover the tapes used in home recording and discuss their contribution to over-all recording quality.

(*Continued Next Month*)

McGEE OFFERS $100,000 STOCK OF CUSTOM RADIO CHASSIS

NEVER BEFORE AT SUCH LOW PRICES! EVEN SAVE ON COAXIAL SPEAKERS AND RECORD CHANGERS

PICK YOUR CHASSIS FROM THESE THREE EACH ONE AN OUTSTANDING McGEE VALUE!



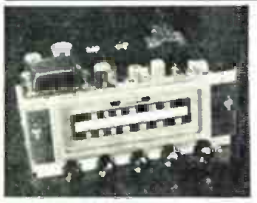
JACKSON FA8C

8-TUBE—FM-AM

REGULAR $59.95 VALUE
SALE PRICE ONLY **$29.95** LESS SPEAKER

Tone Control—Slide Rule Dial
88-108 MC—540-1600 KC

Jackson Model FA8C, 8 tube FM-AM custom chassis. Receives broadcast 540 to 1600 kc and FM 88 to 108 mc. Full superhet with AVC, input for crystal pickup with radio-Phono switch on front of chassis. Has 9" etched glass slide rule dial and full size "High-Q" ferrite loop stick antenna mounted on chassis. Separate antenna for FM. Bass boost tone control. Complete with tubes: 12AT7, 6BE6, 2-6BA6, 6AL5, 6AQ5 and 6X4 rectifier. Output transformer matches 3.2 or 8 ohm speaker. Chassis size, 7" x 13" x 7" high. Knobs, escutcheon, diagram and instructions included. Model FA8C, Sale price, now only $29.95. Ship. wt. 12 lbs. With Model CU-14Y, 12" coaxial speaker, $10.00 extra. 15" coaxial speaker, $20.00 extra.



JACKSON AM9A

9-TUBE HI-FIDELITY

12 Watts Audio
Dual Tone Controls
$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

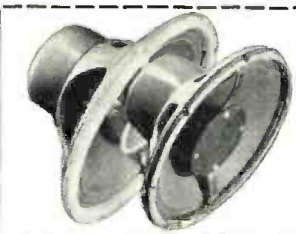
Jackson AM9A, 12 watt hi-fi audio amplifier and broadcast tuner combined. Less than you would pay for the amp alone. Push-pull 6V6's. Response 30 to 15,000 cps. Inputs for crystal or v.r. phono and crystal or dynamic mike. Separate bass boost and treble tone controls, radio-phono switch. Shielded output matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power trans. 9½" illuminated slide rule dial. 3 gang condenser with tuned R.F. and loop ant. Receives 550 to 1650 kc. Size, 13" x 9½" x 6" high. With tubes: 2—6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2—6V6 and 5Y3. Knobs, escutcheon, diagram and instructions included. Model AM9A. Ship. wt. 19 lbs. Sale price, $39.95. CU-14Y 12" coax speaker, $10.00 extra; 15" coax speaker, $20.00 extra.

11-TUBE FM-AM HALLICRAFTERS

HALLICRAFTERS S-78A

Regular $89.50
McGEE'S SALE PRICE **$69.95** LESS SPEAKER
★ HIGH FIDELITY
★ AUTOMATIC FREQUENCY CONTROL

Hallicrafters Model S-78A, 11 tube FM-AM superhet custom chassis. Size 7⅜" x 12½" x 11" deep. Complete with tubes, knobs, escutcheon, diagram and instructions. Receives broadcast 540 to 1700 kc, plus FM 88 to 108 mc. AFC holds FM stations in perfect tune. Output transformer matches 3.2 ohm or 500 ohm. High fidelity response, 50 to 14,000 cps. Bass boost tone control. A full 11 tube transformer powered chassis with push-pull 6K6 audio. This chassis found in S400 to S600 radio combinations. Has input for crystal phono pickup. Self-powered preamplifier necessary for G.E. variable reluctance cartridge, $3.95 extra.
S-78A Hallicrafter 11 tube FM-AM chassis. Ship. wt. 22 lbs. Sale price. $69.95
CU-14Y, 12" COAX SPEAKER $10.00 EXTRA. 15" COAX SPEAKER $20.00 EXTRA.



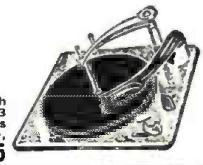
McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

$12.95 12-Inch Model CU-14Y
$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to conneet to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR, McGee's Sale Price, $23.95.

WEBCOR 3 SPEED CHANGER

WITH RPX-050 G. E. CARTRIDGE **$29.95**



114-43, Webcor 3 speed automatic record changer with G.E. RPX-050 variable reluctance cartridge. Plays all 3 speeds and all 3 sizes. Shuts off after last record. Has neutral position to prevent damaging drive wheels. Size, 13½" x 12".
Ship. wt. 12 lbs. Sale price. $29.95

REGULAR $65.00 LIST COLLARO

3 SPEED HI-FI CHANGER

Imported from England — Sale Price **$38.95** — Less Cartridge

Regular $65.00 list Collaro Model 3/532, 3 speed automatic record changer made in England. Intermixes 10" and 12" records of the same speed. Constant speed 4 pole motor and weighted turntable with molded rubber pallet. Compensating spring to shift weight of tone arm for LP and Std. records. Plug-in head will hold any popular cartridge. 14¾" long, 12⅛" wide and 4¾" above motor board. 2⅞" below. Available in grey, cream and gold hammertone finish. Ship. wt. 20 lbs. Regular net, $48.75. Special sale price, $38.95, less cartridge. Large 45 RPM spindle $3.30 extra. 3/352 Collaro changer with G.E. RPX-052A "Golden Treasure" cartridge, $58.95.

ENGLISH GARRARD CHANGERS

RC-80 WITH GE RPX052A **$68.51**

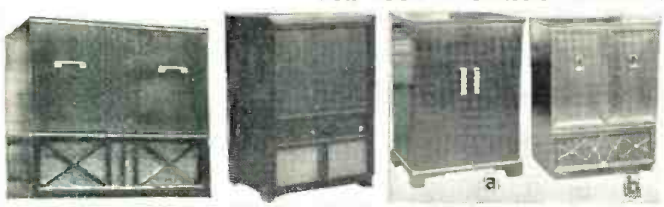
RC-80 Garrard. 3 speed automatic record changer. Shuts off after last record. Heavy 4 pole AC motor and weighted turntable gives constant speed. Muting switch silences pickup during change cycle. Separate plug-in head to fit all cartridges. 13¼" wide, 15½" deep and 8" high. 2½" below motor board. Net price, less cartridge, $48.51, with flip-over crystal cartridge, $52.46, with G.E. RPX-052A "Golden Treasure" cartridge, $68.51. 45 RPM spindle $3.43 extra.

RC-90 w. GE RPX052A **$88.11**

RC-90 Garrard "Crown" 3 speed automatic record changer. All of the features of the RC-80 plus adjustable speed control to regulate speed faster or slower on all 3 speed settings. Has manual position for playing single records. Separate plug-in heads to fit all cartridges. 15½" long, 13½" wide, 5⅜" above motor board, 3⅛" below. Finished in cream and brown. Ship. wt. 20 lbs. Net price, $68.11, less cartridge, with flip-over crystal cartridge, $72.06, with G.E. RPX-052A "Golden Treasure" cartridge, $88.11. 45 RPM spindle $3.43

TELEVISION CONSOLE CABINETS AT LESS THAN FACTORY COST!

FOR YOUR TV CHASSIS—MODELS FOR 27 INCH TO 16 INCH CHASSIS



RT-21MA $49.95 — KL-27X $39.95 — $59.95 — $59.95

21" MAHOGANY ½ DOOR TV-PHONO CABINET $49.95

RT-21MA, Mahogany Television-Phono combination cabinet with half doors, for 20" and 21" TV chassis and record changer. Will hold a TV chassis 29" high, 29" wide and 22" deep. Baffle cut for 12" speaker. TV compartment 21½" high, 21¼" wide and 19" deep will hold most 20" and 21" chassis. Changer shelf 15" x 16" with 9" height clearance. Ship. wt. 75 lbs. Sale price, only $49.95. 21" gold trim plastic safety shield and mask to fit cabinet. $6.95 extra.

24"-27" MAHOGANY TV CABINET $39.95

Large mahogany open face cabinet for 27" or 24" television chassis. 44" high, 30¼" wide and 24¼" deep. Will hold a TV chassis 29" high, 29" wide and 23½" deep. Offered at a fraction of the manufacturer's cost. Limited quantity available. Has room for 8" or 10" speaker. This cabinet and other TV cabinets listed might also be converted to a high fidelity speaker baffle. Stock No. KL-27X. Ship. wt. 90 lbs. Sale price $39.95. Blank front panel available at $5.00 extra.

27" Mahogany Full Door Cab. $59.95

(a) No. 27-MA. Mahogany with full doors for 21", 24" and 27" TV. 43" h. 30¼" w. 23" deep. Chassis area 27¾" w. 25" h. 18¼" deep. Baffle for 10" speaker. A beautiful cabinet that cost the factory over $100. Made for a $600 TV set. Ship. wt 90 lbs. Sale price $59.95. Blank panel $5.00 extra.

27" ¾ Door Mahogany Cab. $59.95

(b) No. 27-34MA. Mahogany with ¾ doors for 21", 24" and 27" sets. 43" h. 31¼" w. 22¾" deep. Chassis area 27½" w. 26¾" h. 21" deep. Baffle cut for 2 10" speakers. Made for one of America's largest TV builders. Cost over $100. Ship. wt. 90 lbs. Sale price $59.95. Blank panel $5.00 extra.

$29.95 — $19.95 — NRT-21M $59.95 — BT-210 $22.95

17" FULL DOOR $29.95

Fig. (e) No. AH-430. Mahogany with full doors. 36" h., 24" w., 21¾" deep. Chassis area 22" w., 17¾" h., 18¾" deep. Blank panel, holds 17" TV easily. Baffle cut for 10" speaker. Ship. wt. 80 lbs. On sale at less than it cost a famous TV factory. Sale price, $29.95.

17" with PHONO DRAWER $19.95

Fig. (g) SE-21, 17" mahogany TV cabinet with phono drawer 40" h., 24" w., 18½" deep. Blank panel. TV chassis area 19" h., 20½" w. Changer drawer 19¾" wide, 13" deep. Baffle cut for 10" speaker. Ship. wt. 75 lbs. Sale price, $19.95.

DELUXE 21" MAHOGANY TV-PHONO CABINET

No. NRT-21M. Deluxe piano finish mahogany combination radio-phono-TV cabinet for 20" or 21" TV chassis. Beautiful full door style with matching front panels. 37" high, 40¼" wide panels, holds 22¾" deep. Baffle cut for a 12" speaker. TV chassis area 21" high, 23½" wide and 19" deep. Changer shelf 15" x 17" with 9" height clearance. Ship. wt. 90 lbs. No. NRT-21M, mahogany cabinet, sale price, $59.95. 21" mask and safety glass, $6.95 extra.

21" BLONDE $22.95—MAHOGANY OR WALNUT $19.95

No. BT-210, blonde oak 21" TV cabinet. 37½" high, 24" wide and 20½" deep. TV chassis area 20½" high, 23½" wide and 18½" deep. Baffle cut for 10" speaker. Open front, no plastic panel furnished. Shipping weight 85 lbs. Sale price, $22.95.
No. WT-210, walnut 21" TV cabinet, same as above, Sale price, $19.95.
No. MT-210, mahogany 21" TV cabinet, same as above, Sale price, $19.95.

6-TUBE, 2-BAND RADIO KIT $14.95

6-18 MC 550-1650 KC

6 tube, 2 band AC-DC radio kit, complete with speaker and plastic cabinet. Popular with schools and colleges for training in radio. Receives broadcast and 6-18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12K8, 2—12SK7, 12SQ7, 50L6 and 35Z5. diagram and instructions. Cabinet 13" x 6¾" x 6¼". Ship. wt. 12 lbs. Model ME6-2, Net $14.95.

3-SPEED AMPLIFIED PLAYER KIT $10.95

2 TUBE AMPLIFIER—8" SPEAKER

New, 3 speed amplified record player kit for only $10.95. Leatherette covered cabinet 9½" x 12" x 18½" high. Wired 2 tube amplifier with separate tone and volume controls. 70L7 and 7E5 tubes. Heavy 8" speaker, all-play pickup, motor and turntable. Cabinet is pre-cut, no holes to drill. Just fasten parts in cabinet. Only a few minutes required to assemble. Complete with simple, easy to follow instructions and all necessary items to build this 3 speed record player. Buy this player kit at less than the cost of the parts. Ship. wt. 15 lbs. Model No. RP-743K. Sale price, $10.95.

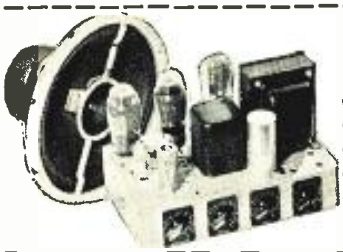
McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

NEW MODEL HF-20-20 WATT HI-FI AMPLIFIER—NOW ONLY $22.95



20 WATT HI-FI AMPLIFIER—SALE PRICE $22.95

RESPONSE 30-15,000 CPS—PUSH PULL 6L6 OUTPUT—TWIN TONE CONTROLS
INPUTS FOR MIKE AND CRYSTAL OR V.R. PHONO PICKUP

With CU-14Y, 12" Coax Speaker.....$32.95
With P15-CR, 15" Coax Speaker.....$42.95
With Imperial IV Speaker System.....$39.95
With SP-12125 CR Speaker System.....$44.95
With HF-33GE Speaker System.....$69.95
(Add $7.00 for HF-30 Instead of HF-20)

A tremendous High Fidelity amplifier value. Response 30 to 15000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7⅜" x 10½" x 7⅛" high. Complete with tubes; 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier, McGee's sale price, $22.95.

This amplifier is recommended for use with the speaker systems described below, as well as the 12" and 15" coaxial PM speakers shown on the opposite page. HF-20 amplifier with CU-14Y, 12" coaxial PM speaker, $32.95; with P15-CR, 15" coaxial PM speaker, $42.95; with Imperial IV speaker system, $39.95; with SP-12125CR speaker system, $44.95; with HF-33GE speaker system, $69.95. If the HF-30 amplifier is desired, add $7.00 to the above combination prices.

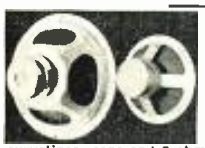
Model HF-30. Same as HF-20 with Heavy Output Trans. Rated at 30 Watts Power Output. Response 30-15,000 CPS. Ship. Weight 20 lbs. Sale Price.....$29.95
Astatic JT-30 Xtal Mike and Desk Stand $9.97 Extra

25 WATT HI-FI SPEAKER SYSTEM

2-12" Woofers
2-5" Tweeters
Power Supply and L-C Cross-over Network

SALE PRICE $24.95

25 watt, High-Fidelity Dynamic Speaker System, complete with 2000 cycle genuine inductance-capacitance cross-over network, two 12" woofer speakers, two 5" high frequency tweeter speakers and separate 110 volt AC power supply for only $24.95. Frequency response 20 to 18,000 cps. Both the woofers and the tweeters are fine quality dynamic speakers with fields excited to saturation by the power supply. Tweeters are specially made with cones designed to respond only to the high frequencies of the audio spectrum. The 2000 cycle cross-over network is of the high quality inductance-capacitance type which prevents frequencies below 2000 cps from entering the tweeters and eliminates frequencies above 2000 cps from the woofer circuit. The cross-over network system is simple to connect to any 4 or 8 ohm output of your high fidelity audio amplifier or radio. No. SP-12125CR, High Fidelity Dynamic Speaker System, Ship. wt. 15 lbs. Sale price, $24.95. No. SPS-12125, High Fidelity Dynamic Speaker System, as described above, but less the 2000 cycle cross-over network and with a separate attenuator control. Sale price, $14.95. Ideal for use with HF-20 and HF-30 amplifiers described above.



HIGH FIDELITY SPEAKERS

8" BLUE STREAK .....$ 6.95
15" BLUE STREAK WOOFER $16.95

Model HF-8J, 8" "Blue Streak," High Fidelity wide range speaker. This one speaker properly baffled will give excellent response to both high and low frequencies and terrific response through the very important middle range. Has 6.8 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. Response essentially flat from 35 to 12,500 cps. Perfect for high fidelity radios, amplifiers and professional music systems. Ship. wt. 6 lbs. Model HF-8J. Sale price, $6.95.

Model HF-15 J, 15" "Blue Streak," HiFi woofer. Has a 14½ oz. Alnico V magnet with curvelinear one piece cone and 1¼", 8 ohm voice coil. Will give good response from 50 to 9500 cps. Takes 15 to 20 watt peak. Ship. wt. 12 lbs. Sale price, $16.95.

CONSOLE HI-FI SPEAKER SYSTEM

BUILT-IN L-C CROSSOVER NETWORK

SALE PRICE $49.95

EQUIPPED WITH 3 PM SPEAKERS
12 IN. GENERAL ELECTRIC WOOFER
10 IN. MID RANGE SPEAKER
8 IN. GENERAL ELECTRIC MID-HIGH RANGE

Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires feed the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker. Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde oak, walnut or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE, Sale price, $49.95. Ideal for use with HF-20 and HF-30 amplifiers described above.

NEW IMPERIAL IV with General Electric

8 in. HIGH FIDELITY SPEAKER $19.95

New 1955 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 8S0 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95. Ideal for use with HF-20 and HF-30 amplifiers described above.

FAMOUS STANDARD COIL CASCODE TUNERS

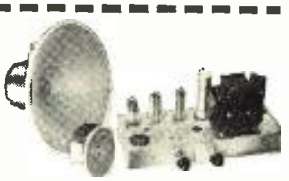
SALE PRICE $12.95
2 FOR $25.00

TV-2000 series Standard Coil cascode tuners complete with 6J6 and 6BK7 or 6BQ7 tubes. Thousands of TV sets use this famous tuner. Tunes 12 channels (2 thru 13). For 21 mc I.F. circuit. This tuner will give 2 to 1 better reception than the old pentode type. Many servicemen replace all older tuners with this cascode model. Available with either 2⅞" or 4¼" shaft length. A tremendous purchase makes our low $12.95 price possible. Specify shaft length desired. Stock No. TV-2000-3. Sale price $12.95 each, 2 for $25.00.

No. TV-4001-7, 41 mc Standard Coil cascode 12 channel tuner with 13th position for use with separate UHF tuner. 6¾" shaft. With tubes 6BQ7 and 6J6. Used in Sentinel, MW, Arvin, etc. Sale price, $12.95.

Matching knobs for Standard Coil tuners. Set No. SCK-2 for fine tuning and channel selector. Set VCK-2, matching volume and contrast knobs. Either set only 59c a pair.

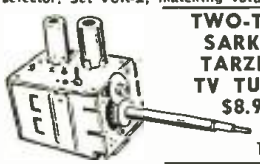
LOW COST 8 WATT HI-FI PHONO AMP



Push-Pull Output. Thordarson Hi-Fi Output Tran. 12" Woofer and 5" Tweeter.
McGee's Sale Price..... $19.95

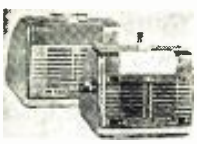
Another outstanding McGee value. 8 watt low cost Hi-Fi phono amplifier for use with any crystal phono pickup. Approx. 1 volt input gives 8 watts audio. Features push-pull 35C5 output and 12AX7 tubes, 12" dynamic woofer and 5" dynamic tweeter. Voltage doubler power supply gives extra power. Amplifier size, 4" x 9¾" x 4⅝" high. Heavy shielded Thordarson Hi-Fi output transformer. Response 30 to 12,000 cps. Amplifier is ready to use. Complete with tubes and speakers. (Does not have gain for mike.) Use as a record player amplifier. Stock No. HF-8, 8 watt amplifier and speakers. Ship. wt, 14 lbs. Sale price, $19.95.

Model HF-5, similar to HF-8, except 5 watts output and equipped with a single 12" dynamic speaker Sale price, $14.95.



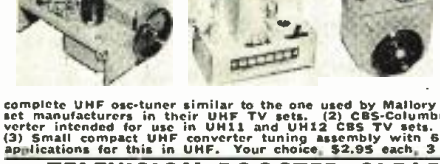
TWO-TUBE SARKES-TARZIAN TV TUNER $8.95 WITH TUBES

New 2 tube Sarkes-Tarzian No. TT-3A, 12 channel TV tuner. 21-25 mc. Popular in many makes. Also, ideal for general replacement use. Has 6J6 and 6BC5 tubes. Used in CBS, Arvin, Crosley F17TOLBU, TOLH, TOLU, F21CDLBH, etc. Also, ideal for general replacement use. A good replacement for one tube tuners. 3⅛" shaft. No. TT-3A, Sale price, $8.95. Takes SCK-2 knob set described above.



3-STATION MASTER SUB-STATIONS $3.95 EACH $16.95

Powerful 3 station master. Chrome plated metal case 7½" x 6" x 5". 3 tube AC-DC amp. Press-to-talk switch on top. Volume control, switch and station selector on side. Master is quiet except when call switch is pressed at sub. Use with one to 3 subs. Model MPM-A3. Ship. wt. 10 lbs., $16.95. Matching sub-station PM-A5, with 5" PM and call-back switch, $3.95 ea.; 3 for $10.00. Requires 3 wire intercom cable, $1.95 per 100 ft.; 500 ft. for $8.95.



UHF CONVERTER TUNERS $2.95
3 FOR $7.50

Take your choice of any of these three UHF converter-tuners at $2.95 each, 3 for $7.50. (1) Mallory in-ducto-tuner with 6AF4 and 1N72 diode. This is a complete UHF osc-tuner similar to the one used by Mallory in a converter and by many set manufacturers in their UHF TV sets. (2) CBS-Columbia single channel UHF converter intended for use in UH11 and UH12 CBS TV sets. Complete with 6AF4 tube. (3) Small compact UHF converter tuning assembly with 6AF4 tube and diode. Many applications for this in UHF. Your choice, $2.95 each, 3 for $7.50.

CROSLEY FM-AM TUNER

SALE PRICE $19.99

AUDIO AMPLIFIER IS REQUIRED TO OPERATE A SPEAKER

Model 362-2, 6 tubes Crosley FM/AM tuner. Receives broadcast 550 to 1600 kc, FM 88 to 108 mc. With tubes; 3—6BA6, 6BE6, 12AT7 and 6T8. Power this tuner from your audio amplifier or TV set. (6.3 v. filament and 125 to 180 v. at 20 mils "B" voltage required.) Chassis 5½" x 10¾" x 3⅜" high. Illuminated slide rule dial 8½" long. 4 position switch selects FM, AM, TV or Phono. One-half of 6T8 used as pre-amp for variable reluctance pickup. Has no volume control. Audio is fed to your TV or hi-fi amp. These are new Crosley FM-AM tuners that cost over $20.00 to build. Model 362-2, complete with escutcheon, knobs, diagram, instructions and parts list. Ship. wt. 9 lbs. Sale price, $19.99.

Crosley 362-2VC, same as above but has volume control and power supply added to make a self-powered AM-FM tuner. Ship. wt. 10 lbs. Sale price, $24.99.

Note: An Audio amplifier is required to operate these tuners thru a speaker.

TELEVISION BOOSTER CLEARANCE SALE

Clearance sale on VHF television boosters for channels 2 through 13. RMS Model SP-S, metal case, brown wrinkle finish. Continuously variable tuning, 6AK5 tube. Ideal for late model sets with cascade front end. Sale price..... $4.95

RMS Model SP-6, brown plastic case. Same as SP-S except has variable gain control. (Pictured.) Sale price..... $4.95

McMurdo-Silver GB-6B continuously variable, includes FM band. 6J6 tube, brown plastic case. Sale price..... $5.95

Standard Coil B-51 printed circuit booster. 6AK5 tube, brown plastic case. Sale price..... $6.95

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 5092
1903 McGEE ST., KANSAS CITY, MISSOURI

REGULAR $59.95 LIST TIMEX MAGNETIC RECORDER

McGEE'S SPECIAL PURCHASE SALE **$29.95**

RECORDS AND PLAYS BACK—PLAYS 16⅔ AND 45 RPM RECORDS

MODEL 40 TIMEX RECORDER $29.95
CRYSTAL PICKUP HEAD TO PLAY PHONO RECORDS $2.95 EXTRA

A product of United States Time Corp. (Timex) A multiple purpose machine made to retail for $59.95. McGee buys a solid carload and you save by buying now at only $29.95, plus $2.95 for a 45 RPM record adaptor and crystal head for 16⅔ or 45 RPM phono records. Records and plays back for 3½ minutes on a wafer thin flexible magnetic disc. Make recordings of your family—use for office dictation—dictate records that may be mailed without breaking. Attractive brown plastic case, 9½ x 11½ x 4½". Turntable speeds 16⅔ and 45 RPM. Response 100 to 4000 cps. Amplifier has neon level indicator, volume control and selector knob with playback, record and phono positions. Uses 12AX7, 50C5, 6C4 and 35W4 tubes. Built-in 4" speaker. Complete with Shure variable reluctance microphone. Provides faithful reproduction at low volume of voice or music, recorded through the microphone supplied or direct from your radio or TV. As simple to operate as a record player. Stock No. TIM-R1 recorder, ship. wt. 13 lbs. Sale price, $29.95.

Recording discs, package of 6 for 99¢. One blank shipped with recorder.

You may purchase a plug-in crystal phono pickup to adapt this recorder for playing 16⅔ or 45 RPM phono records for only $2.95 extra.

SALE PRICE **29.95** MODEL 40 TIMEX

8" EXTENSION SPEAKER $16.95 EXTRA

For $16.95 extra you can have our regular $19.95 Imperial IV extension speaker, equipped with an 8" G.E. speaker as described on the opposite page. When you order this with your Timex recorder we install a jack which makes your Timex play 45 RPM records with better tone quality and with the switch in the record position unit doubles as a small public address system.

50-WATT BOOSTER AMPLIFIER

50-WATT BOOSTER AMP. **$39.95**

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

A sensational value. A 50 watt booster amplifier with push-pull, parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X pre-amplifier to allow the use of 2 microphones and one low level input. The amplifier has one input jack with 1 volt input giving 50 watts of audio. Amplifier has a 6 lb. potted case high fidelity output transformer with taps at 4-8-16-60 and 250 ohms. 225 mil power transformer and 5U4G rectifier. Includes tubes: 4—6L6, 7N7 and 5U4G. Two variable tone controls for master volume and bass boost tone control. Chassis size, 8" x 6½" x 14½". Model No. PA-55N. Ship. wt. 26 lbs. Sales price, $39.95. PR-2X, 2 mike input pre-amplifier plugs directly to the PA55N 50 watt booster amplifier. Allows use of 2 microphones, either crystal or dynamic and one low level input. Furnished with 4 ft. connecting cable and plug for remote control of the 50 watt booster. Chassis size, 5¾" x 3½" x 2½". Model PR-2X, Sale price, $12.95.

25-WATT TRUMPET AND DRIVER

WEATHER-PROOF OUTDOOR SPEAKER

25 Watt HORN AND DRIVER Both for **$27.95**

25 watt driver and 3½ foot air column re-entrant trumpet. The standard type outdoor trumpet and driver most widely used. Drivers are 100% weatherproof. Trumpet is spun aluminum. Offered to you at a considerable saving. Ship. wt. 20 lbs. Stock No. MCG-H25, Sale price, $27.95.

8", 10", 12" SPEAKER-BAFFLE COMBINATIONS

8" - **$3.95** 10" - **$4.95** 12" - **$6.95**

Our most popular speaker-baffle combinations. Brown leatherette covered wood baffle and 8", 2.5 oz. Alnico V magnet speaker. Most economical wall speaker. Stock No. 818-X. Sale price, $3.95 each. Lots of 3 or more, $3.79 each.

Brown leatherette covered wood baffle and 10", 3.16 oz. Alnico V magnet speaker, at little more than the 8" size. Stock No. CA-10Z. Sale price, $4.95. Lots of 3 or more, $4.79 each.

Brown leatherette covered wood baffle and 12" RCA PM speaker. A terrific McGee value. Only 500 to sell. You get the baffle and speaker for the value of the speaker only. Stock No. RCA-B12. Sale price, $6.95. Lots of 3 or more, $6.79 each.

10 WATT PORTABLE P.A. SYSTEM

10" PM SPEAKER CRYSTAL MIKE $34.95

PA-12, 5 tube 10 watt portable P.A. system. Push-pull 7C5's. U.L. approved amplifier with good frequency response. Inputs for crystal microphone and phono. Separate volume controls and variable tone control. Heavy 10" Alnico V PM speaker. Amplifier fits in bottom of case. Case size, 21" x 16" x 13". Snap-on removable back. Complete with tubes, crystal mike on non-removable desk stand and connecting cables. Stock No. PA-12. Ship. wt. 40 lbs. Sale price only, $34.95.

BRUSH CRYSTAL EAR PHONE With Control

$5.49

Simply clip on the speaker voice coil of any radio or TV set or to an audio amplifier. No soldering necessary. Listen in privately to your favorite programs. The tiny Brush crystal ear Phone fits your ear just like a regular hearing aid ear piece. A small remote control box enables using 20 ft. from the radio or TV set. Has its own separate volume control and small matching transformer built-in to operate the crystal from any speaker voice coil. Ideal for hospitals, homes, hundreds of other uses. 10 times more comfortable to wear than conventional earphones. Stock No. BH-500 includes Brush crystal ear piece, remote control box, 20 ft. of cable and instructions. Sale price, $5.49 complete. Brush crystal earphone with 36" cord. Stock No. BR-52. $2.95. (You connect it like any crystal earphone. diagram furnished.) BAC-2 Accessory kit includes volume control with switch plus coupling capacity and instructions, 99¢ extra.

ATTENTION! TV SERVICEMEN
PICTURE TUBE RESTORER-TESTER

NEW—POWERFUL TRANSFORMER OPERATED **$49.95**

Designed to rejuvenate television picture tubes that have become weak due to cathode deterioration. Also repairs shorts and welds open elements in most cases. We have tested several makes and offer this unit as the best value in its field. This unit weighs a full 20 lbs. It incorporates a heavy power transformer. It is more equipment and more for your money. Will perform as well as units selling above $100.00. Relay controlled flashing cycle reduces operating technique to a simple operation. Effective on 90% of all picture tubes. A built-in test feature gives quality test on new or old tube to determine condition before and after rejuvenation. We think every active TV Service Dealer should have a rejuvenator of this type. Operating instructions included. Fully guaranteed. Stock No. AJ-59, ship. wt. 20 lbs. (not mailable). Sale price, $49.95.

OPERADIO 60-WATT AUDITORIUM AMPLIFIER SYSTEM

WITH PRE-AMP AND 15" SPEAKER **$79.95**

A $175.00 dealer value, 60 watt-Auditorium Amplifier System for only $79.95. 60 watt Operadio amplifier with preamplifier and super heavy duty 15" Operadio speaker, with 25 ft. cable and plug. Operadio Model PA-125 amplifier has 4—6L6G tubes in push-pull-parallel, driven by a 6SN7 with 2—5U4G rectifiers. Amplifier size, 17" x 7½" x 7¾" high. We have specially designed a pre-amplifier that has two mike inputs with separate gain controls, input for crystal and magnetic phono pickups and bass and treble tone controls. Pre-amplifier is housed in an attractive grey hammertone metal cabinet 9¾" x 7⅛" x 3¾" high. Pre-amplifier plugs directly into 60 watt Operadio amplifier, controlling the volume and tone. Off-on switch is at the pre-amplifier. This unit sounds like a giant Juke Box. A terrific value if you need lots of audio and plenty of bass response. Schematic diagram and instructions furnished. Stock No. PA-60S, 60 watt amplifier with pre-amplifier and 15" speaker. Ship. wt. 53 lbs. Sale price, $79.95.

60 WATT OPERADIO BOOSTER AMPLIFIER AND SPEAKER **$59.95**

60 watt Operadio amplifier and 15" speaker with 25 ft. cable and plug; less pre-amplifier. Use as a booster amplifier with existing amplifier or pre-amplifier. Requires 1 volt input. Has no controls. Shipping weight 49 lbs. Stock No. A-60S, Sale price, $59.95.

MINIATURE BROADCASTING STATION FOR THE HOME

NEW 1955 MODEL WITH CRYSTAL MIKE $9.95

Sensational new model MCL-E3 miniature broadcasting station for microphone and Phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

6" SESSIONS CLOCK-TIMER

With Plastic Cabinet $3.95

6" Sessions Clock-Timer in plastic case 7" x 9⅝" tall, 3" deep. Was intended for a kitchen clock radio. Lower part of case was used for a small radio chassis. Lower portion has a usable space of 6¾" x 4" high and 2¾" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green or Yellow. Stock No. MCT-63, Sessions Clock Timer with case of your color choice. Sale price only $3.95.

4" Telechron clock-timer with 2⅛" clock face. Clock has sweep second hand and 15 amp., 125 volt appliance switch to turn on at any pre-set time. Made for clock-radio with appliance outlet. Has lullaby switch to allow radio or appliance to run up to one hour and shut-off automatically. Requires 2" mounting depth. Telechron Clock-Timer, Stock No. TCT-42 (not pictured). Sale price, $3.95.

Bel-Com 2-Way Loudspeaker Intercom **$5.95**

FUN FOR THE KIDS—PRACTICAL FOR ADULTS

Here is the ideal gift for the children as well as a practical intercom for the home or office. New Bel-Com self-powered 2 station intercom housed in sturdy one piece burgundy color molded cases. Each unit has a carbon microphone and 4" Alnico V PM speaker. Gives normal room volume with distances up to 150 ft. with just 4 regular flashlight batteries. No AC power required. 2 No. 6 dry cells may be used for distances greater than 150 ft. System comes complete with two stations. 25 ft. of 3 wire cable and batteries. Extra 3 wire cable 1½¢ per ft. Stock No. BL-4, 2 station intercom complete only $5.95. Packaged in attractive gift carton.

$100.00 LIST—12 VOLT BUICK AUTO RADIO **$39.95**

Fits All '53 Models Except Special

No. 981323. 8 tube 12 volt Buick radio. Custom made for all '53 Buicks except the Special. Cost over $100 retail. Magic Selectronic single push-button tunes set electronically. Built-in 8" speaker, tone control, PP 12V6 audio. Ship. wt. 20 lbs. Sale price, $39.95.

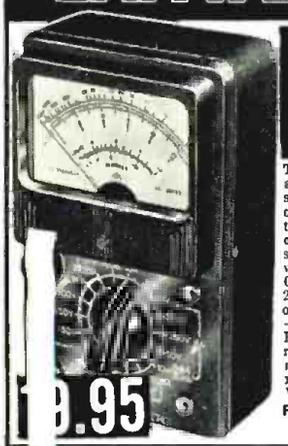
McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER.
BAL. SENT C.O.D.

TELEPHONE VICTOR 5092

1903 McGEE ST., KANSAS CITY, MISSOURI

LAFAYETTE'S SPECTACULAR MONEY SAVERS



HIGH SENSITIVITY AC-DC MULTITESTER
20,000 ohms per Volt

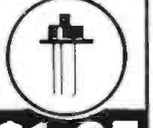
The new Lafayette High Sensitivity Multitester is a complete instrument (not a kit). Here is an instrument packed with every desirable feature found only in instruments costing twice as much. One of the most sensitive multitesters ever offered. 20,000 ohms per volt DC; 8,000 ohms AC, having a high sensitivity 45 microamps meter. Full scale AC-DC voltage ranges are 0-10V, 0-50V, 0-250V, 0-500V, 0-1 000V: DC current ranges 50 microamps, 2.5 ma, 25 ma, 250 ma. Resistance: 0-5K ohms, 0-50K ohms, 0-500K and 0-5 megohms. Decibel range: —20 +5 db; +5 +22 db (0 db - 0.775V - 600 ohms). Extreme versatility and accuracy. 1% precision resistors; 3" meter; beautiful plastic front, with metal bottom for ruggedness. Size: 3¾" x 5¾" x 2⅝". Complete with batteries and leads. Shpg. Wt. 4 lbs.

RW-30G ..... NET **19.95**

In lots of 3 **19.25**

9.95

NEW
TRANSISTOR
TYPE 2N107
P-N-P



$1.25

MAKE YOUR OWN PRINTED CIRCUIT
NOTHING ELSE TO BUY!

Our Inexpensive Etched-Wire Kits Contain: Laminated Copper Boards (XXX-P). Printed Circuit Tube Sockets. Copper Etching Material and instructions. Etch-resistant material for Circuit layouts. Eyelets and drill for connections. Scaled Layout Sheets for making your own or standard Printed Circuits. All Kits Are Supplied with Plastic Case

5004P

5001P—BASIC KIT
Contains a complete assortment of materials needed to make a variety of different Printed Circuits. Circuit Diagrams include Multimeter and 1-tube Receiver.

Only **3.75**

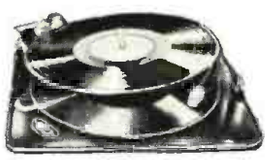
5003P—SERVICEMAN & TECHNICIANS' KIT
Contains three times the material of Kit 5001P with special sockets, connectors and double-faced Copper Boards.

Only **9.75**

5004P—PRODUCT DESIGNERS' KIT
This special Kit enables the Manufacturer and Laboratory to make a pilot run of etched wire Printed Circuits with his own staff and facilities. Contains all the latest information, materials and methods for adapting your product to mass production techniques.

27.00

EBSTER • GARRARD • COLLARO
3-SPEED—HI-FI RECORD CHANGER



Lafayette makes it possible for you to save money on the three popular makes of 3 speed Record changers.

ICOR Diskchanger: It's completely automatic, 33⅓, 45 and 78 , automatic shut off after last Record, balanced tone arm, etc. 13⅜ x 12 x 8¼". Shpg. Wt. 16 lbs.

No. PK-49—With Dual Turnover Cartridge..... **26.50**

No. PK-46—With G.E. RPX 050 Triple Play Cartridge... **29.50**

LARO, THE WORLD'S FINEST 3 SPEED INTERMIX CHANGER: Collaro Model 3/532—3 speed rmix changer designed and engineered to meet the most exacting requirements of the finest audio

ms: While our stocks last. Shpg. Wt. 23 lbs. with G.E. RPX—050 Triple play cartridge...Net **34.50**

G.E. RPX—052A Triple play latest Golden Treasure cartridge with Diamond and Sapphire styli lled ..... Net **44.95**

aro RC-54: Latest Collaro 3 speed Intermix less cartridge..... Net **47.77**

G.E. RPX—050 Triple play cartridge..... Net **49.95**

G.E. RPX—052A Triple play Golden Treasure cartridge with Diamond and Sapphire styli talled ..... Net **59.95**

ard Model RC-80 3 speed Record changer less cartridge..... Net **48.51**

el RC-80 with G.E. RPX—050 Triple play Cartridge..... Net **51.95**

el RC-80 with G.E. RPX—052—A latest triple play Golden Treasure cartridge with Diamond and hire styli installed..... Net **62.53**

TRANSISTOR PREAMP KIT HUMLESS - DISTORTIONLESS

To you the experimenter with the Lafayette transistor preamp kit you can now build a preamplifier in matter of hours at a cost considerably less than commercial vacuum tube preamps. Internal noise is essentially inaudable. Chassis only 3" x 4" x 1" in size including power supply — will supply 2000 hours of service, humless and virtually distortionless. Kit comes complete including 2 Raytheon transistors. Also 115 Page Book. 50 practical Transistor circuits with complete How-To-Do-It-Instructions.

KT-66 ..... Net **7.95**

TWO TRANSISTOR RADIO KIT REGENERATIVE DETECTOR & AUDIO AMPLIFIER

This compact regenerative transistor receiver gives more than earphone volume on broad-cast stations located several hundred miles away. When used with a 60 foot outside antenna, stations well beyond 1000 miles have been heard. Build this receiver and acquire a real basic knowledge of transistors and their application. Kit is complete with perforated masonite breadboard, 2, G.E. Transistors and Argonne Transistor audio transformer, etc. Also includes 115 page book 50 practica transistor circuits with complete How-To-Do-It-Instructions.

KT-67 ..... NET **10.95**

Dynamic Ear Phone (MS-72) NET..... **1.95**

Greatest Tape Buy Ever!

1200 FT. REEL
Genuine Plastic Base
RECORDING TAPE
Shpg. Wt. 14 oz.

.89 per roll plus postage

LAFAYETTE made a terrific deal with one of the leading manufacturers of recording tape to supply us with their regular tape which sells for almost twice our price. WE GUARANTEE ABSOLUTE SATISFACTION OR YOUR MONEY BACK. The finest, professional recording tape obtainable. Highest performance thousands of playings. Red Oxide Base in a smooth coating; greater signal strength; with maximum uniform frequency response from 40-15,000 cps.

In lots of 10 rolls - 1.75 ea

REMOTE CONTROL FOR SILENT TV VIEWING

6.50

- For Hard-of-Hearing
- For Late Listening

The hard-of-hearing can listen to radio or TV without turning the volume so high that others can't stand the noise. They can listen with loud speaker cut off, or if others want to listen with normal speaker volume. Excellent for noisy programs. Let the Kids listen and view with speaker cut off. Comes complete with miniature phone, fits snugly in ear, 20 feet of cable and instructions.

MS-125 ..... **6.50**

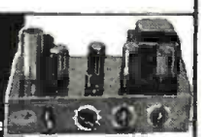
TWO CAN LISTEN WITH ADDITIONAL EAR PHONE **1.95**

RAYTHEON TRANSISTORS

CK-722—Singly, each **2.10**
—In lots of 10, each..... **1.95**
CK-721—Singly, each **2.40**
—In lots of 10, each..... **2.25**

CK-722 RAYTHEON

HIGH FIDELITY AMPLIFIER KIT
10 WATT — BUILT-IN PREAMPLIFIER For G.E. Reluctance Cartridge



FREQUENCY RESPONSE: 20-20,000 CYCLES

Designed for installations where high quality reproduction is required. Separate tone controls for bass and treble. Inverso feedback circuit. Specifications: Power Output 10 watts or 32 db less than 3% distortion. Frequency Response: 20 to 20,000 cps ± 1 db. Tone Control: produces maximum bass boost of + 8 db at 100 cps. Treble Control produces maximum treble boost + 10 db, at 10,000 cycles. Hum: —70 db below rated output. Tube Complement: 1-6SC7, 1-6SL7, 2-6V6GT, 1-5Y3GT. Power Consumption 70 watts 110-120 volts 60 cycles. Shpg. Wt. 15 lbs. Complete with 3D diagrams and instructions.

KT-28—Complete with tubes..... Net **19.95**

Output mic phone

rice
.00 **$12.95**

quality Dynamic microphone onally fine for Public address recording, etc. Flat response 000 cps. Impedance 10,000 at 1,000 cps, output level db. Die cast metal case ed with 6 ft. of shielded Shpg. wt. 3 lbs.

—In lots of 3 ..... 12.45
singly, ea. 12.95

TOP QUALITY CRYSTAL MICROPHONE

COMPARE IT WITH ANY MIKE AT 2 to 3 TIMES THE PRICE

A quality crystal Microphono for PA systems, house recorders, etc. Frequency response 30 to 10,000 cycles. Output level —52 db. Provides ample output for use with low gain amplifiers. Complete with 5 ft. of shielded cable. Shpg. wt. 3½ lbs.

PA-24—In lots of 3 .... **$3.95**
singly, each 4.25

LAPEL MICROPHONE

- REGULAR $16.00 VALUE!
- FULL —55 db. OUTPUT LEVEL!
- IDEAL GENERAL PURPOSE MIKE!

2.95

Specially engineered crystal Microphone. Attaches to lapel. Only 1⅝" in diameter. Exceptional frequency response. Output level —55 db. chrome plated case and clip for attaching to lapel. Includes 5 ft. of shielded cable. Shpg. wt. 1 lb.

PA-18 ..... 2.95

PM SPEAKERS—FINE QUALITY ALNICO V MAGNET

4" P M—3.2 ohm SK-11	1.59
5" P M—3.2 ohm SK-12	1.69
6" P M—3.2 ohm SK-13	2.19
6 x 9 P M—3.2 ohm SK-17	3.15
12" P M—RCA—12 Watt—6.8 oz. ALNICO V Magnet 6.8 ohm SK-40	5.25
12" COAXIAL P M SPEAKER SK-22	9.75

SONOTONE 9980-S
TURNOVER CERAMIC PHONO CARTRIDGE WITH DUAL SAPPHIRE NEEDLES

REPLACEMENT FOR COLUMBIA 360—VM— WEBSTER AND CRESCENT RECORD CHANGERS

SPECIFY STOCK NO. PK-40

In lots of 5, each.... 3.50 Singly, each.... 3.98

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RADIO CATALOG
GET LAFAYETTE'S NEW CATALOG PACKED WITH THE LARGEST SELECTION OF QUALITY ELECTRONICS EQUIPMENT AT BARGAIN PRICES.

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Diode Tester

(*Continued from page 73*)

reading vacuum-tube voltmeter or an oscilloscope. The latter instrument must be calibrated to read peak voltage values.

To determine the forward settings for the diode under consideration, look up the maximum average forward current. For example, the 1N34 has a 50 milliampere maximum. Place a good crystal diode in series with the milliammeter as shown in Fig. 9. Set the control R_1 at minimum voltage, and set R_2 for maximum resistance. Now turn the instrument on. Set the switch S_1 to the forward position and adjust R_1 carefully to produce the maximum average forward current as determined from the manufacturer's rating sheet. Now adjust R_2 to read a little beyond "good" on the forward scale. Note the two settings of R_1 and R_2. This completes the forward calibration.

The reverse calibration is just as easy. This requires either a peak-reading v.t.v.m. or oscilloscope. Either

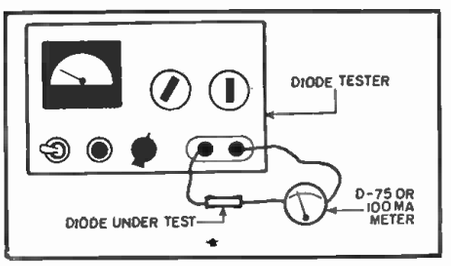
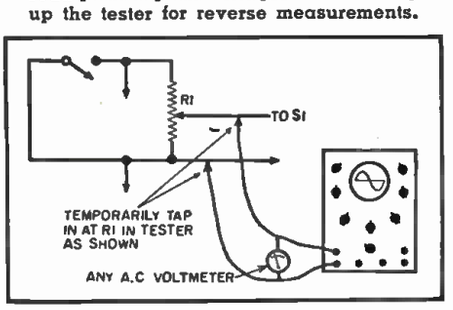


Fig. 9. Setup for calibrating the crystal tester for forward conduction checks.

can be used with good results, however, the oscilloscope screen must be calibrated to read peak voltages. This can easily be done with the setup shown in Fig. 10. The meter shown in Fig. 10 can be any reasonably accurate a.c. voltmeter. To calibrate the scope for, say, a full screen deflection of 100 volts, it is only necessary to set the potentiometer R_1 to produce 35.35 volts r.m.s. on the a.c. meter. This voltage represents a peak-to-peak voltage of 100 volts. Now set the scope for any convenient amplitude, for example, let the signal amplitude be 10 boxes on the scope screen. Now each box height represents 10 volts. To determine the peak-to-peak value of any other voltage read on the a.c.

Fig. 10. Calibrating an oscilloscope to read peak-to-peak voltages when setting up the tester for reverse measurements.



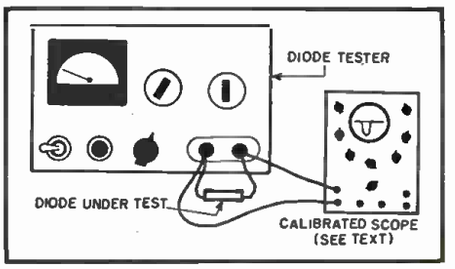


Fig. 11. Setup for calibrating the diode tester for reverse conduction using peak-to-peak measuring oscilloscope.

voltmeter, multiply the reading by 2.828.

The calibration of the instrument for the measurement of reverse current through a crystal diode can be continued by looking up the maximum peak inverse voltage for the crystal under consideration. For example, the 1N34 has a peak inverse voltage rating of 60 volts. Set the control R_1 to minimum as before. Set R_2 for minimum resistance this time. Place the terminals of either the peak-reading v.t.v.m. or calibrated oscilloscope across the diode terminals. This is shown in Fig. 11. Now set the selector switch S_1 to the reverse position and turn the instrument on. Adjust R_1 to produce a peak voltage equal to the peak inverse voltage determined previously from the manufacturer's rating for that particular crystal diode. Adjust R_2 so that the meter reads just a little below "bad" but on the "good" portion of the reverse scale. Note the settings of R_1 and R_2. Actually this whole procedure takes longer to describe than to perform.

In use, the selector switch S_1 has a standby position between the forward and reverse positions. This allows the settings of R_1 and R_2 to be made before switching to either the forward or reverse positions. If one switches to the reverse position when set up for the forward position or *vice versa*, there is a possibility of damaging the crystal under test. The meter is fused to prevent damage to the meter under these circumstances.

A small spiral-bound notebook makes a convenient log for listing the settings of R_1 and R_2 for the forward and reverse positions for the various types of crystal diodes. —30—

ACCREDITED TECHNICIANS

A NEW booklet detailing a plan whereby technically competent TV service technicians can be accredited as such and, thereby, made known to the public, has recently been made available by the Radio-Electronics-Television Manufacturers Association.

Entitled, "Suggested Accreditation Program for TV Receiver Service Technicians," the booklet is available free by writing to the RETMA at 777 14th Street N.W., Washington 5, D. C.

The booklet advises on necessary tests, equipment, and texts for courses, and the requirements necessary for accreditation to be effective. The RETMA points out that such a plan will help the TV set owner identify technically-competent technicians. —30—

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6W6GT
6X5GT
7A5
7A6
7A7
7A8
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7Q7
7V7
7W7
7X7
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12SC7
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12SQ7GT
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12Z3
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14B8
14Q7
14W7
14X7
24A
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25AC5GT
25BQ6GT
25C6G
25W4GT
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25Z5
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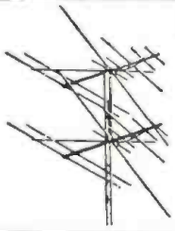

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20-	450V.	.49	100-	50V.	.35
20-20	450V.	.45	20 mfd.	150V.	.45
30-	450V.	.59	20-20	150V.	.49
30-30	450V.	.49	30	150V.	.49
40	450V.	.69	30-30	150V.	.49
40-40	450V.	.89	40	150V.	.49
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VARI-TIME PULSE

Fig. 1. Front panel view of the author's home-built timer. It is housed in a Bud "Minibox." Device offers reliable action.

By **HERBERT L. FILKOFF**

Construction details on a recycling timer which features adjustable timing on both "open" and "closed" portions.

HERE is a device that will find many uses in the laboratory and in the experimenter's home workshop, yet it is reliable enough to control some industrial processes. Essentially we have a device that can apply power in "off" and "on" cycles or pulses of controllable duration from .5 of a second to 30 seconds. The "on" and "off" cycles are independent of each other as we shall see later in this article.

In the laboratory it might be necessary to test components or a system over a wide range of "off" and "on" cycles. The experimenter will get a great deal of satisfaction from studying the properties of *RC* circuits. In an industrial process of temperature control of a substance being heated by infrared where a thermoswitch may be impractical, this unit is the answer to the problem.

The device, being electronic in nature, eliminates all the inherent bad features of commercially-available mechanical or hydraulic timers. There are no gears to change, nor are we dependent upon bleeding of air or oil through an orifice that is critical in adjustment. By changing potentiometer settings we can effect changes in "off" and "on" cycles. Here is a device that is both flexible and accurate.

The timing action of the unit is based on the charging and discharging of capacitor C_1 (see Fig. 3). Since C_1 is connected to the control grid of the 117N7, the magnitude of the plate current is an inverse function of the capacitor voltage, the capacitor being charged from a negative source.

There are two power supplies in the unit. One supplies the "B plus" for the plate circuit of 117N7, the other produces a negative voltage supply for charging capacitor C_1. These are shown within the dotted lines (see Fig. 3). The positive voltage supply is obtained from the rectifier half of the 117N7. The rectifier for the negative voltage supply is of the selenium type. This choice eliminates the necessity for a tube-type rectifier.

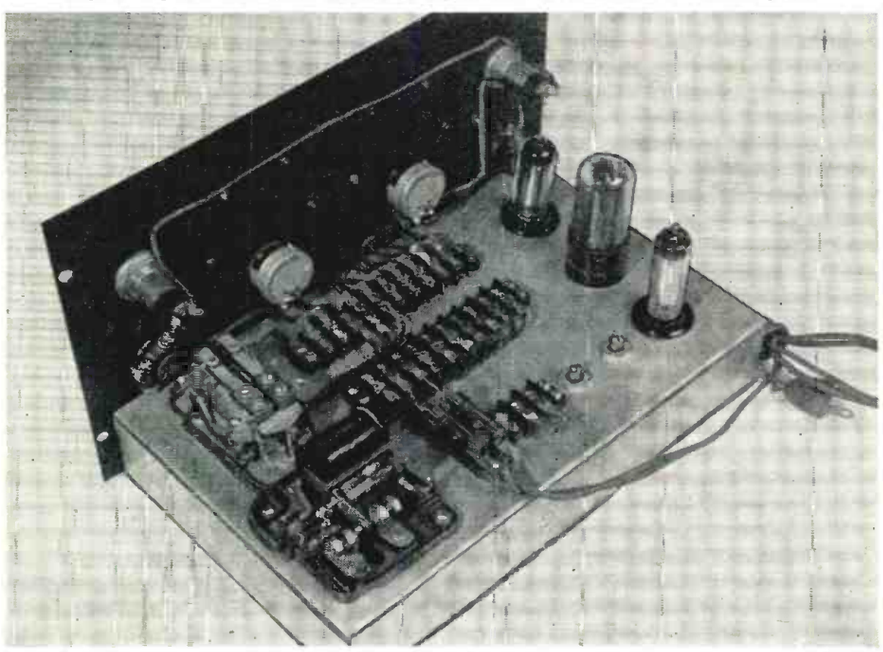
Let us now consider the operation of the *RC* circuits that control the timing intervals. When relay RL_1 is operative, R_3 and R_4 form the charge path for C_1 from the midpoint of R_6 and R_7 which is at a potential of —45 volts. R_1 and R_2 form the discharge path through the normally-closed contacts to ground. Assume that the pentode section of the 117N7 is conducting, RL_2 is energized and it, in turn, closes RL_1. C_1 immediately starts to charge negatively. The plate current diminishes until relay RL_2 drops out, and C_1 discharges through the normally-closed contact of RL_1 until the grid voltage drops and the plate current again picks up RL_2. The cycle repeats itself as long as S_2 is in the "auto" position. Since the charge and discharge paths are separate, we can vary the "on" and "off" cycles independently. R_2 and R_4 were added to the circuit to provide a means of lower-limit time calibrations. The upper limits are set by R_1 and R_3.

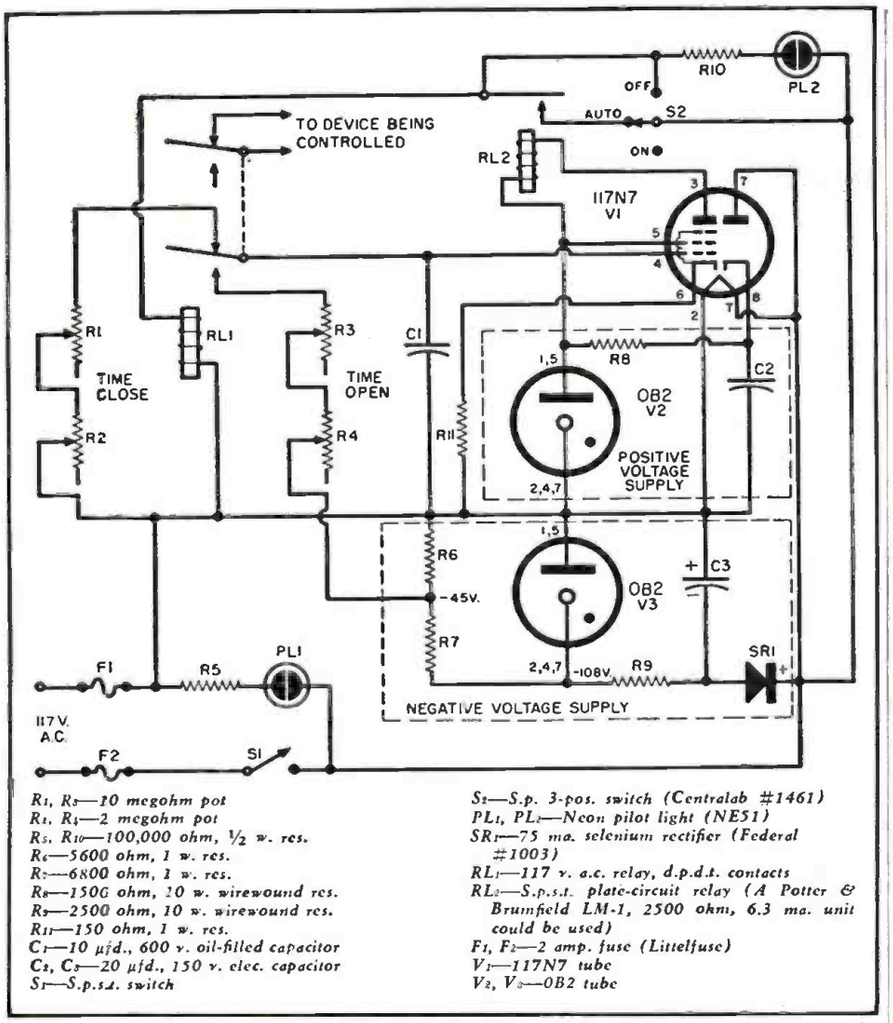
A power transformer is not required since the 117N7 operates across the line. The pilot lights are of the neon type with current limiting resistors R_9 and R_{10}. This results in a very economical unit. PL_2 does not affect the operation of RL_1 because of the very small current drawn by the neon-type light. For convenience, switch S_2 also has "on" and "off" positions.

Capacitor C_1 should be of the oil-impregnated type. An electrolytic capacitor should not be used since its parallel leakage would affect operation of the *RC* circuit. RL_1 is an a.c. relay with sufficient contact carrying capacity for the external load. RL_2 is a sensitive type plate-circuit relay that operates at around 6 ma. with a coil resistance of 2500 ohms.

Fig. 1 is a front view of the controls and indicating lights. A *Bud* #994 cabinet and #1193 chassis were used by the writer. Note the two lower limit potentiometers in Fig. 4. These are of the screwdriver-adjustable type. Since there are several components on the top of the chassis which must be wired in, *Cinch-Jones* Type Y terminal blocks are used to aid in the interconnection to the sub-chassis circuits. The circuit is of the transformerless type and is not grounded to the chassis. V_2 and V_3, the 0B2 voltage regulator tubes can be omitted if desired. They render the positive and negative voltage supplies immune to line variations. This insures consistent timing intervals for setting R_1 and R_3.

Fig. 2. Top chassis view. The use of terminal blocks facilitates neat wiring job.





R1, R5—10 megohm pot
R3, R4—2 megohm pot
R5, R10—100,000 ohm, ½ w. res.
R6—5600 ohm, 1 w. res.
R7—6800 ohm, 1 w. res.
R8—1500 ohm, 10 w. wirewound res.
R9—2500 ohm, 10 w. wirewound res.
R11—150 ohm, 1 w. res.
C1—10 μfd., 600 v. oil-filled capacitor
C2, C3—20 μfd., 150 v. elec. capacitor
S1—S.p.s.t. switch
S2—S.p. 3-pos. switch (Centralab #1461)
PL1, PL2—Neon pilot light (NE51)
SR1—75 ma. selenium rectifier (Federal #1003)
RL1—117 v. a.c. relay, d.p.d.t. contacts
RL2—S.p.s.t. plate-circuit relay (A Potter & Brumfield LM-1, 2500 ohm, 6.3 ma. unit could be used)
F1, F2—2 amp. fuse (Littelfuse)
V1—117N7 tube
V2, V3—0B2 tube

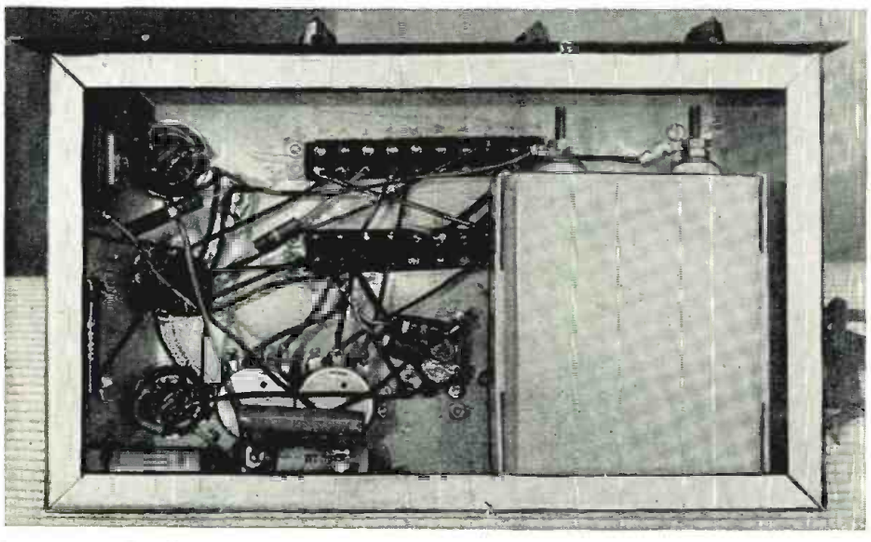
Fig. 3. Schematic of unit. Regulator tubes may be omitted if line voltage is steady.

After the unit is constructed, calibration graphs can be made by connecting an ordinary electric clock with a sweep second hand to the RL_1 contacts. If different timing ranges are desired, changing the values of capacity and resistance is all that is necessary. Ranges as high as 5 minutes are obtainable.

As mentioned previously, although designed essentially for the home experimenter's workshop, this device can be incorporated in industrial timing gear, if desired.

This device offers the constructor the double satisfaction of building both an interesting and useful instrument. —30—

Fig. 4. Under chassis view. Note the two screwdriver-adjust pots at lower left.



Certified Record Revue

(*Continued from page 60*)

sound varies somewhat from disc to disc since quite a period of time exists between the first recording in this series and the last. Over-all, the string tone is generally clean although a little wiry at times. Boyd Neel gets a beautifully balanced sound which more than offsets some of the other minor defects. Acoustic perspective is not over-large which is as it should be for this intimate small orchestra work. This reading has no competition from the *Decca* or *Columbia* albums and unless the forthcoming version of this score on *Westminster* is very, very good, this would be first class buy.

MENDELSSOHN
CONCERTO IN E MINOR FOR VIOLIN AND ORCHESTRA
TCHAIKOVSKY
CONCERTO IN D MAJOR FOR VIOLIN AND ORCHESTRA

Zino Francescatti, violinist with New York Philharmonic Orchestra conducted by Dimitri Mitropoulos. Columbia ML-4964. NARTB (Old) curve. Price $4.95.

A magnum serving of two of the staples in the violin concerti repertoire, this is certainly one of the best record buys dollar-wise to come along in a long while. Francescatti is a performer with prodigious energy and a flashing technique. These attributes he puts to good use in the Mendelssohn and comes up with a stunning reading. There are other versions with more grace and perhaps more warmth, but the excitement of Francescatti's *tour de force* is hard to deny. Strangely in the Tchaikovsky, an even better vehicle for his talents, Francescatti is less athletic, and somehow seems subdued. While it certainly qualifies as a superior reading, it can't be called definitive. Soundwise, *Columbia* has done one of their better jobs. The Francescatti violin is vibrantly reproduced and the strings in general are clean although slightly edgy. Good brass and woodwind sound, very bright and sparkling. Percussion good but slightly on the thick-textured side. Excellent transient response here, although pre- and post-echo mar the picture. This is not unexpected when you realize how much music *Columbia* has managed to crowd on this disc. Mitropoulos manages a good balance between violin and orchestra and elicits some unusually good playing from the Philharmonic. Altogether an excellent rapport exists between soloist and conductor. Francescatti and Mitropoulos seem to always "hit it off" well in recordings if you will remember their notable collaboration in the Paganini and Saint Saens 3rd violin concerto some years ago. Summing up; not definitive, nor the absolute tops in sound, but nevertheless a tremendous value, especially for the beginning audiophile.

RESTFUL GOOD MUSIC

Leopold Stokowski and his Symphony Orchestra. Victor LM1875. RIAA curve. Price $3.98.

A perfectly horrible title (with a lusciously-looking doll on the cover) will probably scare some people away from just the thing they have been looking for . . . to wit, a collection of quiet symphonic works to use as a background. Quite a potpourri is on this disc with works ranging from Bach's "Mein Jesu" and "Siciliano" to the 2nd movement of Beethoven's "Pastoral" and Purcell's "When I am Laid in Earth!" Stokowski has no peer when it comes to this sort of thing and he makes of each piece a masterpiece in orchestral sonorities and dynamic expression. Admittedly, some people will scream at the good Doctor's interpretations, but one should keep in mind the purpose of the album and realize that Stokowski has done an admirable job within these bounds. The sound is on a plane with the readings. Very lush and luminous strings, sensuous woodwinds, semi-intimate acoustics. Strictly not for hi-fi fans, but a darn good one to placate your wife with after a long, serious session of Stravinsky or Hindemith for example!

BARTOK
CONCERTO FOR ORCHESTRA

Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML 4973. NARTB (Old) curve. Price $4.95.

The 5th version on LP and one which must be adjudged near the top. However, it faces some pretty rough competition and for that reason it cannot be called definitive. It was to be expected that Bartok's most readily assimilable work would sooner or later come under the baton of the formidable Ormandy and his fabulous orchestra. Since the work is, in essence, a virtuoso display piece for orchestra, it might also be a foregone conclusion that the Philadelphia would have the prize in the bag. Well, they almost take it, but not quite. The work is really quite new in Ormandy's repertoire and even with rehearsals and regular concerts they can't have played it as many times as the Minneapolis Symphony under Dorati, where it has been regularly programmed for years. Thus, in comparison with the Dorati disc, the Philadelphia shows too fat a tone for the score and the attacks and ritards are not all what they might be. In other words, Ormandy is trying to make the work almost lyrical, which with this score is well nigh impossible.

Other than these falls from grace, this is quite a musical experience and some may prefer the Ormandy treatment to the glittering brilliance of Dorati. Certainly it is a more reasonable survey of the score than the Von Karajan effort on *Angel*. Soundwise this is typical of recent *Columbia*/Philadelphia discs. Generally sharp clean strings, good rousing brass and sweet woodwinds, percussion of good weight and clarity. A little too much reverb for my taste in this score, but it makes for a very live sound Conclusion: a good sounding disc with a magnificent display by the Philadelphia Orchestra and a reasonably good reading. The overwhelming sound and the taut urgency of the Dorati reading still linger in memory and take precedence over all others.

MALCOLM ARNOLD
ENGLISH DANCES

London Philharmonic Orchestra conducted by Sir Adrian Boult. London LD9178. RIAA curve. Price $2.50

Another terrific buy in the low-priced *London* LP series. This is the premier recording of these interesting dances on LP and is definitely worth listening to. Based on English folk dances, they are for the most part very gay and lively. Not anything like profound music here, but you do have the superb playing of the London Philharmonic and the knowing performance of Sir Adrian Boult and above all some fabulous sound. For $2.50 this is just about the best demonstration record you can buy. Strings, woodwinds, brass, percussion, all are heard with exceptional wide range in frequency and dynamics. Virtually no distortion, groove or otherwise, can be noted. Couple all this with near perfect acoustics and you have a outstanding recording of some very pleasant music.

PORTS OF CALL

Philadelphia Orchestra conducted by Eugene Ormandy. Columbia ML4983 NARTB (Old) curve. Price $4.95

The name of the album derives from the

score of the same name by gifted French composer, Jacques Ibert. This is combined with other works by Ravel, Debussy, and Chabrier, whose various pieces are supposed to depict various "Ports of Call." The music succeeds very well in this, especially if you are fortified with the fantastic jacket notes that go with each piece (or port). Boy, I'll tell ya! Whoever wrote those notes is a travelin' fool and an expensive one at that! Just dig this as an accompaniment to Ravel's "La Valse" (Vienna) . . . "there is still politeness and gemutlichkeit, and also chocolate fondants at the Patisserie Demel, crayfish at Prohaska's and glasses of Gumpoldskirchner at idle tables in the afternoon." Hoo Ha!! Musically the various sections are quite well done by Ormandy and his orchestra, especially the Ibert, "Ports of Call," which certainly is the best version available at present. A bonus is the good sound which attractively clothes each work, although string tone gets edgy in several sections. A pleasant record for lazy listening.

DVORAK
CONCERTO IN G MINOR FOR PIANO AND ORCHESTRA
Rudolf Firkusny, pianist with Cleveland Orchestra conducted by George Szell. Columbia ML4967. NARTB (Old) curve. Price $4.95.

If you are a little too full of the Greig or Schumann or Tchaikovsky piano concertos, try this Dvorak for a welcome change. It, too, is in the big romantic vein, but at least you haven't heard it eleventy-nine times! It is quite an interesting and listenable work and deserves to be heard more often in our concert halls. Hi-fi fans will like this concerto not only for the excellent sound, but for the exciting scoring of the first and the third movements. Firkusny is evidently much surer of his ground in this work than was Wuhrer in the old *Vox* recording. He brings the work along logically at a reasonable pace and indulges in few mannerisms.

Szell is right at home with the Dvorak orchestration and he gives excellent support to Firkusny. Piano is big-toned but not harsh. Transients were excellently reproduced and there was no trace of wow or flutter in the piano. A good balance was maintained by the engineers between piano and orchestra. My only complaint . . . rather cramped acoustics, and a bass line on the flabby side. Otherwise an estimable job and a piano score well worth your time.

DEBUSSY
CHILDREN'S CORNER SUITE
LA BOITE A JOUJOUX (THE BOX OF TOYS)
Orchestre National de la Radiodiffusion Francaise conducted by Andre Cluytens. Angel 35172. RIAA curve. Price $4.98.

This is an utterly charming recording and I can't recommend it too highly. The "Children's Corner Suite" is the better known of the two works and gets a reading from Cluytens that is never heavy-handed, but is a model of grace and delicacy. The warmth of the interpretation is extraordinary. The "Box of Toys" is similarly treated and turns out to be a gay little work when handled in so adroit a fashion as Cluytens employs. The three other versions of the "Box" in the catalogue are never in serious contention with this disc, although the *MGM* disc has certain points in its favor. The sound on this disc is in keeping with the score, being small-boned, almost ethereal in some sections. Very luminous almost transparent string tone, the superb French woodwind intonation a miracle of sweetness and precision and acoustic perspective just right for the score.

Jazz Corner

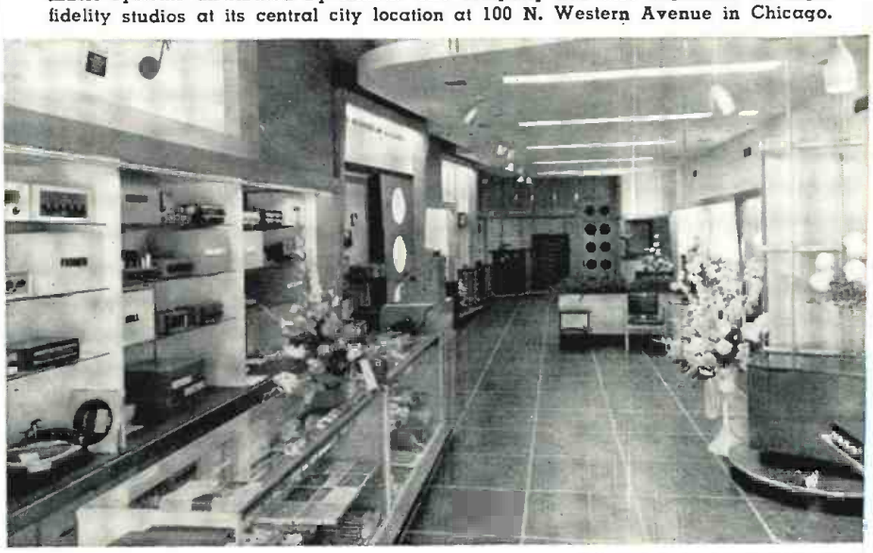
Some outstanding jazz releases this month, and a "pop" or two.

SWING EASY
Songs by Frank Sinatra. Capitol W587. RIAA curve. Price $3.98.

Old Frankie has certainly been the subject of a lot of discussion pro and con about his relative merit. I'm not going to get into the argument other than to comment that no other of the present crop of singers can get as much out of a song as Sinatra. I think the main reason for this is his absolutely fabulous sense of phrasing and timing. By certain inflections and emphasis he can give more meaning to some of his stuff than anybody else I have ever heard.

On this album he does an attractive collection of songs with favorites like "The Girl Next Door," "A Foggy Day," "I Get a Kick out of You," etc. The *big* difference between this and other previous albums by Sinatra is that this is given the benefit of some wonderful hi-fi sound.

Allied Radio Corporation of Chicago has opened a new store at 602 Davis Street in Evanston, Illinois, which will be devoted exclusively to the demonstration and sale of high-fidelity equipment. The new store, with an area of 2400 square feet, is very modern in appearance and includes carefully planned facilities for demonstration and sale of the great variety of famous brand names of components and music systems distributed by Allied. The company has also expanded its high-fidelity studios at its central city location at 100 N. Western Avenue in Chicago.



On a wide range system this is some of the most sensational vocal sound I have heard, and the orchestral accompaniment is superb, too! All tonsil-close of course, but there is no distortion present and in the average living room with good acoustics, the effect with a number like "The Girl Next Door," is slightly fabulous. I don't usually go for this kind of stuff, but this warrants my enthusiasm and you will find that it will serve admirably as a demonstration piece for those friends of yours who don't dig symphony.

BROWN AND ROACH INC.
EmArcy MG36008. RIAA curve. Price $3.98.

The torrid trumpet of Clifford Brown and the drivin' drums of Max Roach team up with George Morrow on the bass, Harold Land on tenor sax, and Richie Powell on piano in a cool group of songs including "Stompin' at the Savoy," "Darn that Dream," "Ghost of a Chance," etc. These boys really dig each other and the result is some of the best small combo jazz I've heard. Their playing is very assured, nothing frantic here. The group is a swinging bunch, but it's an easy swing and it's mighty easy to take. The arrangements are clever, the improvisation still better. The sound is another outstanding job by *EmArcy*. The trumpet has that bell-like clarity and bright resonance we have come to associate with Brown. The tenor sax is full bodied and very sonorous, bass is solid and clean, the skins are heard very cleanly with fine impact and articulation. The piano is not hard sounding, even when used percussively. All recorded very close-to, with enough reverb to keep it live. An outstanding recording for jazz demonstration and one that sounds good on small as well as big sound systems.

Tape Review

MOZART
SYMPHONY #40
SCHUBERT
SYMPHONY #8 (UNFINISHED)
Vienna State Opera Orchestra conducted by Felix Prohaska. AV-1035, 7" reel, 7½ ips. Approx. 1 hour. Price $10.95.

This is another in the new *Audio-Video Vanguard* releases. Here we have items in the standard repertoire and they must stand on their own feet without benefit of gimmicks. The performance, fortunately, is one of the best to come from a small company. The Schubert is given a really excellent reading with careful modeling and just tempo. The Mozart fares less well, but still is nothing to be ashamed about. Both share in common a fine big-hall sound, with enough detail preserved to make for a very fine "presence" effect. The strings are beautifully clean and edgeless, brass has that bright bloom so hard to engrave on a disc and the woodwinds have that breathy, almost palpable sound that one associates with the real thing. Couple all this with ultra-wide frequency range and dynamic range impossible to duplicate on a playable disc and the almost distortionless transients and you have a recording that lives up to the promise of tape. Tape hiss was barely noticeable in my copy and equalization was no problem as played on my *Ampex* 600. Consider the fact that you can play back this tape thousands of times if need be without appreciable deterioration, and you may realize that the asking price is not really exorbitant. With standard repertoire this price is all right, with gimmick repertoire that's another story.

RCA has announced some new tape releases some of which are the very latest "Orthophonic" recordings. Included in this batch are no less than four new stereophonics. As soon as I receive them I will hasten to review them for you. See you next month. —30—

Spot Radio News
(*Continued from page* 24)

tion, there is substantial doubt that CATV operations are broadcasting. If this is so, he added, then perhaps one could say that CATV's are common carriers in interstate commerce. Analyzing this point, the Commissioner said that network programs originating in one station and crossing state lines, by whatever method, and terminating in a receiving set in a distant state, could be classified as interstate commerce. Whether such commerce comes under the jurisdiction of the federal government or state can be debated; and the courts will probably have to decide who does have such control. In the meantime, the government's spokesman said that he was aware that some . . ."community antenna operators insist that they are not common carriers for hire; that their operations are merely an extension of individual home antennas upon a high point to capture a signal which is about to escape its earthly usefulness on its way to infinite space. . . . Although this may have merit insofar as federal regulation is concerned, it is doubtful that it could successfully resist assumption of jurisdiction by a state."

If, continued the Commissioner, the FCC were to declare CATV systems to be common carriers in interstate commerce, then it would become necessary to issue certificates of convenience and necessity. Under this condition, it was noted, the Commission could . . . "hardly deny such a certificate to a . . . system . . . rendering a service to a group of people isolated from any broadcast service . . ."

Emphasizing that the objective of the Commission is to . . ."make possible for everyone in the United States

NEW TV GRANTS SINCE FREEZE LIFT

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

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Hawaii	Wailuku (Maui)	KMVI-TV (To be satellite for KONA-TV; Channel 11)	12	204-210	30.2
Kansas	Wichita	KTVR	3	60-66	100
New Mexico	Carlsbad	KAVE-TV	6	82-88	1.41
Oregon	Roseburg	KPIC	4	66-72	5.3

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Alabama	Mobile	WKRG-TV	5	76-82
Arizona	Tucson	KDWI-TV	9	186-192
Louisiana	Shreveport	KCIS	12	204-210
Mississippi	Hattiesburg	WDAM-TV	9	186-192
Washington	Ephrata	KBAS-TV	43	644-650

CALL LETTER CHANGES

Mississippi	Jackson	WJTV (Formerly WSLI-TV)	12	204-210
Nebraska	Hastings	KHAS-TV (Formerly KTVR)	5	76-82
Vermont	Burlington	WCAX-TV (Formerly WMVT)	3	60-66
Wisconsin	Milwaukee	WISN-TV (Formerly WTVW)	12	204-210

*ERP=(effective radiated power, kw.)

NEW TV STATIONS ON THE AIR

(As of August 25, 1955)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
Florida Miami	WTHS-TV†	2	54-60	17.8	11.5
Illinois Champaign-Urbana	WILL-TV†	12	204-210	4.79	60
Indiana Notre Dame-South Bend	WNDU-TV	46	662-668	1.49	164
Iowa Des Moines	KRNT-TV	8	180-186	5.43	316
North Carolina Fayetteville	WFLB-TV	18	494-500	1.98	12.9
South Dakota Rapid City	KOTA-TV	3	60-66	16.06	1.5
Texas El Paso	KOKE-TV	13	210-216	4.65	29.5
Virginia Petersburg	WXEX-TV	8	180-186	5.43	316
West Virginia Bluefield	WHIS-TV	6	82-88	11.8	50

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 442 (116 of which are u. h. f.). †Educational

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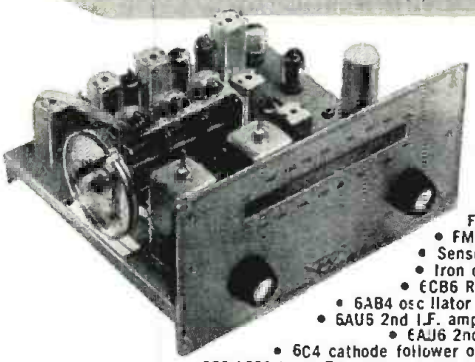
AND SAVE

NEW Approved policy...

eliminates percentages to "middlemen"—brings equipment direct from factory to you for buys that can't be beat...anywhere! Approved kits are NOT AVAILABLE FROM DISTRIBUTORS OR JOBBERS.

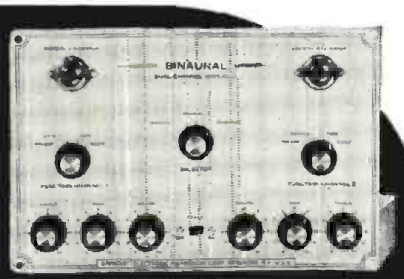


New Imperial V— 12-tube AM-FM Tuner Kit

- Band width-200 kc
- Tuned RF stage
- Frequency Response FM-20-20,000 CPS ± .5DB
- FM Tuning Range 88-108 mc
- Sensitivity 5-10 u/v, 20-30 DB
- Iron core tuned I.F. disc trans.
- 6CB6 RF amplifier • 6AB4 mixer
- 6AB4 osc llator • 6AU6 1st I.F. amplifier
- 6AU6 2nd I.F. amplifier • 6AU6 1st limiter
- 6AU6 2nd limiter • 6AL5 detector
- 6C4 cathode follower output • AM tuning range 530-1650 kc • Frequency response AM-20-7,500 CPS ± 3DB
- Iron core tuned coils throughout • 6BA6 RF amplifier • 6BE6 converter
- 6BA6 1st I.F. amplifier • IN34 crystal diode detector • Tuned RF stage
- Chassis dimensions: 9¾" long, 5" high, 8" wide.

Complete kit of parts including tubes, step by step, pictorial and schematic diagrams, less power supply **$37.50**
Wired and tested extra **$10.00**
Power Supply—6.3V-4 Amp., 190 Volts 55 MA—117V. 50-60 cycles **$12.00**
Tuning Eye Kit ..... **$ 2.95**
Shipping Weight 10 lbs.

New Binaural Twin Channel Amplifier Kit Channel 1 and 2



- 1-6SC7-Pre Amp. Common to both Chan.
- 2-6F5—1st Stage Amp.
- 2-6F5—Voltage Amp.
- 2-6V6—Power Amp.
- 1-5Y3—Rectifier Amp.
- 2-Cathode Ray Output Indicators
- Individual Channel Volume controls
- Individual Bass control boost 12DB
- Individual Treble control boost 12 DB
- Inputs for Radio, Tape, Crystal, GE Reluctance
- Chrome plated chassis
- Hum levels—78 DB below full output
- Frequency response each Channel ± 1 DB 40-12,000 CPS
- Maximum power output each channel, 4 Watts
- Output, 4-8-16 ohms
- Size 13" Long x 9" Wide x 8½" High

Complete kit of parts including AC power supply, tubes, step by step pictorial and schematic diagrams **$39.95**
Shipping Weight 18 lbs.

New V-5 Am Tuner Kit

- Self-contained AC power supply
- Tuning range 530-1650 kc
- 6BA6 RF Amplifier
- 6BE6 converter
- 6BA6 1st I.F. amplifier
- 6AL5 detector
- 6C4 cathode follower output
- #65 selenium rectifier • Sensitivity 5 microvolts
- Frequency response 20-20 000 CPS ± .5DB
- 3 section variable cond. • Tuned RF stage
- Iron core tuned coils throughout • Dimensions 9¾" x 5" x 5⅞"

Complete kit of parts, including AC power supply, tubes, step by step, pictorial and schematic diagrams **$24.50**
Wired and tested extra **$5.50**
Tuning Eye Kit **$2.95**
Shipping Weight 9 lbs.

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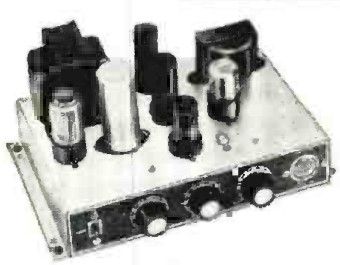
New V-9 Tuner Kit

- Self-contained AC Power Supply
- 3 section variable condenser
- Tuning range 88-108 mc
- Band width 200 kc
- Sensitivity 10 microvolts 20 DB
- Tuned RF stage
- Iron core tuned I.F.—disc. trans.
- 6CB6 R.F. amplifier
- 6AB4 mixer
- 6AB4 oscillator (temp. compensated)
- 6AU6 1st I.F. amplifier
- 6AU6 2nd I.F. amplifier
- 6AU6 1st limiter
- 6AU6 2nd limiter
- 6AL5 detector
- 6C4 cathode follower output
- 65 MA selenium rectifier
- Dimensions 9¾" x 5" x 5⅞"
- Frequency response 20-7,500 CPS ± 3 DB

Complete kit of parts including AC power supply, tubes, step by step, pictorial and schematic diagrams **$29.50**
Wired and tested extra **$7.50**
Tuning Eye Kit **$2.95**
Shipping Weight 10 lbs.

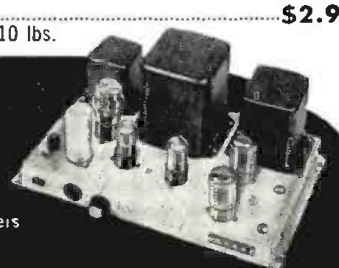


New Push Pull 6 Watt Amplifier Kit

- 1-12J5—1st stage Amp.
- 1-12SL7—Phase Inverter
- 2-12A6—P.P. Beam Power
- 1-5Y3—Rectifier
- 1-Cathode Ray Output Indicator
- Tapped outputs, 4-8-16 ohms
- Volume, Continuously variable
- Chrome plated chassis
- Bass Control Boost 12 DB • Treble Control Boost 12 DB • Hum level—78 DB below full output • Frequency response ± 1.5 DB 20-20,000 CPS
- Size 5½" high x 6½" wide x 11" long

Complete kit of parts, including AC power supply, tubes, step by step pictorial and schematic diagrams **$15.45**
Shipping Weight 13 lbs.

New 20 Watt Williamson Type HI-FI Amplifier Kit



- New Chicago Kit of transformers
- Chrome plated chassis
- 1-6SN7—1st stage Amp.
- 1-6SN7—Phase inverter
- 2-5881—Push Pull Power Output
- 1-5V4G—Rectifier
- Frequency Response ± 1 DB, 10-100,000 CPS
- Output 4-8-16 ohms
- Volume control
- On-off power switch
- IM Distortion—.1% using 60 and 3000 cycles sine wave output, at 12 watts indicated
- Hum Level—78DB below full output
- Pre Amp., Voltage supply outlet
- Size 15" Long x 9" Wide x 7" High

Complete kit of parts, including AC power supply, tubes, step by step pictorial and schematic diagrams **$39.55**
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at least one free television service . . ." the FCC representative said that in his own opinion, it ". . . would be more consistent with American philosophy to accomplish this by providing opportunity, rather than by imposing artificial restraints or outright prohibition of a competing CATV service by government fiat . . . whether they are ultimately designated common carrier or broadcasting."

THE ULTRA-HIGHS, now battling for recognition as a solid partner in TV broadcasting, are finding the fight rougher and tougher.

The blunt announcement by WEEU-TV (Channel 33, Reading, Pa.), some weeks ago, that it would have to shut their plant, was a shocking admission of defeat. Pointing out that the tremendous . . ."operating costs involved in maintaining an efficient television service . . . coupled with apathy on the part of national and network advertisers to support the Channel 33 development . . ." made it necessary to suspend operations, station management said that the blame for this unfortunate situation could not be placed on the doorstep of any individual or group.

"The problems facing the operators of u.h.f. television stations across the nation are varied and complex," the announcement added. "The competitive factors involving viewing habits and lack of equal opportunity to be on every television dial are only part of the story. . . . The electronic curtain has been drawn, and WEEU-TV . . . now joins the long list of ultra-high stations across the nation that have found it necessary to withdraw from broadcasting operations, because of economic instability that is plaguing u.h.f. broadcasting."

The situation has ruffled most of the experts in Washington. Those supporting the high bands say that if the Commission really wants u.h.f. to remain as a useful entity, the upstairs stations must be protected from v.h.f. competition. Entry of the low-band stations into the ultra-high zones can only lead to disaster for the u.h.f. operator, for network affiliations almost always swing to the low-band transmitters. Those in favor of v.h.f. or mixture of the high and low, declare that certainly both types of stations can live together, particularly if the ultra-high station has been entrenched and is now serving an audience.

FCC did make a move that would give the higher bands a lift; they issued a proposal that would permit the use of 5-million watts on u.h.f. Present maximum power is 1 megawatt, now being used by two stations, both in Wilkes-Barre, Pa. This power push would certainly go a long way towards the spreading of signals around on a basis that would satisfy sponsors.

AN INSTRUMENT, the velocimeter, that automatically measures the speed of sound in the sea to depths as great

as 300 feet, and plots the result as a function of depth or time, has been developed in the sound lab of the Bureau of Standards.

The device consists essentially of a pair of piezoelectric transducers of polarized barium-calcium-lead titanate and a reflector, mounted to form a sound path of fixed length. The transmitter (a transducer) is connected to a pulse generator and another transducer acting as a receiver provides the input for a high-gain pulse-shaping amplifier. The amplifier's output retriggers the pulse generator, which then applies another pulse to the transmitter. In turn, the transmitter produces a sound pulse in the water to actuate the receiver. Thus, the system continually regenerates a sound pulse whose repetition rate or frequency depends on the time it takes the pulse to move through the water. Since the path length is fixed, the frequency depends only on the speed of sound through the water and on the circuit delays. Any variations in sound velocity are recorded as variations in the operating frequency of the instrument.

The speed of sound in large natural bodies of water varies from about 4600 to 5140 feet-per-second. These variations occur with changes in temperature and, to a lesser extent, with changes in the salinity (salty condition) of the water. Sound velocity also increases about 1 foot-per-second for each 55 feet increase in depth. The sound velocity gradients due to these variables, produce curvatures in the rays of sound being propagated in the sea. In some instances, reflections are produced, if, as is often the case, the thermal or salinity gradients are abrupt. In current practice an estimate of the sound velocity is calculated from the measured temperature and an assumed salinity. The Bureau of Standards development provides an almost instantaneous meter reading of the actual sound velocity.

AS SUMMER CALM reigned in the hearing rooms of the Commission, grant activity was feeble. As we went to press, but a trickle of authorizations were on hand. These, plus new station calls and call changes, appear on page 152, this issue.

RESIDENTS OF Washington, D. C., and Beverly Hills, California, and everyone in the audio world were shocked to hear that Edgar M. Berliner, famed throughout the country for his phono developments, had passed on. . . . The son of the inventor of the microphone, Emile Berliner, he headed the *Victor Talking Machine Company* of Canada for years, and was responsible for a long chain of outstanding sound system innovations that have become standards in the industry.

His keen insight, resourcefulness, and inventive and administrative skills will be missed by all in the design, production, and manufacturing fraternity. . . . . L.W.

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ALL TYPE SUPPRESSORS.....18¢ ea. 10 Assorted $1.60

6 x 9 SPEAKER KIT - Complete with Grill, Switch, Wire and Mounting Plate - Bronze or Grey.....$1.99 ea.

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BASEBALL COLORED ANTENNAS - 3 Section - 1 Man Mount - Brass Fittings - Red, Blue, Black, Yellow and Chrome .....$3.99 ea.

SNYDER TWIN REAR DECK ANTENNAS RD-8 .....$5.39 ea.

INDOOR ANTENNAS

NEW JFD VENUS ANTENNA TA141 - Boxed Marked $7.95 - Large Round Ball - 3 Section Aluminum Dipoles - Ivory or Mahogany Base - Tilt proof Single $1.19 ea. 10 - 30 $1.09 ea. 30 or more 99¢ ea.

NEW JFD VENUS ANTENNA TA144 - Carton Labeled $8.95 - 3 Section Brass - Real Heavy Base - Large Type Ball in either Ivory or Mahogany.....Single $1.49 ea. 10 - 30 $1.39 ea. 30 or more $1.24 ea.

WORLD FAMOUS SNYDER 3-D - Indoor 3 Section Brass with Phasing Switch Single $2.49 ea. 25 or more $2.39 ea.

SNYDER 2-D ANTENNA - Same as 3-D except smaller base.....Single $2.09 ea. 25 or more $1.99 ea.

CLOSEOUT ON SNYDER 4-D - Halo Type with same Switch and Base as 3-D Single $1.79 ea. 12 or more $1.59 ea.

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HI-LO ANTENNA OR SOLID ROD CLIPPER KITS - Complete with 75' 100 Mil Wire - 5' Mast - Chimney or Vent Mount - Screweyes - Mast Stand-offs, etc. (May be Assorted for Quantity Prices) 12 Lot $5.29 ea. 6 Lot $5.69 ea. Single $5.99 ea.

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NEW ALLIANCE AUTOMATIC ROTOR, Model U-98 (18 Improvements Over older U-83).....$23.97 ea.

NEW ALLIANCE T-10 SEMI AUTOMATIC ROTOR .....$19.97 ea.

3½" SCREWEYES .....100 for $1.49

LIGHTNING ARRESTORS - J.F.D. or TELCO - UL Approved .....6 or more 39¢ ea. Single 49¢ ea.

TV TABLES

UNIVERSAL HIGHPOINT MAHOGANY OR EBONY SWIVEL TOP TABLES - Brass Tipped Legs - Screened Top - Made Especially For Us - 22" x 24" - Top Gold Inlaid.....6 or more $7.95 ea. Single $8.45 ea.

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55° YOKES .....6 or more $1.29 ea. Single $1.49 ea.

7.5 OHM FUSIBLE RESISTORS...10 Lot 29¢ ea. Single 39¢ ea.

HOOK UP WIRE - 25' Hanks...5 Hanks for 99¢

L-28 CARTRIDGE AND TONE ARM - Super Special .....$2.29 ea.

REAR SEAT SPEAKER SWITCH KIT - Complete with Mounting Plate - Boxed..99¢ ea.

GUY RINGS & SLEEVES for Mast - 89¢ Value .....16¢ ea.

12" AUTO ANTENNA EXTENSIONS....49¢ ea.

AC RADIO ANTENNA HANKS.....10 for $1.49

PHILLIPS SOLDERING GUN - Regular Price $14.95 - Our Price .....$6.95 ea.

CLOCK RADIO KNOBS - Brown, Ivory or Gold for GE or Telechron.....16¢ ea. 10 for $1.49

2 PIECE MAST COUPLERS - Heavy Duty.75¢ ea.

465 K.C. I-F TRANSFORMERS - Matched - Set of 2.....$1.69

VERTICAL BLOCKING OSCILLATOR TRANSFORMERS - Brand New - Boxed - Similar to Merit A3000 or Stancor A-8111 .....6 Lot $1.09 ea. Single $1.19 ea.

VERTICAL OUTPUT TRANSFORMERS - Similar to Stancor A-8112 or Merit A3036 .....6 Lot $1.39 ea. Single $1.69 ea.

ANTENNA OR OSCILLATOR COILS FOR RADIOS - Standard Types 6 Assorted 59¢ ea. Single 79¢ ea.

HI VOLTAGE PHONO CARTRIDGES - Standard Brand - Plastic Boxed 6 Lot $1.69 ea. Single $1.89 ea.

AS ABOVE BUT DUAL HI-LO OUTPUT 6 Lot $1.99 ea. Single $2.29 ea.

PARALLEL TUBE BRIGHTENERS 5 Wire 10 Lot 74¢ ea. Single 82¢ ea. 6 Wire 10 Lot 89¢ ea. Single 99¢ ea.

HEAVY DUTY 6V6GT or 50L6GT OUTPUT TRANSFORMERS with Speaker Plugs or Leads Attached.....6 Lot 89¢ ea. Single 99¢ ea.

HORIZONTAL OSCILLATOR RINGING COILS - Similar to Merit TV-163 - Fits All Sets.....39¢ ea.

1500 OHM FOCUS CONTROLS - Standard Brand Only.....4 Watt 10 for $5.90 Single 69¢ ea. 2 Watt 10 for $2.90 Single 39¢ ea.

ELECTROLYTIC CONDENSER SPECIAL — BUY 10 50/30/150V BRAND NEW FRESH CONDENSERS, STANDARD BRAND AT $5.90—AND YOU GET 10 20/20/150V Condensers at 5¢ ea. with above or 10 10/500V Condensers at 5¢ ea. with above.

TV INTERLOCK CORDS - 6' Length 10 for $2.20

TV BOARD TO SET CORDS - 6' Length 10 for $2.40

2 SET COUPLERS.....69¢ ea.

CHIMNEY MOUNTS - 12' Strapping - Galvanized Z Type (or Vent Mounts) 10 for $7.90 Single 99¢ ea.

CHIMNEY MOUNTS - Stainless Steel - 12' Strappings - Z or Y Types..12 Lot $1.49 ea. Single $1.69 ea.

HI-CAP CONDENSERS - 500 MMFD. - 20 K.V. - Standard Brand .....10 for $5.90 Single 69¢ ea.

A.C. RUBBER CAPS - UL Approved..10 for 79¢

A.C. BAKELITE CAPS - UL Approved..10 for 69¢

SINGLE ION TRAPS.....10 for $3.90 Single 49¢ ea.

PERFORATED 12' CHIMNEY STRAPS 2 Pair for 29¢

FREE—A pair of diagonal or long nose pliers with any order over $25.

DESCRIPTIVE LITERATURE AVAILABLE ON ANY ITEM LISTED

ALL ORDERS SHIPPED SAME DAY RECEIVED

Send complete shipping instructions plus 25% deposit. Balance C.O.D., or deduct 2% for check or money order in advance.

WE WILL BE GLAD TO QUOTE ON ANY STANDARD BRAND ITEM IN OUR FIELD
(We carry a complete stock of Dumont Parts)

TEE·VEE Supply Co.

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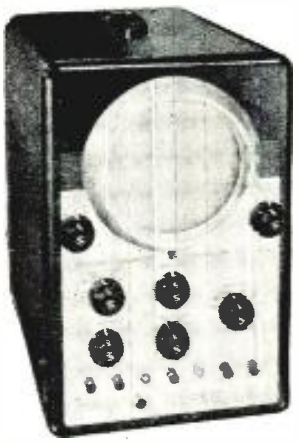
NEW SYLVANIA TEST EQUIPMENT

FULLY WIRED — READY TO OPERATE

Type 620 TUBE TESTER

- Tests 600MA Tube types
- Composite Emission-Transconductance Test
- Leakage Test—Directly in megohms
- Shorts Test
- Open Element Test
- Tests Tubes with Two Top Caps
- Factory Correlated Readings Provided
- Clear plastic Meter Case
- Switching Accommodates all Possible Tube Basings

Price $139.50



Type 404 TV LABORATORY OSCILLOSCOPE

An exceptionally high-gain, wide band scope created specially for designing and servicing TV receivers. It displays TV pulses, waveshapes and signals on a large 7 inch screen. Compare these other features:

- Flat response within 3db. from 10 cycles to 2 megacycles.
- Extremely sensitive—0.01 volts (10 millivolts per inch peak to peak deflection.)
- High input impedance of 5meg and only 26 mmf.
- Hard tube linear sweeps, from 25 cycles to 50 kilocycles.
- Positive & negative sync control.
- Wide range phasing control.
- Vertical & horizontal polarity reversing switches.
- Frequency compensated step attenuator.
- High voltage & demodulator probes incl. with instrument.

Price $299.50

Type 301 SERVICE POLYMETER

Designed for laboratory and field measurement, is stabilized against errors in calibration due to normally changing line voltage, or to gas current in tubes. The unusually high input impedance (17 megohm) of the Polymeter makes it ideal for use in high impedance circuits encountered in electronic equipment. The Sylvania patented full wave rectifier circuit gives optimum full scale accuracy necessary on the lower ac ranges. Rapid, accurate service is insured by these features:

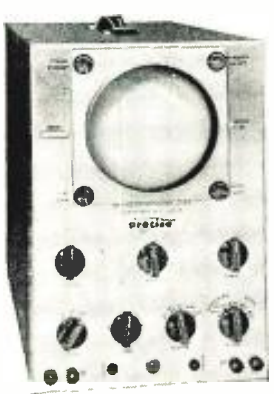
- Peak to peak scale.
- 17 megohm effective input resistance.
- New Sylvania 7" meter movement.
- Sylvania patented linearity circuit.
- Shielded AC lead.
- Illuminated Meter.
- Screw-on connectors.

Price $109.50

ANY INSTRUMENT ON THIS PAGE CAN BE OBTAINED ABSOLUTELY FREE OF CHARGE IF YOU PURCHASE YOUR SYLVANIA BRAND RECEIVING TUBES FROM US. SEND FOR COMPLETE INFORMATION—FILL IN COUPON BELOW, MAIL IT TODAY!

NEW, ADVANCED *Precise* TEST EQUIPMENT

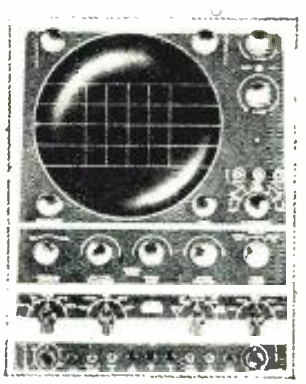
KIT FORM—ALL NEW COMPONENTS—NO SURPLUS



No. 315K 5" OSCILLOSCOPE

- Has frequency compensated vertical and horizontal attenuators along with identical vertical & horizontal amplifiers (within 5DB through 500KC).
- Uses 5CP1 type tube with post accelerator. Both horizontal and vertical sections are cathode-follower input type and are AC coupled. Outputs are push-pull.
- Basic sensitivity is approximately 250 millivolts per inch.
- Sweep rate from approximately 10 cycles to 100KC. Hard vacuum type sweep circuit.

Price $49.95



No. 308K 8½" OSCILLOSCOPE

- Does everything more expensive commercial scopes can do and does it better.
- Full 8¼" tube designed specially for this model.
- Voltage regulated
- Electronic magnifier allows any part of a signal to be magnified up to 10 times equivalent to 70" of horizontal deflection.
- High frequency—Low Frequency—Normal Frequency—Synchronization Circuit.
- Separate intensifier anode.

PLUS dozens of other features found only in more expensive scopes.

Price $129.95

No. 111K TUBE TESTER

CHECKS BOTH EMISSION & GM SEPARATELY

- Allows filament current to be measured directly on the meter.
- Checks AC-DC tubes & indicates "Voltage Sapping."
- Tests horizontal sweep tubes by pulse emission.
- Tests all tubes for emission and GM at the flick of a switch
- Short tests simply made without complicated switch manipulation.
- Measures tube bias directly.
- Tests all types of tubes including latest types & cathode ray tubes

Price $69.95

TEE·VEE Supply Co.

Send complete shipping instructions plus 25% deposit. Balance C.O.D., or, deduct 2% for check or money order in advance.

SEND FOR COMPLETE CATALOG

TEE-VEE SUPPLY CO.
3211 Washington St., Jamaica Plain 30, Mass.

Please send us complete data on your RECEIVING TUBE OFFER.

Name.....

Address.....

.....

Cadmium Sulfide Photocell

(*Continued from page 77*)

When the light source is interrupted, the resistance of the photocell increases considerably, reducing the series current and opening the relay. A conventional half-wave selenium rectifier (SR_1) together with a simple "L"-type brute force filter, consisting of R_1 and C_1, form the power source, permitting operation of the unit on an a.c. line. The values of the components in the filter network are not too critical, but they should be choosen for optimum operation with the relay and photocell used. In the author's model, good operation is obtained with approximately 50 footcandles illumination. Greater or lesser sensitivity or a change in response time might be obtained by changing the relay adjustment. There is no noticeable relay humming as the light level is gradually increased or decreased. With another relay, or a different relay adjustment, however, some change in the value of R_1 or C_1 (or both) might be necessary. Since the current requirements are small (in the neighborhood of 1 ma.), a battery might well be substituted for the a.c. power supply for remote operation. Battery life will depend on the size and type of battery employed, of course. A 90-volt battery will give good results, but lower voltages may be used.

The model shown is assembled in a small, commercially-available aluminum box. As can be seen in Fig. 3, the components are not crowded and there is plenty of room for wiring. A more compact assembly is possible if a smaller case is used. An *Atlas* AD-11 female microphone adapter is fastened to the base of the box with machine screws to permit mounting the assembled unit on a regular microphone stand (see Fig. 5).

Neither parts layout nor lead dress is critical. However, standard good wiring practice should be followed when assembling such a unit. The relay should be mounted to permit easy access to its adjustment screws. Care should be taken to avoid applying excessive heat to the photocell leads or to the terminals of the selenium rectifier. In the author's experimental model, the photocell is mounted within a thick rubber grommet. In a unit designed for industrial or commercial use, some other type of photocell mounting, such as a small clamp, would be preferred.

Applications

The experimental cadmium sulfide photocell relay may be used in any general application requiring a photocell relay of moderate sensitivity. It may be used as a burglar alarm, as a doorway annunciator, as an automatic light switch, as a door control, as a jam detector on conveyor lines, as a counter, or in similar control applications. A simple light source must be provided, of course, and the controlled device and its power source connected to the proper relay contacts. Small alarm bells, chimes or buzzers, and signal lights may be operated directly with the relay used in the model and specified in the parts list. Such devices may be used in burglar alarm, annunciator, and jam detector applications. But where any great amount of power is to be handled, as where the controlled device is a motor or heavy-duty solenoid, then a separate heavy-duty power relay should be provided, with its energizing coil operated by the sensitive relay in the photocell assembly.

But the cadmium sulfide photocell, itself, need not be limited to relay control applications. The basic cell is potentially suited to such applications as light measuring instruments, colorimeters, densitometers, pyrometers, sound reproduction—in short, to virtually any application requiring a compact, inexpensive, reliable, and fairly rugged light-sensitive device. —30—

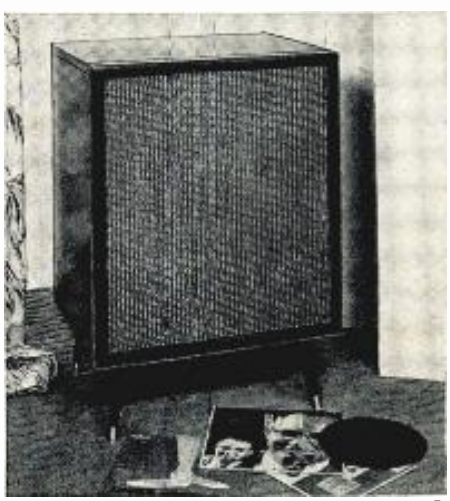
DU MONT ENTERS HI-FI FIELD

DU MONT has joined the high-fidelity equipment parade with the unveiling of two new self-contained reproducing units.

Both units incorporate turntables, pickups, amplifiers, and speakers in a single enclosure. The "Sound Stage" console, pictured below, will retail at $150. It features a three-speed changer and two speakers. Frequency range of the associated amplifier is 40-12,000 cps with distortion, at average listening levels, below 1%. Three controls are provided: a bass compensated loudness control, a bass control, and a treble control. The enclosure for the 3½" tweeter and 15" woofer is of the bass reflex type with internal padding. The crystal cartridge is of the turnover variety.

The second unit retails at $275 and includes both AM and FM receivers, three-speed changer, double sapphire stylus, three speakers, and a specially-engineered bass reflex enclosure. Power output is 20 watts with 1% distortion at 10 watts. Frequency response is from 20 to 20,000 cps. —30—

The "Sound Stage," one of the two consoles in the new Du Mont hi-fi equipment line.



FAMOUS BC-645 XMITTER-RECEIVER

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. CONVERSION DIAGRAM INCLUDED. This swell rig originally cost over $1000—yours for practically a song! You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. Shpg. wt. 25 lbs. **$29.50**

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation) ..... only **$6.95**

UHF ANTENNA ASSEMBLY, for BC-645 ..... **$2.45**

CONVERSION BOOKLET. Instructions for most useful surplus rigs **$2.50**

CONTROL BOX for above $2.25
SHOCK MOUNT for above 1.25

NAVY RECEIVER TYPE ARB

Four Band. 105 to 9050 kc. Low Freq., Ship, Broadcast—40 to 80 meters. Includes tubes and dynamotor, for 24 volt operation. Easily converted for 110 V., 12 V. or 6 V. Schematic Included. Excellent Condition. Overall: 8¼" x 7¼" x 15¼". Wt. 30 lbs. ....Special **$18.65**

SCR-522 RECEIVER (BC-624) with tubes . $22.50
SCR-522 TRANSMITTER (BC-625) with tubes 29.50

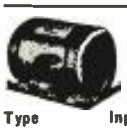
BC-1151-B INDICATOR complete with all tubes, NEW, demilitarized **$11.95**

ID-60/APA-10 SIGNAL INDICATOR, for 115 V AC, complete with all tubes including scope tube—NEW, demilitarized **$23.25**

BC-929 INDICATOR complete with tubes, excellent $14.75

TRANSMITTER
BC-223-AX

Ideal for 80-meter band! 801 osc., 801 P.A., 2—46 modulators, 1—46 speech amp., 4 xtal freq. and master osc., on selector switch. 10 to 30-watt output, tone, voice or C.W. Black wrinkle case, complete with freq. chart, 3 tuning units and tubes in original cases, less xtals. Sensationally low price, shpg. wt. 80 lbs. BRAND NEW $64.50
Used, Exc. Cond. with tubes, 2 tuning units . $29.50
PE-135AX 12/24V Dynamotor, NEW 24.95
Dynamotor Cable for Above 2.75



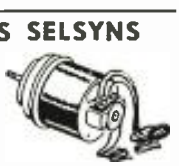
DYNAMOTORS

Type	Input	Output	Excellent Used	BRAND NEW
DM-64A	12V 5.1A	275V .150A		$7.95
DM-40	14V 3.4A	172V .138A	1.95	3.95
DM-42A	14V 46A	515/1030/2/8 MA 215/260	8.95	12.95
DM-43A	28V 23A	515/1030/2/8 MA 215/260	22.50	.....
DM-32A	28V 1.1A	250V .05A	2.95	7.50
DM-34D	12V 2.8A	220V .080A	7.95	....
DM-35D	12.5V 18.7A.	625V .225A.	9.95	....
DM-37	25.5V 9.2A.	625V .225A	8.95	..
DM-28	28V	224V .07A	1.95	4.95
DM-53A	28V 1.4A	220V .080A	2.95	5.95
DM-31A	28V 5A	575V .16A		
	28V 7A	540V .25A	1.95	3.95
PE-73C	28V 20A	1000V .350A	8.50	10.50
PE-101C	13V 12.6A	400V .135A		
	26V 6.3A	9VAC 1.12A		7.95
PE-94A	28V 10A	300V .200A		
		150V .101A	2.95	4.95
PE-94C	26V 10A	300V .200A		
		150V .101A	4.95	6.95
PE-103	6V	500V .160A		
	12V	500V .160A	19.50	34.50
PE-86	28V 1.25A	250V .080A	2.95	5.24
PE-135AX with filter	24V 12A	500V .200A		24.95
BD-77	12V	1000V .350A	14.95	19.50

INVERTERS

PE-206 Inverter. Leland. Input: 28V DC @ 38A. Output: 500V 800 cyc. 80VA. 1ph ..... BRAND NEW 10.50
Used, Excellent Condition 8.95
PE-218 Inverter. Leland-Wincharger-DE. Input 28V DC @ 92A. Output: 115V 380/500 cycles 1500VA. 1 ph ..... BRAND NEW 16.50
Used. Excellent Condition 8.95

SYNCHRONOUS SELSYNS



Specially priced! Mfd. by Diehl and Bendix. Brass cased, 6" long x 4" dia. For 110 Volt 60 Cycle AC. Quantities available. BRAND NEW. Transmitters . . each Repeaters . . . . each **$8.95**

TS-100/AP OSCILLOSCOPE!
BRAND NEW (worth $750)

OUR LOW PRICE **$34.50**

Can be used with linear sweep or general purpose test scope. Cables included. Also used with circular sweep as precision range calibrator. PRF rate 300-1500 per sec. Trigger input 15V @ 100V per microsec. rise. Trigger output 120V (+20V). Can be used to detect "jitter" in trigger divider circuits and modulator trigger pulse, also determining and adjusting division rate. Self-contained in metal case 8" x 12½" x 16" deep. For 110V 50 to 1200 cycles AC. Demilitarized, NEW, with all tubes including crystals and C. R. Tube.

TS-126/AP RANGE CALIBRATOR complete with 10 tubes. **BRAND NEW,** includes scope, test leads demilitarized **$16.95**

TS-10/APN TEST SET complete with tubes . $17.95

TG-34A CODE KEYER

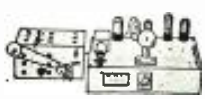
Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 5 to 25 WPM.

BRAND NEW, in original carton. $16.88

TG-10 CODE KEYER complete with 7 tubes and electric eye. 65 lbs. Used, exc. cond. **$17.45**

TG-5 TELEGRAPH SET, complete with key, headset, ready to operate. Ideal for two-way communication. **BRAND NEW** in carrying case **$6.95**

McElroy Automatic KEYER



Suitable for keying transmitter, or for code practice. Has photoelectric cell and sensitive relay. Variable speed motor operates on 110 volts 60 cycles AC. complete with tubes, excellent cond., your cost $12.95

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance	$2.25	$4.35
HS-33	Low Impedance	1.79	4.65
HS-30	Low Imp. (featherwt.)	1.49	1.85
H-16/U	High Imp. (2 units)	2.75	7.95
CD-307A	Cords. with PL55 Plug and JK26 Jack	....	.88

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike	$5.45	$7.95
T-30	Carbon Throat Mike	.33	.69
T-45	Navy Lip Mike	....	.99
RS-38	Navy Type	2.25	4.95
T-24	Carbon Mike	....	3.95

AGFA ANSCO Bubble Sextant

Made for U. S. Armed Forces. Actually worth $150 or more! Has illuminated averaging disc for nighttime use. Complete with carrying case, recording discs, flashlight with rheostat for using sextant at night, 2X telescope for faint stars, and Allen wrench. Only . . Complete **$9.95**

2-VOLT "PACKAGE"

1—2V. Amp. Hr. Willard Storage Battery $1.95
1—2V. 7 Prong Synchronous Plug-in Vibrator 1.49
1—Quart Bottle Electrolyte (for 2 cells) 1.45
ALL BRAND NEW! Total Value $4.89
G & G Combination Price, Only **$3.99**

Willard 6-Volt Midget Storage Battery
3 Amp. Hour. **BRAND NEW,** 3⅝" x 1-1316" x 2⅜". Uses Standard Electrolyte ..... Only $1.85

Please include 25% Deposits with order—Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

G & G Radio Supply Co.
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51 Vesey St., New York 7, N. Y., CO 7-4605
Branch: 544 So. Broadway St., Dayton, Ohio

BC-946-B BROADCAST RECEIVER

520 to 1500 Kc broadcast band. 6 tubes: 3-12SK7, 12SR7, 12A6, 12K8. For dynamotor operation. Easily converted to 110 volt or 32 volt use. Two IF stages, 3-gang tuning cond. BRAND NEW in sealed carton, with tubes and instruction manual, less dynamotor **$23.25**

SCR-274 COMMAND EQUIPMENT
ALL COMPLETE WITH TUBES

Type	Description	Used	Excellent Used	BRAND NEW
BC-453	Rcvr 190-550 Kc	10.95	14.95	22.50
BC-454	Rcvr 3-6 Mc	7.19	8.95	14.95
BD-455	Rcvr 6-9 Mc	5.25	7.95	11.95
BC-456	Modulator	....	2.75	4.24
BC-457	Xmtr 4-5.3 Mc	9.95	12.95	15.45
BC-458	Xmtr 5.3-7 Mc	6.95	8.95	12.95
BC-459	Xmtr 7-9.1 Mc	9.95	10.95	14.95
BC-450	3-Rcvr Control Box	....	1.49	1.95
BC-451	Xmtr Control Box	....	1.25	1.49
BC-696	Xmtr 3-4 Mc (Like New)	....	18.95	....
3-Receiver Rack		....	1.79	2.95
2-Transmitter Rack		....	1.59	2.25
Single Transmitter Rack		....	....	2.25

BC-375 TRANSMITTER

200-500 Kc, 1500-12500 Kc using plugin units. 100 watts. Voice and CW. **$24.95**
Used ..... $2.25 and up
All tuning units for above .....

BC1206-C BEACON RECEIVER

195 to 420 Kc, made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. **BRAND NEW . . . $9.95**
Used, with tubes $5.95

ARC-5/R-28 RECEIVER

2 Meter superhet, 100 to 156 Mc in 4 xtal channels. Louvred alum. cabinet 7⅜ x 4⅞ x 14". Complete with 10 tubes. Excel. Cond.. $16.95

ARC-5/T-23 TRANSMITTER

Companion for above. Brand New $29.95

ARC-5 MARINE RECEIVER-TRANSMITTER
Rcvr 1.5 to 3 Mc. **BRAND NEW** $19.50
Xmitter 2.1 to 3 Mc. **BRAND NEW** 22.50
Comb. Xmtr and Rcvr with Tubes, **NEW** 39.50

BC-442 ANTENNA RELAY UNIT. Consists of switching relay and 0-10 RF Indicator. **BRAND NEW $1.95**

LORAN APN-4
FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter: Set of Plugs; Visor for Indicator; Operation manual: Brand New, Export packed. **COMPLETE $129.50**

R-65/APN-9 LORAN Receiver-Indicator

Furnishes position data at greater distances from transmitting stations that is possible by any other methods. Accurate to within 1% of distance from ground transmitters. Operates entirely by radio. Complete in one case. BRAND NEW export packed **$295.00**

BENDIX DIRECTION FINDER

MN-26-C. 12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands. 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises: **$16.50**
MN-26-C Receiver complete with 12 tubes . .
MN-20-E Rotatable Loop $4.25
MN-52 Azimuth Control Box 2.95

MN26Y DIRECTION FINDER

150 to 7 Mc. Complete with tubes, motor; original manuals. BRAND NEW . . **$21.95**

BC-221 FREQ. METER CASE

Aluminum case for BC-221 or TS-164 Freq. Meters. With volt. reg. supply using VR105. 2 ballast tubes, relay, cable, etc. Inside front: 9¾ x 7½ x 7⅜". Inside rear: 2" deep. Shock-mounted.

BRAND NEW, in original packing! $39.95

FL8-A RADIO FILTER, Used $1.59
New 2.45

Why a Rotator?

(*Continued from page 56*)

1. Freezing or binding of the main bearings.
2. Gear teeth being stripped by motor drive in overcoming excess torque.
3. Motor windings burning out due to stalling and overheating.
4. Mechanical breakage of component parts or housing.
5. Electrical discontinuity due to short circuits, corrosion resistance, or failure of an electrical component.

It may be instructive in this connection to study one particular rotator to see how it has attempted to eliminate the causes of these defects. This unit is made by *LaPointe* and is shown in Fig. 1. Basically, the housing differs from other types in that both the supporting mast and the antenna mast are always in true axial alignment. This inline design equalizes the antenna and rotator weight factor to maintain a uniform peripheral distribution with respect to the central mounting axis. Additionally, there are provisions for either three or four guy wire fastenings for proper guying.

Structurally, the rotator is of heavy-duty construction, with two halved sectional castings enclosing the entire mechanism. Large diameter bearings of bronze and special alloy, spaced 3½ inches apart, are employed to assure long life, optimum axial support, and frictionless operation during the usual variations of temperature extremes. This housing is made permanent and weatherproof by sealing with a watertight gasket.

Too often it has been apparent that large rotator housings were inadequately supported when attached to small diameter masts. Strong winds and ice storms often caused the antenna system to collapse, usually breaking at a point just below the rotator mounting. Mounting provisions of a rotator should, therefore, include a large enough pipe to serve as a safe supporting mast. The rotator base, shown in the cutaway view of Fig. 2, will accept a mast as large as two inches in diameter. Three sliding wedge clamps, spaced 120 degrees apart, hold the top and lower masts securely in position irrespective of the mast pipe diameter. All clamps move independently in alignment grooves and are always held in place with a screw bolt which also retains the sliding wedge so that it cannot drop out during installation.

Antenna rotators should be designed for ease and simplicity of installation. The service technician will naturally favor the rotator that is the easiest for him to install. Today, popularity and public acceptance are largely determined by unit cost and installation charge. Dispensing with the necessity for extras, like thrust bearings, special conductor cables, and callbacks for adjustments, all contribute to keeping the costs down and within reason.

To simplify rooftop installation, it should be possible to completely assemble the mast, rotator, and antenna or antennas in one simple operation. The assembly can then be hoisted into position with the aid of guy wires.

Indoors, cable connections at the control console must be kept simple, neat, and conveniently accessible.

Antenna rotators are destined to receive wider acceptance as viewers desire to receive programs from more and more stations. A good rotator enables the proper combination of antennas to be employed so that optimum reception is obtained from various directions under varying conditions of service. For those who are located in the fringe areas, the addition of the rotator provides a choice of programs and the assurance of being able to receive all of the new stations as they come on the air. —30—

A SIMPLE AUDIO FILTER

By EDMUND H. MARRINER

THE circuit of a simple communications filter is shown in Fig. 1. It can be used on a voice-operated transmitter or in the audio system of a communications receiver. It will eliminate the high-frequency response of the receiver thus reducing annoying adjacent heterodynes and the high-frequency hiss present during short-wave reception.

Using the filter in conjunction with a transmitter will filter out the high voice frequencies making the transmitted signal sharp and reducing splatter.

The filter is simple to make. It requires only two .05 μfd. bathtub oil-filled paper capacitors and a 68 millihenry toroid.

Fig. 2 shows the response, which is 36 db down at 10 kc. To achieve this response, the filter must be fed from a high-impedance source, such as a mike-to-grid transformer, and must work into a high-impedance load, such as a conventional interstage transformer. —30—

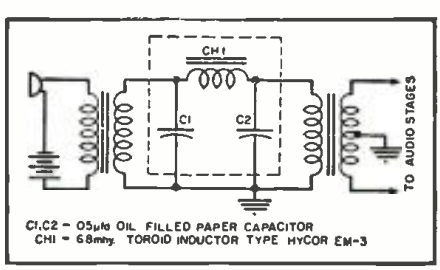
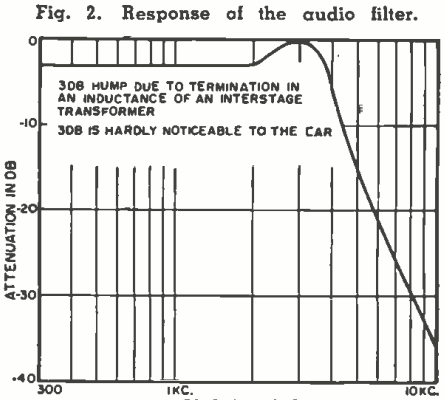


Fig. 1. Circuit for a simple audio filter.

Fig. 2. Response of the audio filter.



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14BP4	$16.86	21AP4	$28.79
16RP4	$19.38	21EP4	$28.79
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- 10 Assorted resistors
- 10 assorted 2 color "blank" tube cartons
- 1 6BQ6GT tube
- 1 6AU6 tube
- 1 6CB6 tube

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Both UHF and VHF. Brings better reception than most outdoor antennas. Use on top of TV.

List Price $9.95

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$3.99 each

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- Immediate Shipment
- Free Postage On All Orders With Full Remittance
- There are fewer "call backs"
- There are no "out of date" tubes
- "Peak Performance" testing in our fully equipped Testing Department before shipment guarantees quality

0Z4	.43	5AW4	.75	6BL7GT	.75	6X4	.34	12SK7	.45
1A4P	.33	5J6	.63	6BN6	.58	6X5	.34	12SN7GT	.68
1A7GT	.43	5T4	.69	6BQ6GT	.78	6X8	.73	12SQ7	.37
1B3GT	.65	5U4G	.43	6BQ7	.78	6Y6G	.55	12SR7	.45
1C5GT	.41	5U8	.74	6BY5G	.58	7A4	.45	12V6GT	.45
1D5GP	.43	5V4G	.59	6BZ7	.88	7A5	.53	12X4	.37
1E7GT	.41	5Y3	.31	6C4	.37	7A6	.45	14A7	.42
1G6GT	.41	5Y4G	.36	6C5	.35	7A7	.43	14B6	.38
1H4G	.43	5Z3	.41	6CB6	.49	7A8	.45	14Q7	.50
1H5GT	.47	6A7	.57	6CD6G	1.15	7B5	.39	19BG6G	1.15
1J6GT	.47	6A8	.45	6D6	.48	7B6	.42	19T8	.65
1L4	.45	6AB4	.43	6E5	.44	7B7	.41	24A	.39
1L6	.55	6AC7	.67	6F5	.37	7B8	.45	25AV5GT	.78
1LA4	.57	6AF4	.79	6F6	.38	7C4	.39	25BQ6GT	.78
1LA6	.47	6AG5	.50	6G6	.40	7C5	.45	25L6GT	.47
1LB4	.57	6AG7	.69	6H6	.38	7C6	.43	25W4GT	.43
1LC5	.49	6AH6	.69	6J4	1.79	7C7	.45	25Z5	.37
1LC6	.47	6AJ5	.70	6J5	.39	7E5	.45	25Z6	.37
1LG5	.57	6AK5	.54	6J6	.47	7E6	.55	27	.25
1LE3	.57	6AL5	.39	6J7	.43	7E7	.70	35A5	.46
1LG5	.57	6AQ5	.46	6J8G	.85	7F7	.59	35B5	.50
1LH4	.64	6AR5	.46	6K6GT	.37	7F8	.70	35C5	.50
1LN5	.47	6AS5	.48	6K7	.39	7G7	.75	35L6GT	.47
1N5GT	.50	6AS6	1.70	6K8	.65	7H7	.50	35W4	.34
1R5	.50	6AS7G	2.19	6L6	.68	7J7	.75	35Y4	.34
1S5	.42	6AT6	.39	6L7	.42	7K7	.75	35Z3	.39
1T4	.50	6AU4GT	.69	6N7	.60	7L7	.77	35Z5GT	.34
1U4	.42	6AU5GT	.59	6Q7	.50	7N7	.50	37	.29
1U5	.42	6AU6	.42	6S4	.40	12AT6	.37	50A5	.46
1V2	.65	6AV5GT	.65	6SA7	.45	12AT7	.66	50B5	.50
1X2	.61	6AV6	.39	6SC7	.48	12AZ7	.63	50C5	.50
2A3	.55	6AX4GT	.60	6SG7	.41	12AU6	.41	50L6GT	.47
2A5	.57	6AX5GT	.57	6SH7	.43	12AU7	.53	75	.42
2A7	.55	6B4G	.52	6SJ7	.43	12AV6	.35	76	.42
3A4	.51	6B8	.69	6SK7	.45	12AV7	.67	77	.38
3A5	.50	6BA6	.47	6SL7GT	.55	12AX4GT	.65	78	.38
3AL5	.45	6BA7	.58	6SN7GT	.55	12AX7	.58	80	.34
3AU6	.46	6BC5	.47	6SQ7	.39	12B4	.68	84/6Z4	.44
3BC5	.54	6BC7	.80	6SR7	.42	12BA6	.46	117L7GT	1.09
3BN6	.70	6BE6	.45	6SS7	.41	12BD6	.48	117N7GT	1.09
3CB6	.52	6BF5	.40	6T4	.95	12BE6	.46	117P7GT	1.09
3Q4	.46	6BF6	.50	6T8	.68	12BH7	.60		
3Q5GT	.57	5BG6G	1.15	6U8	.75	12BY7	.65		
3S4	.47	6BH6	.50	6V3	.80	12BZ7	.61		
3V4	.47	6BJ6	.47	6V6GT	.46	12CU6	.95		
4BQ7	.89	6BK5	.68	6W4GT	.39	12SA7	.45	117Z3	.35
4BZ7	.95	6BK7	.76	6W6GT	.53	12SJ7	.45	117Z6GT	.63

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370 KC—538 KC

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RANGE 1015 KC—8733 KC

FT-241A

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Low Frequency—FT-241A for SSB, Lattice Filter, etc. .093" Pins, .486" SPC, marked in Channel Nos. 0 to 79, 54th Harmonic and 270 to 289, 72nd Harmonic. Listed below by Fundamental Frequencies, fractions omitted.

49¢ each—10 for $4.00 | 79¢ each—10 for $6.50

370	392	412	436	501	522	400	459
372	393	413	438	502	525	440	461
374	394	414	481	503	526	441	462
375	395	415	483	504	527	442	463
376	396	416	484	506	529	444	464
377	397	418	485	507	530	445	465
379	398	419	487	508	531	446	466
380	401	420	488	509	533	447	468
381	402	422	490	511	534	448	469
383	403	423	491	512	536	450	470
384	404	424	492	513	537	451	472
385	405	425	493	514	538	452	473
386	406	426	494	515		453	474
387	407	427	495	516		454	475
388	408	431	496	518		455	476
390	409	433	497	519		456	477
391	411	435	498	520		457	479
						458	480

79¢ each—10 for only $6.50

CR-1A SCR 522-½ Pin, ½" SP

5910	7350	2030	2220	2360	3202	3945
6370	7380	2045	2258	2390	3215	3955
6450	7390	2065	2260	2415	3237	3995
6470	7480	2082	2282	2435	3250	
6497	7580	2105	2290	2442	3322	
6522	7810	2125	2300	2532	3510	
6547	7930	2145	2305	2545	3520	
6610		2155	2320	2557	3550	

FT-171B—BC-610 Banana Plugs ¼" SPC

TG 34A CODE KEYER
AUTOMATIC CODE PRACTICE SENDING AND KEYING OSCILLATOR.
115 or 230 V @ 50-60 cycles.

Portable. Built-in speaker and amplifier. Variable speed from 5 to 25 w.p.m. Uses inked tapes.
Brand new..... $19.95
Set of three tapes. Sold with Keyer only. Nos. 2, 8, 11..... $3.75

FT-243—.093" Dia.—.486 SPC

49c each—10 for $4.00

4035	5385	5802	6700	7575	7850
4080	5397	5900	6706	7583	7873
4165	5435	5906	6725	7600	7875
4190	5437	5925	6740	7606	7900
4280	5485	5940	6750	7625	7906
4330	5500	5955	6773	7640	7925
4340	5582	5973	6775	7641	7940
4397	5660	6206	6800	7650	7955
4445	5675	6225	6825	7660	7970
4450	5677	6240	6850	7673	8240
4490	5700	6250	6875	7675	8250
4495	5706	6273	6900	7700	8273
4535	5740	6275	6925	7706	8280
4695	5750	6300	6950	7710	8300
4735	5760	6306	6975	7725	8306
4840	5773	6325	7450	7740	8310
4852	5775	6340	7473	7750	8316
4930	5780	6350	7475	7766	8320
4950	5806	6373	7500	7773	8325
5030	5840	6375	7506	7775	8630
5205	5850	6400	7520	7800	8683
5295	5852	6406	7525	7806	8690
5305	5873	6425	7540	7825	
5327	5875	6673	7550	7840	
5360	5880	6675	7573	7841	

79c each—10 for $6.50

1015	6100	6540	7150	8150	8500
3655	6106	6550	7250	8173	8525
3680	6125	6573	7300	8175	8550
3735	6140	6575	7306	8200	8558
3800	6150	6600	7325	8225	8566
3885	6173	6606	7340	8340	8575
3940	6175	6625	7350	8350	8583
3990	6185	6640	7375	8360	8600
6000	6200	6650	7400	8370	8625
6006	6440	7000	7425	8375	8650
6025	6450	7025	7440	8380	8680
6040	6473	7050	8000	8383	8700
6042	6475	7075	8025	8400	8733
6050	6500	7100	8050	8425	
6073	6506	7125	8100	8450	
6075	6525	7140	8125	8475	

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Carrier-Current Transmitter

(*Continued from page 46*)

chassis) in the "High" position, switch S_3 to "Low" and note new reading. Change taps of L_2 to various positions on either side of mid-position until the cathode current is about 70 ma. and the screen grid current is around 7 or 8 ma. Put S_2 back to "High" and if screen current is not more than 10 ma. leave it in that position. Now start increasing the coupling of L_3 one turn at a time, each time re-adjusting the taps on L_2 to give correct cathode and screen currents. Settings should be found where the r.f. output current is a maximum, corresponding to a minimum plate current. This is the correct tuning for L_2 and L_3. Oscillator frequency should again be checked with audio gain (mike level) off but this time with the lead to the transmitter from the scope or a.c. vacuum-tube voltmeter loosely coupled by about one-half turn to the inside of L_2 at the top of the coil form. If necessary, adjust C_{15} slightly, using C_{10} for fine adjustment. Unless frequency has shifted badly, it will not materially affect the tap setting of L_2. Disconnect the r.f. ammeter and place the L_3 clip on the correct tap. As a wind-up procedure, cathode and screen currents should be noted under minimum and peak line-loading conditions since they will affect the readings. Make sure that at minimum loading cathode current does not exceed 80 ma. and the screen current 10 ma. The transmitter is now ready for use, after first checking the voltages at points *C, D, F, Q, E,* and at the top of R_{14}. These should be about 245, 120, 300, 120, 200, and 415 volts respectively.

If by chance inexpensive broadcast receivers *on the same meter circuit only* should pick up any weak harmonics at the low end of the dial, they can, if bothersome, be eliminated by either or both of two methods.

1. Change the oscillator inductance L_1 from 2½ mhy. to a 4-pi, 1.0 mhy. r.f. choke (*Miller* #4531-1 is one type), and install an extra mica capacitor in shunt with C_{15} (700 $\mu\mu$fd. for 148 kc. and 350 $\mu\mu$fd. for 206 kc.). A lower *LC* ratio (higher *"Q"*) circuit than this is not recommended.

2. Standard r.f. filters can be installed in the receivers. (*a*) If of the a.c.-d.c. type, the "hot" side of the filament circuit can be bypassed to the chassis with a 0.001 μfd. disc or mica capacitor, and the rectifier positive output lead fitted with a series r.f. choke of at least 10 mhy., shunted on the *load* side by a 0.01 μfd. disc or mica capacitor. (*b*) For transformer-type receivers, the filament and both sides of the high-voltage windings could be shunted with 0.002 μfd. disc or mica capacitors and, if necessary, the same choke and capacitor mentioned for a.c.-d.c. receivers, installed in the "B+" output of the rectifier tube, ahead of the filter system. —30—

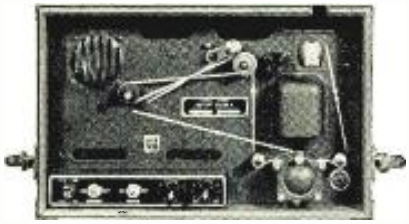
BLANK PAPER TAPES FOR CODE RECORDERS

⅜" Wide, in 900 Foot Rolls—Prices: 25¢ Each—or 6 Rolls f/$1.00—30 Rolls f/$3.00—60 Rolls f/$5.00

PRACTICE CODE TAPES & TG-34A KEYER

PRACTICE CODE TAPES—Code Training and Practice Inked Paper Tapes on 16MM 400 Ft. Reels for Telegraph and Radio Operators. Fifteen (15) Reels to a Set—in Wood Case. For use with TG-34A or TG-10 KEYERS.

COMPLETE SET—Price: **$14.95**



TG-34A KEYER—115 or 230 Volts at 50 to 60 cycles—an automatic unit for reproducing audible code practice signals previously recorded in ink on paper tape. By use of the self contained speaker, the unit will provide code practice signals to one or more persons—or provide a keying oscillator for use with a hand key. Unit is compact in portable carrying case, and complete with Tubes. Photo Cell and Operating Manual. Size: 10 9/16" x 10½" x 15 13/16". Shipping weight: 45 lbs. .....NEW: **$16.95**

SET OF 15 TAPES and TG-34A KEYER—BOTH: $30.00

RECORDER for CODE TAPES and TAPE PULLER

RECORDER—BC-791 Recorder & Amplifier of Code Signals from Radio Receiver or Local Key sending on ⅜" Paper Tape with Ink Writing Stylus. Tape can be played back on any TG-34 or TG-10 KEYER. 115 Volt 60 cycle operation with Tubes. (No Tape or Tape Puller included.) Prices: NEW: $9.95. USED: **$6.95**

TAPE PULLER—MC-310 Tape Puller—Variable speed Motor driven—for use with ⅜" Paper Tape. 115 Volt 60 cycle operation. Complete with Motor Reel Assy. & Blank Reel. Prices: NEW: $12.95. USED: **$9.95**

BOTH BC-791 RECORDER and MC-310 TAPE PULLER—NEW: $20.00 or BOTH—USED: $15.00

6 VDC VIBRATOR POWER SUPPLY

RCA MJ-8—6 VDC Input; output 275 VDC 80 MA w/0Z4 Tube, 11 Ft. Batt. & Power Cable. Switch & Fused Line. 4½" x 4" x 6".....NEW: **$7.95**

Address Dept. RN • $5.00 Order Minimum, & 25% Deposit on C.O.D.'s. • Prices are F.O.B., Lima, Ohio

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TRIANGLE TOWER—Galvanized steel Tower, 12½" Base. 30 Ft. high—in 10 Ft. Sections, knocked down. Complete with hardware, two 50 Ft. & one 80 Ft. Guys: three 5 Ft. Anchors, & Base Plate. Each Section weighs 45 lbs. Complete with Erection Manual. Shipping Weight; Approx. 350 lbs. F.O.B., Ky.—Price..... **$31.95**

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TELESCOPING ANTENNA—94" 1.00

WHIP ANTENNA, with Rigid Base, 5 Ft. 1.50

WHIP ANTENNA, less Base, 6 Ft. 1.50

MAST BASES—INSULATED

MP-22 BASE—Ins. spring action, direction of bracket can be raised or lowered easily.....$2.95

MP-S-33 BASE—Ins. type with heavy coil spring and 5" dia. Ins. Requires 2" hole for mounting. Weight: 9 lbs. $5.95

MP-37 BASE—Ins. type with heavy coil spring, 7" dia. Ins. Requires 1⅜" hole for mounting. Weight: Approx. 10 lbs. $8.95

MAST SECTIONS FOR ABOVE BASES

Tubular steel, copper coated, painted in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section.....@ 50¢ Each

Larger Diameter Section: MS-54.....75¢

FM RECEIVER

27 to 38.9 MC

Four Preselected Channels—Frequency Ranges 27 to 29.5—29 to 32—31.5 to 34.4—and 34.4 to 38.9 MC. Complete with 16 Tubes: 1/12SA7; 3/12SC7; 2/12SG7; 2/12SJ7; 1/VR-150; 1/6H6; 1/6SJ7; 2/6SL7; 1/6V6; 2/6AC7; 1/NE-20; and DC-14 Crystal 1000 KC.; Crystal, Calibrator, and Speaker. Power required: 12 or 24 V. DC and 275 V. DC 150 MA. Size: 6¾" x 11 5/16" x 11½". **$34.95**

BC-923 RECEIVER .....NEW:

12 Volt DYNAMOTOR for BC-923.....$5.95

AC POWER SUPPLY, 115 V 60 cycle, f/BC-923. 22.50

PLUG for Rear of BC-923..... 1.00

ALL ITEMS PREVIOUSLY ADVERTISED ARE STILL AVAILABLE—WRITE FOR LIST!

DYNAMOTORS:

INPUT VOLTS:	OUTPUT: VOLTS:	MA.	STOCK No.	PRICES: USED:	NEW:
14 VDC	330	150	BD-87	3.95	$5.95
14	250	50	DM-25	6.95	8.95
14	1000	350	BD.77	14.95	20.95
14	500	500	BD-500		12.95
14	600	300	BD-86		12.95
14	1030	260			
	515	215	DM-42	8.95	12.95
28	1000	350	PE.73	8.95	
12 or 24	275	110	USA/0516		4.95
12	230	90	PE-133	4.95	6.95
14 VDC	375	150	BD-83	3.95	4.95
12 VDC	220	80	DM-34	2.50	4.95

BLOWERS:

12/24 VDC-AC CAST ALUMINUM BLOWER—100 CFM: 3" intake; 2" outlet. Shunt Motor 4" x 2", 3000 RPM @ 24 VDC..... **$5.95**

6 VDC SINGLE—100 CFM—No. 6100 .....$4.95

6 VDC FLANGE—150 CFM—No. 6150 .....$6.95

12 VDC SINGLE—10 CFM—Min.—No. 1210.... 7.95

24 VDC SINGLE—10 CFM—Min.—No. 2410.... 5.95

24 VDC DUAL—20 CFM—Min.—No. 2420..... 7.95

115 Volt 400 cycle—10 CFM. Eastern Air Devices Motor J31A—7200 RPM; 1/100 HP. L-R #2 Blower Assy. Overall Size: 4½" x 3½". No. 3110..... **$5.95**

115 VOLT 60 CYCLE BLOWERS:

115 VAC 60 CYCLE SINGLE TYPE

100 CFM; 2¼" intake: 2" outlet. Complete Size: 5" x 6". No. 1C939..... **$8.95**

115 VAC 60 CYCLE DUAL TYPE—100 CFM: 4" Intake; 2" Dis. Each Side. Complete Size: 8" x 6". No. 1C880..... **$13.95**

115 VAC 60 cycle COMPACT TYPE—108 CFM: Motor built inside squirrel cage; 4½" intake; 3¾" x 3" Dis. Complete size: 4¼" W x 8⅜" H x 8⅛" D—No. 2C067 ..... **$14.50**

115 VAC 60 cycle FLANGE TYPE—140 CFM: 3½" intake; 2½" Dis. Complete size 7½" W x 7¼" H x 6¾" D—No. 1C807 ..... **$13.95**

115 VAC 60 cycle FLANGE TWIN—275 CFM: 4½" intake; 3¼" x 3" Dis. Complete size: 11¾" W x 8⅜" H x 8-1/16" D— No. 2C069 ..... **$21.95**

BROADCAST BAND RECEIVER

NAVY/TYPE—520 to 1500 KC..NEW: **$24.95**

NAVY/TYPE REC.—6 to 9 MC. Less Tubes USED: 3.00

BC-455 REC.—6 to 9 MC. W/tubes.....Used: $4.95

R-28/ARC-5 REC.—100-156 MC. W/tubes..Used: 10.95

Navy Comm. TRANS. 2.1-3 MC.—N: $12.95—U: 8.95

Navy Type COMM. TRANS. 3—4 MC.....U: 12.05

BC-458—TRANSMITTER—5.3—7 MC...NEW: 5.95

BC-459—TRANSMITTER—7 to 9 MC.....NEW: 8.95

CLASSIFIED ITEMS:

BC-221/TS-164 Frequency Case: W/V. Reg. Supply, Tubes, Relay, Cable, etc. Shock Mtd. .....N: $ 4.95

BC-442 Antenna Relay Unit, w/Ind. & Vac. Cap. .....N: 3.95

BC-1206 BEACON REC. 200-400 KC., w/Tubes.N: 9.95

BC-347 AMPLIFIER—1/6F8G.....N: $3.95—U: 1.95

BC-709 AMP.—Batt. Op.—1 Tube...N: $3.95—U: 2.95

RT-34/APS-13 TRANSCEIVER—Less Tubes...U: 3.95

FL-8A Range Filter, U: $1.49—FL-5 Filter...U: 1.00

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BC-229/429 REC., 2500-7700 KC. w/Coils..U: 5.95

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TECHNIQUES INC.

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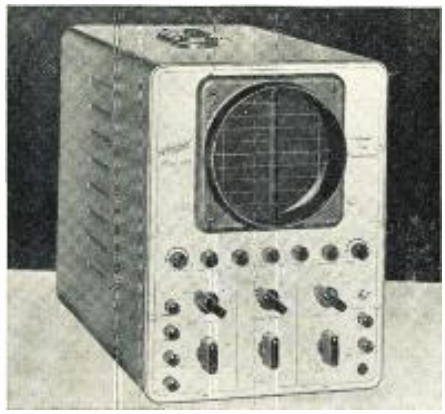
What's New in Radio

(*Continued from page* 106)

which the prospective builder can buy separately, assemble, and study.

5" SERVICE SCOPE

Hickok Electrical Instrument Company, 10524 Dupont Avenue, Cleveland 8, Ohio has just released a high-sensitivity wide-band scope which is compatible for color or black-and-white television servicing.



Identified as the Model 675, the instrument features a calibrated and illuminated scale with a green filter to reduce reflections caused by incidental illumination. An astigmatic focus control provides excellent undistorted trace sharpness.

The Model 675 has a frequency response of 1 cps to 4.5 mc. (within 3 db) and is flat through the color burst frequency of 3.58 mc. Sensitivity is 20 mv. r.m.s. per inch. The unit is housed in a portable steel case measuring 13" x 10" x 16". Test leads are included.

FM-AM SIGNAL GENERATOR

Marconi Instruments Limited, 23-25 Beaver Street, New York 4, N. Y. has developed a new signal generator, the Model TF 995A/1, with continuous frequency coverage from 2 to 220 mc.

Normal deviation is continuously variable for 0-25 kc. and 0-75 kc. on all bands. High deviation of 2X normal is also available on the 2-13.5 and 27-54 mc. bands, with 4X normal on the 54 to 108 mc. band and 8X normal on the 108-220 mc. band also available. Modulation distortion is less than 2 per-cent. Amplitude modulation, either internal or external, is variable up to 50 per-cent.

The generator enables measurements at i.f. and carrier frequencies to be made with a single instrument. It is supplied with American tubes and BNC connectors.

SHEET METAL PUNCH

General Cement Mfg. Co., 919 Taylor Avenue, Rockford, Illinois has designed a new double-purpose sheet metal punch for the radio and TV service technician.

The unit punches tube socket and capacitor holes easily and quickly, taking metal up to 3/32" thick without burrs. Hole sizes punched are 7/8" and 1 5/32". Additional information will be provided by the company on request.

FREQUENCY STANDARD

Eldico of New York, Inc., 72 East Second Street, Mineola, N. Y. is now offering a transistorized, self-contained 100 kc. frequency standard which has been especially designed for the amateur, experimenter, service technician, and laboratory man.

The unit is constructed in a gray hammertone case and is self-powered by a miniature battery. Due to the low current drain of the 2N38 transistor, shelf life of the battery is obtained. A miniature variable capacitor is provided to zero the FS-100 frequency standard with WWV. Operation is simple. Just throw the switch and couple to the receiving antenna. The 100 kc. transistor oscillator will give accurate frequency measurements every 100 kc. on the receiving dial.

EICO BATTERY TESTER

Electronic Instrument Co., Inc., 84 Withers Street, Brooklyn 11, N. Y. is now offering a new battery tester which will handle all "A" and "B" portable radio batteries and equivalent types under actual receiver conditions without requiring them to be installed in the equipment.

The Model 584 has positions for testing 1.5, 4.5, 6, 7.5, 9, 22.5, 45, 67.5, 75, and 90 volt batteries in addition to providing a spare position. The meter indicates "good," "usable," and "bad" on a three-color scale.

The tester is currently available in kit and factory-wired form. Write the company for complete information.

10-IN-1 WRENCH

Yonkers Industries, Inc., 28-30 School Street, Yonkers, N. Y. is now marketing its new "Victor Wrench," an American-made hex nut wrench.

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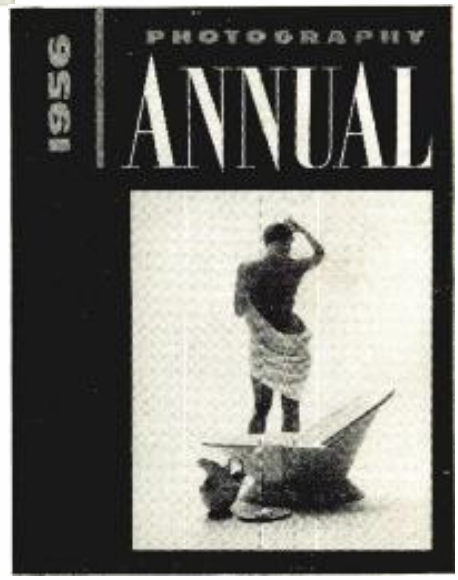

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ZIFF-DAVIS PUBLISHING COMPANY, *publishers of* POPULAR PHOTOGRAPHY, PHOTOGRAPHY Annual, PHOTOGRAPHY Directory, FLYING, MODERN BRIDE, RADIO & TELEVISION NEWS, POPULAR ELECTRONICS, AMAZING STORIES, FANTASTIC, G. I. JOE.

This non-magnetic precision instrument is 4" x 1" and includes ten sizes up to ¾" American standards. The tool is made from Zamak No. 3, S.A.E. 903, A.S.T.M. XXIII, with a tensile strength of 41,000 psi; it is chrome plated and guaranteed for life against breakage, rust, or any defects.

For full details, write the manufacturer direct.

ALPHA'S FLUX KIT

Alpha Metals, Inc., 56 Water Street, Jersey City 4, N. J. has produced a general purpose soft-soldering flux kit which is designed as a time saver for engineers, designers, and production men.

The kit contains a complete set of the most useful fluxes, including printed circuit, electronic, and general purpose types. There are sixteen fluxes included in the kit, each flux being housed in an appropriately labeled glass bottle. The flap of the carton has a chart showing each flux in its position in the carton.

A bulletin describing this new kit is available on request.

TWO-WAY RADIO GEAR

Communications Company, Inc., 300 Greco Avenue, Coral Gables, Florida is now offering its Model 500 two-way mobile radio equipment for 6 or 12 volt operation in the 25-54 mc. band.

Transmitter output is 5 to 7 watts with provision for limiting to 3 watts input for low-powered industrial service. The Model 500 consists of a communications unit including the transmitter-receiver, 6-12 volt d.c. power supply, tubes, crystals, speaker, controls, indicator lights, etc., all mounted in a compact case for underdash mounting; a hand microphone, coil cord, and plug; a mobile type spring base antenna cut to specified frequency with coaxial transmission line and connector plug; mounting brackets for

case with necessary hardware; battery cable, plug and fuse box with instructions for 6 or 12 volt installation; and the necessary instruction books.

Complete specifications will be supplied by the company on request.

"UNIVERSAL" TEST LEADS

Herman H. Smith, 2326 Nostrand Avenue, Brooklyn, N. Y. is currently in production on a completely interchangeable test lead that is of par-

ticular interest to the servicing field.

Tips, clips, plugs, and lugs have threaded inserts which can be interchanged easily and quickly into one pair of test leads at both the prod and meter ends. Service technicians, lab men, bench workers, etc. will find the new design useful since, according to the company, a single pair of test leads does the work of more than fifty different pairs.

FUSIBLE RESISTORS

Bradford Components, Inc, 33-35 Bishop Street, Bradford, Pa. has developed a diversified line of fusible resistors, known as "Fusistors," for use in protecting the more expensive components in TV and radio circuits.

These new plug-in units serve as both a fuse and a resistor. They are constructed of material that will withstand a guaranteed load surge current yet will fuse when the current exceeds a given amperage.

The line is currently available in a variety of sizes.

CITIZENS BAND EQUIPMENT

The company's complete line of u.h.f. two-way radio equipment has been approved by the FCC for district licensing for operation in the Citizens band, according to the Communications Equipment Marketing section of *RCA's* Engineering Products Division, Camden, N. J.

Approval covers the company's "Carfone-450" equipment which has been especially designed to operate on the frequencies between 450 and 470 mc. One of the Citizens bands extends from 460 to 470 mc.

"SILENT VIEWER"

Lafayette Radio, 100 6th Avenue, New York 13, New York has introduced a new low-priced TV remote control, the "Silent Viewer" Model MS 125.

Ideal for late listeners (one or two people), children who are devoted to the more raucous type of programs, or the hard of hearing, the new unit plugs into the TV set sound system without affecting normal use of the set. The speaker may be cut off by the switch on the remote control unit.

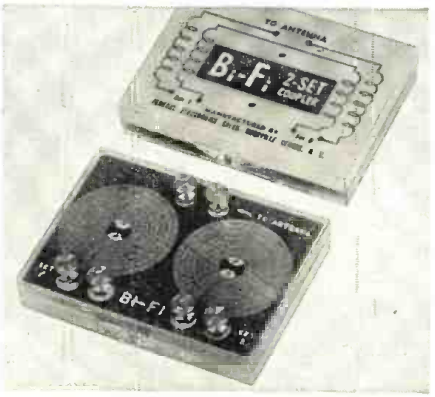
The unit comes complete with a 20-foot cable and a dynamic earphone. Additional earphones are available at a slight extra charge. For full details on this unit, write Dept. RTN of the company.

TWO-SET COUPLER

Federal Electronics Sales of Rockville Centre, New York is in production on a new two-set antenna coupler which has been tradenamed the "Bi-Fi."

The unit, featuring precision-engineered printed circuit bifilar coils, is designed to effectively operate two TV or FM sets from a single antenna. The "Bi-Fi" can also be used to operate one TV and one FM set simultaneously from one antenna.

The coupler is mounted within a durable, transparent plastic case which eliminates losses due to impedance changes that can occur when metal



cases are used. For full details on these couplers and the special counter display for merchandising these items, write the company direct.

BROADBAND AMPLIFIERS

Transvision, Incorporated, New Rochelle, New York has introduced a new line of low-cost TV broadband amplifiers for master television antenna systems.

Eight different types of units are available—all similar in appearance but each designed to handle particular problems encountered in installing master community or building systems.

Special features include built-in cable loss equalizers for repeater amplifiers, dual outputs for systems requiring more than one main line, and a choice of low band only, high band only or low band-high band amplifiers.

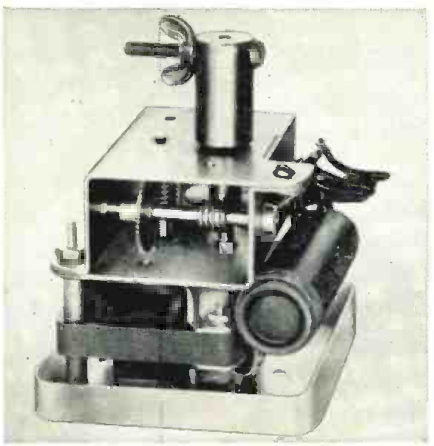
For full specifications on the eight units in the line, write the company direct.

"VEE-D-X ROTENNA"

LaPointe Electronics Inc. of Rockville, Conn. has introduced a new indoor antenna of outdoor design for attic installation, with a built-in rotator.

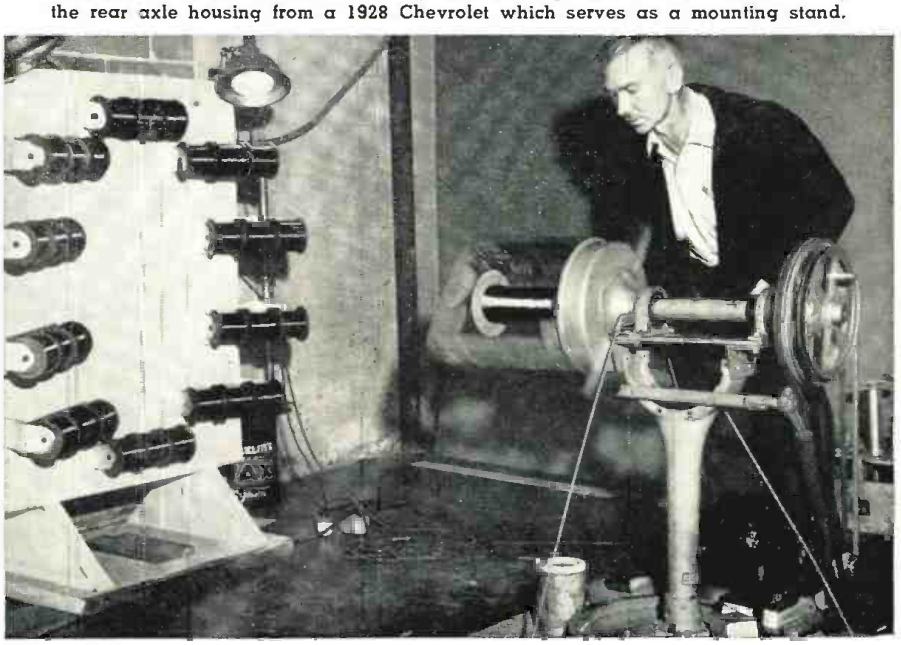
The new unit, tradenamed the "Rotenna," is available in two types; the Model RO-283 for all channel u.h.f.-v.h.f. and the Model RO-213 for v.h.f. only. Both units feature a reversible 24-volt rotator motor built into the boom of the antenna and a modernistically-styled control unit in pale green or mahogany.

Both units are sold as a complete kit consisting of the antenna rotator and control box, 50 feet of rotor and



antenna transmission line, stand-off insulators, and a supporting mast. These antennas, which feature snap-con-

When a Seattle electronics manufacturer found that special wire needed to make choke coils for aircraft radio noise filters was not available through commercial channels, T. W. Babcock came to the rescue by building a motor-driven spinning wheel. The machine spins 30 hair-fine wires into "yarn" at the rate of 1500 feet per hour. Three synchronized planetary actions impart a uniform twist to the cable and all guides and pulleys are highly polished to prevent binding or scoring individual strands. An 18-inch reversing worm gear is used to level wind the spun cable onto spools. Babcock, a machinist, has successfully test spun up to 100 strands of .007" diameter insulated wire with the machine. He used a number of automotive bearings and other parts in the device, including the rear axle housing from a 1928 Chevrolet which serves as a mounting stand.



struction requiring no hardware, are attached to an attic beam by an adjustable mast. The antenna hangs down from the beam and rotates in a 56-inch radius.

A data sheet on the new "Rotennas" is available on request.

"TUNER-TONIC"

A new product, called "Tuner-Tonic," has been introduced by *Electronic Chemical Corp.* of Jersey City, N. J.

The liquid cleans, lubricates, and restores all tuners, including the wafer type. The manufacturer states that the product will not change or affect capacities, inductances, or resistances in the tuner. It will not harm insulation or precious metals, nor will it attack plastics.

"Tuner-Tonic" can be used on TV, radio, and FM equipment. By merely applying the liquid to any tuner, noise, oxidation, and dirt can be eliminated indefinitely. It is said to be non-toxic and non-inflammable. "Tuner-Tonic" is packaged in an aerosol can for easy use.

—30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

AS THE industry edges toward the fall and coming winter, three important developments which have appeared on the horizon will have a marked influence on the trend of service in the year ahead as well as in the increasing volume of business it will be called upon to handle.

The first of these developments is the quickening interest among service people in all sections of the country on the subject of national unity in a national organization that will work for the best interests of the independent service shops and servicing dealers. Murray Barlowe, dynamic president of the Radio Television Guild of Long Island, has been literally swamped with letters stimulated by his article, "Now—or Never," referred to and quoted in this department in the August issue. This avalanche of letters is an indication of the growing realization on the part of service operators that they hold the future of the independent electronic servicing industry in their hands. Whether it becomes a good business to be in or remains a treacherous, unstable activity hinges completely on the degree of cooperation that is achieved between the thousands of full-time service businesses now in existence.

Time and tide wait for no man. The slowly rising star of color television injects a time element in the achievement of national unity. The almost complete futility of efforts to create a clean business atmosphere for service on a local level when the root of many of the underlying causes of the industry's troubles is national in scope, has finally dawned upon many hundreds of service businessmen. They have learned, too, that no other elements of the industry will take service by the hand and lead it out of the wilderness of trouble. They have found that service must take the first long steps to put a foundation of stability beneath its activities. Once that is accomplished, other elements of the industry will help to build a solid structure on that foundation.

During August, the sixth annual NATESA convention was held at the Morrison Hotel in Chicago. Delegates from the many NATESA affiliates attended the three-day affair to present and discuss the reports of the various committees, decide on projects for committee attention during the year ahead, and to complete their annual election of officers.

One event of unusual significance in connection with the NATESA convention was their invitation to the Television Technicians Lecture Bureau to take over the final day to present a series of service business forums.

National Radio-TV Week

"National Radio and Television Week—Dedicated to Better Home Entertainment," is the slogan adopted for the week of September 18 during which an intensive radio and television set-selling campaign will be carried out.

Through the joint sponsorship of RETMA and the National Association of Radio and Television Broadcasters, National Appliance and Radio-TV Dealers Association, National Association of Electrical Distributors, with the assistance and cooperation of "Life Magazine" and the "Saturday Evening Post," a detailed merchandising and promotional program has been prepared to stimulate consumer traffic in radio, phonograph, and TV retail outlets during the week.

This national drive to stimulate the sales of electronic home devices will also spur the service business, particularly for the companies that aggressively sell and install TV antennas.

Talking movies fell flat when they were first demonstrated in 1914. When, in 1929, as a sort of last resort, a financially-distressed company took a gamble on a talking movie, the public stormed the theaters where it was shown, and an entirely new motion picture industry was born.

One of the biggest deterrents to color TV progress in the eyes of the public has been the negative attitude of most dealers and service operators toward it. These people who would have most to gain from a boom in color TV interest and sales have made more noise over the high cost of color sets than the run-of-the-mill general public. The mental block on price ceilings for electronic products seems to be an idiosyncrasy that is peculiar to many men who sell and service elec-

tronic products. Sometimes it seems as if they are unhappy if they are not giving merchandise away at no profit to themselves. But the unpredictable public has its own ideas about what it wants and what it will pay for it. Present a product with a strong enough appeal at the time it is shown, and enough people will buy it irrespective of price to create a boom in it. Of course, we know that when color TV breaks there are dealers who will sell color sets at a discount even when deliveries are on allocation.

RCA is getting set to sell color TV sets this fall. They have geared up their Lancaster plant to produce one thousand color tubes a month. *NBC* paid half a million dollars for the Alexander Korda film, "Richard the Third," for color transmission sometime during the winter. Other good color films have been purchased. The World Series and some of the football games will be televised in color. All of this adds up to a package of entertainment that will whet the desires of thousands of people to own a color set after they see good programs in color in clubs and taverns.

The race is to the swift. Color television will pay off handsomely to the dealers and service companies who get into it with enthusiasm, promote it vigorously, and expand their facilities to handle installations and service efficiently.

Color TV probably will not expand with the rapidity that marked the growth of monochrome TV. It will be harder for the johnny-come-lately's and the fast-dollar boys to stick their lecherous claws into. It can be a bonanza for sales-minded dealers and service companies who get "hot" enough over it to sell it and keep it sold with enthusiasm.

In 1952 the interest in the quadrennial political conventions and the presidential campaign stimulated a boom in TV sales and service that started early in July and continued unabated far into the following year. There is another red hot political campaign scheduled to be staged next year. Chances are good that a lot of it will be televised in color. It could bring about a real boom in color set sales, installations, and service. Wise dealers and service operators will be prepared for it.

Association Promotions

One of the most interesting association promotions that has come to the attention of your editors is the program now being carried on by the Associated Radio and Television Servicemen of Chicago. Under the chairmanship of Howard Wolfson, who operates *Mercury Radio Service* at 433 South Wabash in Chicago. the ARTS promotion committee developed a complete list of service shops and servicing companies in the State of Illinois. They are now in the process of sending a series of mailings to this entire list for the purpose of interesting all established service shops in the State in the im-

portance of cooperation through established service associations.

A number of progressive service shop operators in Peoria invited ARTS officials to visit the city and help them establish a service association. The Chicago organization is hopeful that associations will be formed in such cities as Springfield, Decatur, Bloomington, Danville, and Kankakee, and that service operators in smaller towns will become active in the associations in cities nearest to them.

ARTS is made up entirely of the small shops—mostly one-man businesses. Radios, phonos, and sound equipment, rather than television, provide their bread-and-butter business. Most of the shops are situated in good traffic locations where it is convenient for customers to bring in small sets, portable radios, and portable phonographs for adjustments and repairs. Some of these shops do a fairly good over-the-counter business in the sale of receiving-type tubes.

Management and operational problems are entirely different in these small service establishments as compared to those in a basically TV service business that accomplishes eighty per-cent of its service jobs in the customer's home. Where the small, basically radio, service shop gears its promotion to develop store traffic, the larger TV service companies focus their promotions on the development of home service calls.

Because of these wide operational differences, many operators of small service shops feel, like some of the officials of ARTS, that two distinct types of national associations are needed. One of these national organizations, they think, should be geared to the needs of the small service shops and the other should be representative of the special interests of the larger TV service establishments and the servicing dealers. A coordinating committee made up of representatives of both national associations would work together on national problems common to both groups.

There are two distinct schools of thought on whether service associations should be basically *business* or *technical* organizations. Those who feel that they should be basically business associations limit full membership only to management officials or to businesses and accept technicians as associate members. The out and out technical associations provide full membership privileges to self-employed and employed technicians with no differentiation in the dues structure. Many of the technical associations accord full membership privileges to part-time service technicians.

Historically, the basically business type of association has been the most successful both in accomplishments and in longevity. The regular, scheduled monthly meetings are concerned with local business operating problems. Association business promotion programs keep attention focussed on the key problem in any service business—maintaining volume—and the exchange of information on the results achieved in individual business promotion is profitable to participating members. Many of the business type of associations schedule technical meetings at regular intervals, usually on a quarterly basis, and enlist the cooperation of their local jobbers in getting top-flight technical lecturers to conduct these meetings. They are open to all technicians in the area, whether or not they are employed by association members.

Another factor that greatly influences the success record of business-type associations is that the organizers take a more realistic view of the income necessary to operate an association when they set up the dues structure.

The technical type of service association leans toward a concentration on technical meetings. Two factors constantly tend to undermine members' interest in the association meetings and, hence, in the success of the association itself. The first is the wide difference in basic training, experience, and competence that exists among service technicians in a given area. Association-developed technical programs are either too elementary for many members or too advanced for others.

The other factor that works against the success of a basically technical association is the inability to schedule top-flight lecture programs at regular enough intervals to maintain a high degree of member interest. Many technicians' associations have been formed with a lot of fanfare that resulted in the signing of fifty to one hundred technicians as members. The interest tapered off rapidly as the technical lectures failed to develop according to plan. At the end of six months, attendance at meetings would dwindle to a dozen or less members. Conversely, most service business associations were formed by a handful of men imbued with the spirit to lift the business level of the activity in their areas. Through the successes achieved by these few men, other service businessmen were attracted to the associations. By maintaining aggressive and progressive programs, these associations have continued to grow and to broaden their influence in their areas.

The technical association is a carry-over from radio days. In the radio era, practically every service business was a one-man operation. Technical literature was not too plentiful and a free interchange of information between shop owners on servicing short-cuts on various sets was both helpful and profitable. To most of these men, the service shop was not a business but a technical activity which they enjoyed working at and from which they hoped to wrest a living. The technical association provided a forum where they could meet at regular intervals to exchange servicing information.

Television changed the entire perspective of the radio service activity. Service became a business—big busi-

ness—that attracted a lot of men who had a flair for business promotion. Technical literature and servicing aids pour into service shops in an unending stream. The big problem is what to do with it. In this TV era the problem of technical skill, knowledge, and competence is a minor one. The major problems are business promotion and effective customer relations. Getting service customers and keeping them—that is the problem of every service shop operator. It is basically the reason why business associations have been succeeding while technical associations have had such a job to keep alive.

Many associations have been formed with a great deal of enthusiasm on the part of their organizers and charter members only to wither on the vine and die through loss of interest. The men who form these groups usually spend a great deal of time and energy building up interest in an association. Why do they fail?

In most cases, failure is caused by a lack of understanding among the officers about how to operate an association after it has been started. A contributing cause, too, is the expectation of many members that the association will provide specific benefits immediately. When these benefits fail to materialize, membership interest lags and the organization flounders.

A new manual has just been released that is indispensable to men who are interested in forming service associations. Titled "How to Organize and Operate a Small Association," the manual contains a wealth of down-to-earth information on the hows and whys of association operation. It was written by C. D. "Jack" Hughes, manager of the Wichita Appliance Dealers Association, who has been instrumental in building one of the most successful small town associations in the country.

This manual is available as part of a package of information that should be in the hands of every service association officer. Information about it may be obtained by writing to C. D. "Jack" Hughes, 822 Central Building, Wichita, Kansas. —30—

FREE TV SERVICE COURSE

FREE courses in radio and television service will be offered to residents of New York City at the Queens Evening Trade School, located at 37-02 47th Avenue, Long Island City, N. Y., during the 1955-56 school year. Registration for all classes will be held at the school on September 12 and 13 from 7 p.m. to 9 p.m. Additional information on the courses may be obtained at that time.

Mac's Service Shop

(*Continued from page 84*)

controls; and by adjusting these painstakingly, you could get a picture for a few seconds at a time.

"The 'spurious pips' the technician reported on the display of the vertical sync signals were nothing more than the traces from the free-running horizontal oscillator. Since these were constantly shifting back and forth through the vertical sync signals, they upset any vertical sync that was present."

"So you decided the trouble was in the horizontal sync circuit."

"That's right. I began tracing out this entire circuit, and sure enough I found a misplaced wire on the socket of the horizontal oscillator control tube. Instead of going to pin 5, where it belonged, it went to pin 6. When this was properly connected, the picture would sync all right; but it was not too stable. A little further investigation revealed that the technician had removed the 6AC7 in the oscillator control socket and had replaced it with a 6SK7. When the 6AC7 was put back where it belonged, the horizontal hold control could be moved to either extreme without the picture running, and the vertical hold was steady as a rock. In fact, the performance of the whole set was excellent. When I gave it back to the boy's father, I stressed that his son had done an excellent job to make only one tiny mistake in a wiring job of this magnitude."

"How did you charge for the job?"

"That was quite a problem," Mac said with a grin. "Chappie, who does electronic work in an aircraft factory out in Wichita dropped in on vacation while I was working on it; and he insists you ought to charge the way oil-well drillers out in his country do for finishing drilling a well someone else has started and failed on; that is, charge just as though you drilled the well from the beginning. He thinks you should charge the same for straightening out a kit that you would charge for wiring the kit entirely; but I'll admit I was not that rough—Say, what are you doing with that old beat-up lead-in?" Mac interrupted himself.

"This twin-lead was used to feed a ham friend's antenna when lightning either hit the antenna or very close to it," Barney explained. "The lead was open-circuited at a switch inside the house, and apparently the bolt of lightning produced a standing wave on the lead line. Just look at these evenly spaced sections in which the web is melted away from the conductors for a couple of inches or so. I had it in mind to measure the distances between the melted spots and so arrive at an idea of the wavelength of the electromagnetic wave that was produced by the bolt. The distances seem to average out just about twelve and one-half inches between the current nodes."

"Well, now, that is interesting that

the lightning should leave a thumbprint of its frequency, so to speak," Mac said, always eager to encourage intellectual curiosity in his apprentice. "Let's see if we can work out the frequency," he said as he pulled open a drawer and took out his slide rule. "Do you recall the velocity factor of that twin-lead?"

"Yep," Barney said promptly. "It's .82."

"Fine. If I remember correctly, the frequency of a wave in megacycles is equal to 5904 times the velocity factor of the conductor divided by the length of a half-wave in inches. The distance between current nodes would be a half-wave; so that gives us 5904 times .82 divided by 12.5, which is—just about 387 megacycles."

"That figures," Barney agreed. "I've been fooling around with a 420 megacycle transmitter, and I know a half-wave at that frequency is pretty close to eleven inches long."

"I'm rather surprised the frequency should be so high," Mac observed. "I remember reading about some experiments carried out by Dr. Jones of Oklahoma A. & M. in which he determined that tornado static seemed to peak up at about 350 kilocycles. Off hand, I'd expect the frequency of the wave produced by a lightning bolt to be in that vicinity."

"Maybe the standing wave on this lead-line was simply produced by a harmonic of the discharge," Barney offered. "A lightning discharge must be rich in harmonics to cover such a wide range of frequencies with static the way it does. I'll just keep this line, though, and I'll try to collect some more examples of conductors that have been marked by lightning."

"A good idea," Mac applauded; "and I'll pass the word around among the other TV technicians in town that you're interested in any lead lines that have been marked by lightning. However," he remarked as he looked at the lead-in in his hands in which the conductors themselves had been fused in places, "if a harmonic can do all this, just think how much power must be in the fundamental!" —30—

TV SERVICE HINTS

By H. R. HOLTZ

RECENTLY a set came into the shop that baffled us for awhile. It was a G-E Model 16C113 with intermittent vertical roll and the picture completely negative with contrast reduced.

We made the usual voltage checks and tried another picture tube just to be sure. Finally and reluctantly (because it is inside the shield around the third i.f. transformer) we decided it had to be the 1N64 crystal detector. It was! Operation after replacement of the crystal was perfectly normal. Crystals hold up well, but occasionally one does deteriorate.

Another G-E model TV receiver had intermittent heaters; all tubes lit or none did. Filing into pins 1 and 12 of the picture tube, near the base, exposed the wires running down into the pins from the gun. Solder was then flowed in, clearing a cold solder joint and restoring satisfactory operation. —30—

BROADCASTING FROM FORMOSA

By KENNETH R. BOORD

THE present situation in the Far East has focused new attention on the radio broadcasting activities of the "Voice of Free China" from Taiwan (Formosa).

Jack K. Chow, Chief of the English Language Section of the *Broadcasting Corporation of China,* and Nei-han Soong, Secretary of the Broadcasting Administration Commission of the Ministry of Education in Taipei, point out that despite the fact that Free China is in a state of war with the Chinese Communist regime in Peiping (Peking), which took control of the vast Chinese mainland some six years ago, radio broadcasting on Taiwan—better known to the outside world as Formosa—may be said to have made great strides in the highly competitive and fast-developing radio world. In addition, it has been playing an indispensable role in Free China's continuous campaign against Communist totalitarianism.

To make the best use of radio as an effective psychological warfare weapon in the vital anti-Communist war, radio workers in Free China have worked indefatigably to improve and strengthen radio broadcasting since they were forced to abandon the mainland and move to the island stronghold to continue their fight against world Communism.

Before 1949, when the Republic of China still had its government seat in Nanking, radio development on Taiwan was far behind any other country in the Far East worthy of mention. There was only the Taiwan Broadcasting Station with its five studios operated in five major cities of the island. The total power output then was only 127.9 kw. from 12 transmitters.

With the loss of the China mainland in 1949, many leading radio stations were evacuated to Taiwan—including the government-operated Central Broadcasting Station, the "Voice of the Chinese Air Force," and the Chinese Armed Forces Radio Service which later put up additional studios in the island's major localities aside from Taipei, the provisional capital of the Republic of China.

Soon another 10 broadcasting stations came successively into being on Taiwan. These include "The Voice of Righteousness," the "Voice of Victory," Cheng Shen Radio Station, Fong Ming Radio Station, Chung Shen Radio Station, Kuo Shen Radio Station, Chinese Farmers' Radio Station, Police Radio Station, I Shih Radio Station, and Chung Hua Radio Station.

And on December 23, 1954, an *all-English* language radio station was inaugurated in Taipei. Constructed and operated by the Chinese Friends of Armed Forces Association, the new station was presented to Major General William C. Chase, Chief of the U. S. Military Assistance Advisory Group, as a Christmas gift from the people of Free China. This was in appreciation of General Chase's valuable and memorable contributions to the training and buildup of the Chinese Armed Forces.

The new studio—known as MAAG Radio Station BEC-27—is for the exclusive use of MAAG personnel and their dependents. It is on the air an average of 8 hours a day and has become very popular with both the Chinese and American communities on Taiwan. About 85 per-cent of its programming is music. It plans to expand its programs to a maximum of 15 hours daily in the near future.

At present, 27 radio stations on Taiwan operate 39 transmitters which represent a total power capacity of approximately 272.85 kw.—an increase of more than 110 per-cent in power output, which is only 36 per-cent less than the total radio transmission power back in the mainland days. Largest broadcasting organization on Taiwan is the *Broadcasting Corporation of China (BCC)* which alone operates 10 studios—including the "Voice of Free China" with a total power output of 235.1 kw. from 13 transmitters.

Radio officials in Taipei point out that radio broadcasting today presents one of the most effective instruments for propaganda and education. With such an understanding, the Chinese Government on Taiwan has tried to improve and further develop the radio industry to serve the interests of the nation and its people. Intensive efforts

Best times and frequencies to log broadcasts from "Voice of Free China," Formosa.

Daily to Japan, Korea, South Sea Islands—BED7, 7.130, BED6, 11.736, 0450-0830 EST (0150-0530 PST; 0950-1330 GMT) in Japanese, Korean, Hakka dialect, Amoy dialect, Cantonese, Vietnamese, and Mandarin.

Daily to the United States—BED4, 11.920, BED6, 11.736, 2200-0100 EST (1900-2200 PST; 0300-0600 GMT); English, Cantonese, and Mandarin; English news 2205 and 2330 EST (1905 and 2030 PST; 0305 and 0430 GMT).

Daily to Europe—BED4, 11.920, BED6, 11.736, 0230-0400 EST (2330-0100 PST; 0730-0900 GMT); English news 0235 EST (2330 PST; 0235 GMT).

Daily from the Taiwan Broadcasting Station—BED29, 6.095, 1730-2100, 2255-0200, and 0430-1030 EST (1430-1800, 1955-2300, and 0130-0730 PST; 2230-0200, 0355-0700, and 0930-1530 GMT).

The 125 kw. medium-wave transmitter, BED2, 750 kc., operates in Chinese dialects daily 1700-2000, 2300-0100, and 0500-1200 EST (1400-1700, 2000-2200, and 0200-0900 PST; 2200-0100, 0400-0600, and 1000-1700 GMT).

BCC welcomes letters from its listeners and comments and suggestions will be seriously studied. Every letter will be acknowledged immediately upon receipt and correct reception reports will be verified by QSL card from: "Voice of Free China," Taipei, Taiwan (Formosa).

have been made to step up radio activities in every part of the island.

Radio stations on Taiwan are government-operated, military-operated, or civilian-operated. Operation expenses of *BCC* come chiefly from government appropriations. At present, a radio license fee is one of the chief financial sources on which *BCC* depends to keep its eight broadcasting stations running. The military-operated stations derive part of their support from radio license fees, while commercial broadcasting companies depend wholly on advertising revenue.

Since Taiwan stations operate for different purposes, their targets and languages used vary greatly. For example, the "Voice of Free China" broadcasts to different parts of the world over both medium- and short-waves with emphasis on listeners on the Communist-occupied China mainland and Chinese nationals abroad. Launched in Taipei in July, 1949, the "Voice of Free China" presents programs in 14 languages and native dialects—*English*, French, Japanese, Korean, Vietnamese, Arabic, Mongolian, Tibetan, Mandarin, Amoy, Shanghai, Hakka, Chouchow, and Cantonese dialects.

The "Voice of Free China's" operations against the Red-held mainland of China were stepped up last summer when a new 125 kw. medium-wave transmitter was installed May 20, 1954, for use specifically against the Chinese mainland. Its daily transmission hours total 20:10.

The Taiwan Broadcasting Station, operated by *BCC*, radiates chiefly to the local populace on Taiwan in Chinese, Mandarin, and Taiwanese dialect only, with transmissions running as high as 21:30 hours a day. This does not include airtime for its six substations in other parts of the island.

The Armed Forces Radio Service carries on programs for military personnel in particular, and for the mainland people and overseas Chinese in general. It broadcasts in three Chinese dialects—Mandarin, Amoy (similar to Taiwanese), and Cantonese—for 10 hours a day.

A survey just made reveals the total number of daily transmission hours for all stations on Taiwan is 231:10, with the average daily broadcasts running as high as 12 hours.

"To join the nation in fighting international Communism, radio programs of all Taiwan stations are designed in line with government policies, although the form of their presentation differs at times," officials say.

"The 'Voice of Free China's' programs to the Chinese mainland are often arranged to meet the psychological situation of the people under Communist oppression in the light of current developments. Programs such as the 'Communication Over the Radio' and 'Happy Family' are aimed to further the pent-up feelings of the oppressed people toward Communism and to encourage them to flee Communist rule.

"In fact, the 'Communication Over the Radio' session is actually a call-by-name broadcast to swing Communist party officials and functionaries away from Communist ideology and to seek freedom outside the Iron Curtain. This program usually is carried out by having Free China's leaders call the names of their old friends and relatives who are now members of the Chinese Communist Party. They tell the Reds about the encouraging conditions in Taiwan and that their fellow compatriots in Free China are eager to see that they make their way out of Red China, and will welcome them with open arms.

"The 'Happy Family' broadcasts continue to tell the mainland people how families are living happily in Free China as a means to further their loathing for the recently-promulgated and immoral Communist 'New Marriage Law.'"

Another example is the leading radio network, the Taiwan Broadcasting Station, which radiates chiefly to the people on Taiwan, including both Taiwanese natives and those who hail from the mainland. Its programs cover a wide variety of subjects—ranging from astronomy, geography, and international developments to family chores.

One of the station's most popular programs is called "The Wife and Her Husband." It is quite similar to the U. S. TV program, "I Love Lucy." This program is on the air five times a week with a three-member family as its background. The presentation takes the form of casual conversation which covers a variety of subjects which relate to family affairs. It has been aired for about six years and has probably enjoyed the highest reception rate of any program on Taiwan.

Broadcasts of the commercial stations are, of course, designed to suit the tastes of the general public.

Radio programs in Free China include news, education, music, drama, and public service. Special entertainment programs, aired from time to time, usually are conducted by local musical and theatrical groups or by Chinese motion picture stars when they visit Taiwan from Hong-Kong. On-the-spot broadcasts of such events as the election and inauguration of the nation's president and vice-president, the visit of distinguished guests, and sports events are also heard over Taiwan's radio networks.

The most current survey shows news constitutes an average of 16.33 percent of all Taiwan broadcasts; education, 35.5; music, 32.4; drama, 14.92, and public service, 6.74 per-cent.

A "family" program is sponsored by many stations, including the Taiwan Broadcasting Station, the Voice of the Chinese Air Force, and the privately-owned Cheng Shen Radio Station. It touches on the domestic economy, culinary art, woman and infant health, social life, and other household affairs. It is aired as a panel by inviting specialists in these fields to talk over the

radio, or is broadcast by professional announcers in a conversational style accompanied by musical sound effects.

Some 11 Taiwan stations sponsor programs for children which comprise story telling, singing, wit contests, plays, and musical performances. These programs are undertaken by boys and girls from various kindergarten and elementary schools. The programs have been so successful that one day after a short skit called "A Match Salesgirl" was heard, a station in Taipei received a letter of appreciation from a woman listener who stated that after listening to this program, her husband had voluntarily stopped spanking their son!

A short radio skit—aired each Sunday by the Drama Club of the *BCC*—enjoys unmatched popularity, ranking right along in audience support with "The Wife and Her Husband."

As of December 15, 1953, official statistics showed there was a total of 72,371 radio receivers throughout Taiwan, while the population has grown from 6 to nearly 9 million since the Chinese Government moved there from the China mainland in 1949. Unofficial information, however, indicates there are at least upwards of 100,000 radio sets on Taiwan. In addition, there is an unknown number of unregistered sets owned by those who try to evade payment of the license fee. The fee on Taiwan is $30 local currency for each receiving set *per year*—compared to England where British radio owners pay 1 pound each month for each receiving set, Canada with $2 for each set, Japan with 35 yen Japanese currency, France with 1000 francs, and Russia with 36 rubles for each radio set monthly.

In June 1952, the Broadcasting Administration Commission was established under the Ministry of Education to take over-all charge of Taiwan's radio networks.

Under the managing director of *BCC*, there are four departments—general affairs, engineering, program, and mainland broadcast; three offices of personnel, comptroller, and materials, and a service department which manufactures and sells radio receivers, transmitters, and amplifiers.

In addition to its chairmanship, held concurrently by the Minister of Education, the Commission has 9 to 15 members drawn from all quarters concerned — with three divisions — programming, data library, and technical engineering. Of all the working personnel in the Commission, only four are full-time staff members while the rest work part-time. With limited working personnel and a lack of adequate operational funds, the Commission has been unable to improve the radio work on Taiwan as it would like.

However, the officials summarize that "it may be safely concluded that notable progress has been made in the field of radio broadcasting on Taiwan which will undoubtedly play a still more important role in Free China's campaign against Communism." —30—

"COLOR TELEVISION FOR THE SERVICE TECHNICIAN" by Albert C. W. Saunders. Published by *Howard W. Sams & Co., Inc.*, Indianapolis, 108 pages. Price $2.50. Paper bound.

Public acceptance of color television is inevitable and its march is inexorable so the on-the-ball service technician will prepare for its advent before he is handed his first color installation job.

A good start toward getting a practical working knowledge of color circuitry would be this new book by Mr. Saunders. The material is presented in a straightforward, clear, and easy-to-understand manner. The text progresses in an orderly fashion from a discussion of colorimetry, through the color signal, color carrier, and signal analysis. The tri-color picture tube receives thorough treatment along with the all-important details on how such tubes should be handled and installed for maximum safety.

The balance of the book is devoted to a discussion of the color receiver itself, how it should be installed, how it operates, and troubleshooting procedures for this circuitry. The various commercially-available color sets are discussed in some detail both as to their similarities and their differences.

The appendix contains a wealth of hard-to-locate information which will be of help to the color technician. Lavish use of diagrams, color charts, and other illustrative material adds immeasurably to the value of this book as a reference work and as a practical how-to-do-it manual.

* * *

"INTRODUCTION TO PHYSICS" by Frank M. Durbin. Published by *Prentice-Hall, Inc.*, New York. 763 pages. Price $9.00.

This is a basic course in physics at the college level and is offered as a classroom text both in form and subject presentation.

In the belief that a subject can best be mastered if a thorough working knowledge of the basic "tools" is acquired first, the author of this text, himself a professor of physics, has devoted the early chapters to mathematical procedures and the various systems and units that the student will encounter later in the course.

The chapters on vibrations and waves, audible sound, electricity, electrical circuits, magnetic and chemical effects of currents, electromagnetic induction, light, the electron, electronic devices, and applications of nuclear phenomena are all subjects of interest to those in the electronic and radio-TV industry. Readers will find this

material carefully presented in clear and concise form. Chapters are summarized and related problems dealing with the subject matter under discussion are included for self checking.

Those with a sturdy foundation of mathematics and an insatiable curiosity about the nature of the world in which we live will find abundant food for thought and study in this text.

* * *

"F-M LIMITERS AND DETECTORS" by Alexander Schure. Published by *John F. Rider, Publisher, Inc.*, New York. 43 pages. Price $.90. Paper bound.

Although the subject matter of this book is limited in scope, the topic is one which needs clarification in the minds of most service technicians. The author has succeeded admirably in his self-appointed task of clearing up many common misconceptions regarding FM limiters and detectors.

The text material is divided into five chapters covering the circuits which preceded modern FM detectors, FM limiters, the modern FM discriminator, the ratio detector, and the gated beam (6BN6) tube.

The book is lavishly illustrated with circuit diagrams, graphs, and line drawings—all of which contribute to the clarity of the presentation and the general usefulness of the text.

* * *

"SPECIALIZED AUTO RADIO MANUAL" by The Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 208 pages. Price $3.00. Volume 6-A.

This latest volume in the current *Rider* series covers the installation and service of custom-built *Motorola* auto radios made during the years 1948 through 1955.

Like its predecessor volumes, this book includes general information, dial cord restringing data, alignment information, tube and trimmer location diagrams, top and bottom chassis views, and a complete schematic on each of the various models.

A complete index listing the model number of the receiver, the car in which it is used, and the year in which the receiver appeared is provided to facilitate locating the set being serviced.

Service organizations which do any auto receiver work will undoubtedly wish to add this volume to their service libraries. -30-

MIDWEST "REPS" MEET

THE "Heart of America" chapter of "The Representatives" will hold its annual conference at Lake Taneycomo, Rockaway Beach, Missouri, September 11 to 15th.

One of the special features of the conference is the drawing for a station wagon which will take place during the banquet to be held Wednesday evening, September 14th. A special system of validating the drawing cards will ensure jobber attendance at all the conference sessions. -30-

Additional Notes on "Electronic Ignition System"

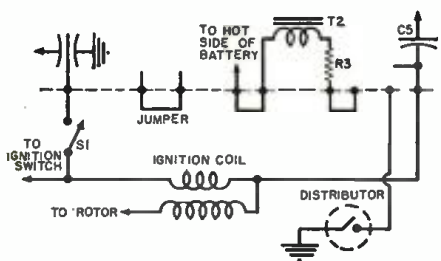
THE article "Electronic Ignition System" published in our July, 1955 issue has generated an enormous amount of interest among our readers and as a result we have been literally swamped by correspondence. Most of the readers are having trouble duplicating this unit, and the unfortunate part is that it is an impossibility for us to pinpoint exactly some of the problems that are being encountered in view of the fact that we do not have the specific models with which to work.

The circuit is rather critical and most of the problems seem to originate in the application of this unit to various makes of cars, substitution of parts, and, most serious of all, variations in car battery voltages.

We would, however, like to list below suggestions which should be of assistance to all who have run into trouble:

1. Terminal #1 of the transformer, T_2, should go to the hot side of the battery instead of ground as shown in Fig. 6.

2. One of the major difficulties seems to be in not being able to effect thyratron extinction. This may be caused by connecting the ignition coil in the circuit improperly. To eliminate this possibility the diagram below should help clarify this situation. Some ignition coils have the primaries and secondaries as separate windings with one side of the high-voltage winding connected to its casing. This unit can be used without any change, even though one side is grounded.



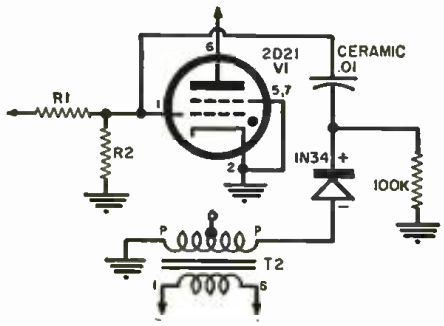
Another cause of improper extinction could be due to capacitor C_5. If a low quality unit is used, it would present a relatively high distributed capacity to ground. This would cause poor extinction. The capacitor should be a high quality unit, such as the Cornell-Dubilier Type 1005.

The d.c. grid bias at the thyratron should be −75 to −100 volts (vary R_1 to obtain proper voltage).

The article specifically suggested removing turns from the choke, L_1. This, no doubt, has been the cause of some of the trouble; that the choke then gets quite close to its saturation point. It is therefore suggested that the Stancor C2326 choke mentioned in the text be used "as is" without removing the turns. Obviously the inductance of this coil will be higher than specified but will not affect operation adversely.

All of the above should help in obtaining a workable unit. However, should any trouble still be encountered, the author has tried and tested another circuit in regard to the 2D21 thyratron. This is shown on following page. This circuit is

not as critical and the grid bias voltage could vary as much as −50 to −100



volts. The above comments in regard to L_1 and C_5 will still apply for this new circuit.

3. The 2D21 thyratron is operated above its rated specifications. Although this has not caused any trouble in the author's unit, it is suggested that a 6012 tube be used in its place. This tube is a heavy-duty type and, when used, the grid bias voltage could range up to −150 volts. R_1 could almost be removed from the circuit entirely.

4. For 12-volt operation, the following parts should be used:

RL_1 should be a 12-volt relay (Amperite 12N015T).

T_1 should be a 12.6 volt, center-tapped, @ 2 amp. unit.

R_3 should be changed to 100 ohms, 1 watt.

Vibrator should be a 12-volt unit.

An 11-ohm, 4-watt wirewound resistor should be in series with the filament when using a 2D21 (Two 22-ohm, 2-watt resistors can be connected in parallel).

If a 6012 tube is used, this resistor should be 2.5 ohms, 20-watts. (Two 5-ohm, 10-watt units in parallel can be used).

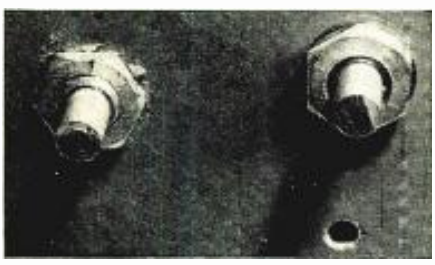
In addition to the above, there is one important point to watch carefully and that is in regards to keeping the distributed capacity of the thyratron circuit as low as possible. Make sure that all grid and plate leads are kept short and, preferably, away from chassis. -30-

PROTECT THAT PANEL!!!

WHENEVER you mount a volume control or switch on a finished panel, use a lockwasher behind the panel and a smooth flat washer between the panel and the mounting nut. If you don't use the lockwasher, the switch or control may tend to work loose. And if you don't protect the panel with a flat washer, you may ruin the finish as you tighten the mounting nut.

The photograph gives examples of both good and bad practice when mounting volume controls. -30-

Incorrect (left) and correct (right) methods of mounting a volume control or switch.



SELF-SERVICE DISPLAY

Tentenna, Inc., 122 East 42nd Street, New York 17, New York, is now offering a new self-service display unit for its "Twin Ogyro," invisible indoor TV and FM antenna.

The display panel is only 11" wide by 16" high and is a three-color unit in brilliant yellow, black, and red. The card is supported by a Masonite center easel and holds twelve of the individually wrapped transparent blister-packed color cards, each containing a "Twin Ogyro" indoor antenna.

The self-service panels are compactly and attractively designed for use on counters, walls, and show windows. Each rack has a double-spoke pegboard mounting which permits easy on and off handling of the item.

* * *

MAILING PIECE

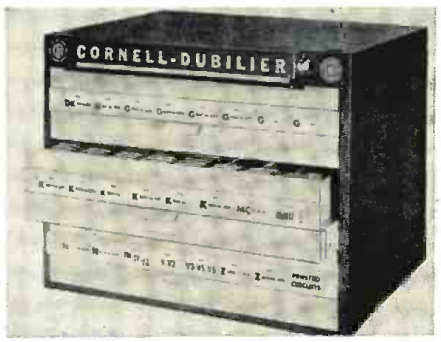
Channel Master Corp. of Ellenville, N. Y. is offering reproductions of its current "There's a Goldmine in Your Own Backyard" advertisement as a special mailing piece for dealers.

Emphasizing the theme of antenna replacements as an excellent source of additional revenue, the promotion is designed to encourage dealers to go after the antenna replacement business aggressively. Such replacement sales are also promoted as an excellent income-producer for those between-season doldrums in the TV service industry.

* * *

C-D- CERAMISERVER

Cornell-Dubilier Electric Corporation on South Plainfield, New Jersey has announced a new "Ceramiserver"



merchandising cabinet and ceramic capacitor assortment for distributors and dealers.

The "Ceramiserver" is a heavy-

gauge steel merchandise cabinet especially designed for use as a self-server, counter display, or stock dispenser. Planned as a complete ceramic capacitor stock center, the cabinet contains a basic assortment of 87 different types of disc, tubular, universal, and printed circuit capacitors. The cabinet measures 11" x 11½" x 15" and contains 844 assorted capacitors in three divided drawers. A retractable index chart gives the type number, size, and price of the various units.

Bulletin RP-455, available from the company, gives complete information on this display unit.

* * *

CABLE DISPLAY

CBC Electronics Co., Inc., 2601 N. Howard Street, Philadelphia 33, Pa. is currently offering an attractive rotating counter display merchandiser to dealers and jobbers.

The unit is designed to hold the company's complete line of prepared cables for high-fidelity equipment, tape recorders, and packaged radios and phonographs. The merchandiser stands 26" high and 18" wide. It has 16 arms making every model easily accessible for cable selection. An attractive doubleface, three-color display sign is mounted on top of the merchandiser.

The display is being made available free with a qualifying order for the cables.

* * *

POWER RESISTOR CARD-KITS

A wide selection of resistance and wattage values is available at your fingertips with the card-kits being offered by *Clarostat Mfg. Co., Inc.* of Dover, New Hampshire.

Each of the Series GK cards holds a selection of power resistors by means of handy clips. Any resistor instantly slips off the card while its designation remains to facilitate re-ordering that particular value. There are six GK cards in all: GK1 consists of twenty 10-watt "Greenohm" resistors; CK2 has thirty-two "Glasohm" or flexible glass-insulated resistors; GK3 offers thirty-six "Greenohm Jr." 5-watt axial lead resistors; the GK4 assortment contains fifty-four 5-watt "Greenohm" units; the GK5 has fifty "Greenohm, Jr." 10-watt axial lead units; while the GK6 contains forty-five 10-watt "Greenohms."

These several assortments of wattages and resistance values take care of the usual requirements of research and engineering laboratories, servicing, and general experimentation.

* * *

SIMPSON DISPLAY BOARD

A new display board on which is mounted an actual sample of the company's Model 355 "Midgetester" miniature voltohmmeter has been announced

by *Simpson Electric Company,* 5200 W. Kinzie Street, Chicago 44, Illinois.

The "Midgetester" can be removed from the display for examination by prospective buyers but is connected to it by a small chain to prevent loss. The display board is arranged for either counter or wall use and is printed in bright orange and black. Size has been held to a compact 9" by 12".

The instrument has a transparent plastic back cover so that the prospective buyer can examine the interior of the device. The standard black plastic cover is included, however, so that jobbers can sell the sample.

* * *

G-E SERVICE AIDS

The Tube Department of *General Electric Company,* Schenectady 5, New York has a whole series of service aids for television and radio dealers which

are described in detail in its 1955 catalogue of "Promotional & Service Aids."

The catalogue, now available from the company's tube distributors, lists display signs, public relations packets, stationery, and other items that the firm has developed for the dealer.

* * *

SNYDER PROMOTION DRIVE

Snyder Mfg. Co., Philadelphia 40, Pa. has launched an intensive sales and promotion drive to sell both the com-

pany's "5-D" push-button "Directronic" indoor antenna and the Model K-80 Do-It-Yourself "Directronic Tenna Kit" as Christmas gifts.

The campaign, through advertising, direct promotion, and publicity, will promote both of the items as "Ideal Gifts for Anyone." According to the company, the promotion of TV antennas as a gift item rather than solely as a television accessory is a departure from the usual antenna merchandising procedure.

* * *

"GOLDEN HARVEST" CAMPAIGN

Kay-Townes Antenna Company, Rome, Georgia has announced its "Golden Harvest Campaign" in which the first prize will be a 1956 Cadillac sedan.

The company, which manufactures the "Big Jack" and other antennas, is also offering a 1956 Buick and nine other prizes in this $12,000 contest for dealers.

Full details on the competition, which will run until November 30th, are available from the company direct.

* * *

JENSEN FLASHER SIGN

Jensen Manufacturing Company, 6601 South Laramie Ave., Chicago 38, Ill. has created an attractive, three-color flasher sign designed to focus attention on a display of the company's high-fidelity speakers.

The new sign is made of high impact polystyrene and is silk screened in

three brilliant colors. The sign is 19¼" wide, 14¼" high, and 7" deep. It is equipped with a 9-foot cord and a sturdy chain to facilitate hanging in a display area.

For information on how to obtain one of these promotional aids, contact your authorized *Jensen* wholesaler or write Edward F. Shaver, sales promotion manager, at the company address.

* * *

RAYTHEON "CO-OP CLUB"

Raytheon Manufacturing Company's television and radio department, Chicago, Ill. has set up a unique "TV Owners Co-op Club" which permits purchasers of *Raytheon* TV receivers to obtain top quality silverware at a substantial discount.

A person buying a TV receiver will receive from the factory a premium catalogue, an order blank, and a membership card, after the warranty card has been mailed in. The membership card will carry the consumer's TV serial number on it. After selecting one or more articles from the 16-page catalogue, the set purchaser can send in

the order blank with a remittance, and the merchandise will be shipped directly from the silver companies to the purchaser's home.

The catalogue lists such articles as a 52-piece set of flatware, a 7-piece tea and coffee service, candelabra, lazy susan, chafing dish, 8-cup coffee pot, ice bucket, etc. -30-

NEUTRALIZING THE 2E26

IN JACK NAJORK'S July article, "Combination V.H.F.-L.F. Final Amplifier," the author commented on the difficulty in neutralizing the 2E26 at both v.h.f. and l.f. using series-tuning.

H. G. Ryan, assistant director of commercial engineering at CBS-Hytron, Danvers, Mass., has come up with a different technique from that resorted to by Mr. Najork. Mr. Ryan's suggestion eliminates the loading requirement on the l.f. exciter and still maintains stable performance at both v.h.f. and l.f.

The technique is as follows: The use of a large screen grid capacitor such as a .005 μfd. or .01 μfd. disc capacitor will provide stable performance at l.f. At v.h.f., the tube screen lead inductance is high enough to result in a finite impedance to v.h.f. energy so that feedback and oscillation result at v.h.f.

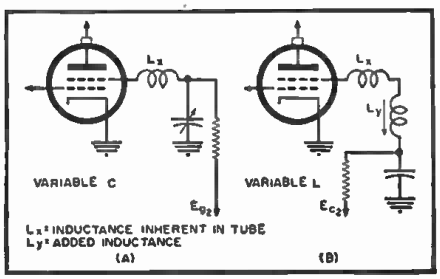
It is common practice to screen neutralize the tube by making the a.c. screen circuit series resonant at v.h.f. This may be accomplished by use of a series capacitor as the author did but to eliminate loading requirements, it is better done by replacing the small capacitor with a large disc unit on the order of .005 μfd. to .01 μfd. and adding, in series with the tube screen grid lead, sufficient inductance to make the circuit series resonant at v.h.f. See diagram below.

The added-inductance approach can be accomplished by cut-and-try coil techniques, checking for resonance with a grid dip meter or other well-known methods. It may also be satisfactory and perhaps more flexible to use a small slug-tuned coil form for L_y. The total inductance added then forms a series-resonant circuit with the interelectrode capacitances of the tube, the .01 μfd. capacitor being a short circuit to the a.c. component. Mr. Ryan reports that this procedure has proven successful using an Ohmite Z-144 choke with .005 μfd. discs.

The impedance offered to the l.f. signal by the small added inductance is negligible. Adequate l.f. screen grid bypassing is obtained with the .005 μfd. to .01 μfd. capacitor. The system has the obvious advantage that no loading is required of the l.f. exciter and consequently more efficient operation results.

Our thanks to Mr. Ryan for passing along this tip. -30-

Two simple ways of neutralizing the 2E26 for operation at both v.h.f. and l.f.



Motorola Test Points

(*Continued from page 65*)

chassis previously mentioned for setting the horizontal oscillator coil properly. This is done as follows:

1. Set the a.g.c. control to the local position and all other controls for a normal picture.
2. Short the a.f.c. voltage to ground and shunt the horizontal oscillator coil to ground with a .1 μfd., 400 volt capacitor. (Note: Some production units do not contain the horizontal oscillator terminal on test receptacle "B." In this case, where improper operation is noted, short the horizontal oscillator to ground directly at the circuit junction in the chassis.)
3. Adjust the horizontal hold control to the point where the picture almost remains stationary horizontally.
4. Remove the .1 μfd. capacitor shunting the horizontal oscillator coil and without moving the horizontal hold control adjust the horizontal oscillator coil slug to the center of the range in which the picture again almost remains stationary horizontally.
5. Remove the short from the a.f.c. voltage to ground and adjust the horizontal hold control so that no fold appears on either side of the raster.

When this is completed, the horizontal hold control should have a sync range of approximately 50 degrees.

The wise use of the test points on the *Motorola* chassis will expedite service work and increase efficiency, which will allow the service technician to pass on some of the labor savings to his customers to enhance his prestige and value. —30—

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NOTE

For additional data on the "Electronic Ignition System" described in our July issue, see pages 182 and 183 of this issue.

INDEX OF *Advertisers*

SEPTEMBER 1955

[While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.]

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Rate 50c per word. Minimum 10 words

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COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

PARTS, meters, gadgetry, oddities. List Free. Art Sorrell, Riverdale, Maryland.

TV Trade-In sets. Philco, R.C.A., Emerson, others. List available. 10"—$17. 12" to 17"—$20, up. Washtek Service Co., Dept. R, 956 Southern Blvd., Bronx, N. Y.

FOR Sale—Geiger Counter Kits $38.50. Geiger Counter & Scintillator Diagrams $1.00. Free Catalog. "R. F. Chambers," 13833 San Antonio Dr., Norwalk, Calif.

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1955 TELEVISION, National Brand, 16,000,000 Sold 24"—$199; 21"—$139; UHF Add $20.00 Blonde or Mahogany finish. RTMA Warranty. Electronic Supply Co., 128 State St., Schenectady, N. Y.

TRADE-IN Television Sets $14. Jones Radio, 1115 Rambler, Pottstown, Pa.

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90% DISCOUNT—New 24-hour nationally advertised 115-230 volt timeswitches. SPST 35-amp contacts. Free circulars. Timer Sales, P. O. Box 22, Boulder City, Nevada.

SCINTILLATION Crystals. NE-101 Plastic Phosphors have distinct advantages over sodium iodide: Cost is low. Sensitivity is high. Not affected by moisture. Unbreakable. Easy to attach. Mfrs. and individuals are adopting their use. Write for details. Western Radiation Laboratory, 1107 West 24th Street, Los Angeles 7, California.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

TELEVISION Receivers, $28.80 Up. W4APL, 1420 South Randolph, Arlington, Virginia.

TV-FM antennas. All types including UHF. Mounts, Accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

RC-348P RECEIVER, brand new, original carton, covers 6 bands, 200-500 kc., 1.5-18 mc. Designed for 28 v.d.c., easily converted to 117 v.a.c., $75.00 f.o.b., New York. Box 51, % Radio & Television News.

HI FI at Low cost prices. All standard and imported brands. Write telling us your requirements. We will quote you lowest prices. Premier TV Radio Supply, 3239 West North Avenue., Chicago 47, Illinois.

FIDELITY Unlimited: Authorized Distributors of High Fidelity Components. Shipments Prepaid and Insured. Specials: New Collaro RC-54 with Mounting Board, 45 Spindle, dual Blank Heads, $38.75. Accessories: RPX-050, dual sapphires: $6.50. Diamond and Sapphire Stylus, $10.75. Write Us Your Hi-Fi Requirements. Free Audio Guide, Complete Stock. Fidelity Unlimited, 63-03 39th Ave., Woodside 77, N. Y. Dept. RN.

DIAGRAMS—Radio $1.00; record changers, recorders $1.25. Television with service data $2.00. Where model unknown, give part numbers. Kramer's Radio Service, Dept. S53, 36 Columbus Ave., New York 23, N. Y.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. F. Gensler, W2LNI, 512 Broadway, New York 12, N. Y.

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AN/APR-4, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. Engineering Associates, 434 Patterson Rd., Dayton 9, Ohio.

WILL Buy All. ART-13/type T-47A $225.00. ART-13/type T-47 $150.00. BC-788C Altimeters Receiver, $150.00. R5/ARN7 Radio Compass $160.00. ARC-3 Complete $185.00. BC-348 Rec'r Modified $35. BC-348 Rec'r unmodified $50. ARC-1 Radio $150.00. BC-312 Rec'r $40.00. BC-342 Rec'r $50.00. Ship Via Express C.O.D., Subject to inspection to: H. Finnegan, 49-57 Washington Ave., Little Ferry, New Jersey.

CYLINDER and old disc phonographs. Edison Concert, Balmoral, Conqueror, Opera, and Oratorio models. Berliner Gramophones and Zono-o-phones. Columbia disc and cylinder Graphophones, Bettini micro-reproducer. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Box 50 % Radio & Television News.

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SPEAKER Reconing 48-Hour Service. Mc's, 506 North Ward Street, Benton, Illinois.

ALL types TV Tuner serviced within 36 hours. For information write Dan's TV Laboratory, 2 West 183rd St., New York 53, N. Y.

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(Not a Kit)

A complete precision test instrument. 20,000 Ohms per Volt DC—10,000 Ohms p/v AC. 38 microampere movement. 8 easy to read scales: DC 0-6, 30, 120, 600, 1200, 6000 Volts. AC 0-6, 30, 120, 600, 1200 Volts. Current 0-60 ua, 6, 60, 600 ma. Resistance 0-8K, 80K, 800K, 8 megohms. Decibels Cal. 600 ohm −20 to +6, 20, 34, 46, 60 DBs. Capacity 250 uufd to 10 mfd. Inductance 10 to 1000 millhys. Hi accuracy, versatile, 1% Precision Resistors. Scale 3". Plastic engraved panel. Rugged metal case. Lgth 4¼"x6¼"x2¾". Complete w/batteries & leads. RF Diode Probe included for signal measurement. Shpg. wt. 4 lbs. SINGLY @ $22.95. HV 30,000 Volt Probe....Special $5.95 ea.

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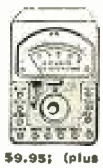

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Hi-accuracy precision VOM 1000 Ohms per V. Reads AC & DC Volts 0, 5, 25, 250, 1000V. DCMA: 0, 1, 10, 100MA. Ohms 0, 10, 100K. Size 1¼" D. 4⅜" L. 3¼" W. Test Leads. Sold Singly $9.95; (plus 40c ship. in U.S.A.).

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0A2	.74	6AF6	1.18	6X5	.46
0A3	.98	6AG5	.50	6Z7	2.11
0B2	.64	6AG7	1.14	7A4	.78
0B3	.84	6AH6	.88	7A8	.68
0C3	.82	6AK5	.62	7AD7	1.41
0D3	.78	6AK6	.74	7B6	.72
0Z4	.50	6AL5	.42	7B8	.82
1A5GT	.64	6AL7	1.22	7C4	.26
1A7GT	.96	6AQ5	.46	7C7	.68
1AD4	3.95	6AQ6	.54	7E6	.54
1AE4	3.75	6AR6	2.74	7E7	.72
1AH4	1.07	6AS6	1.60	7F7	.82
1AX2	1.25	6AS7	2.98	7F8	1.18
1B3	.66	6AT6	.42	7H7	.72
1C6	.49	6AU6	.46	7N7	.68
1D8GT	.89	6AV5	.84	7S7	1.29
1E5	.69	6AV6	.48	7V7	1.06
1E7	.49	6AX4	.81	7X6	.89
1G4GT	.69	6B4	1.12	7Y4	.64
1G5	.69	6B5	1.18	10	.49
1G6GT	.69	6B7	.91	12A6	.48
1H4G	.49	6B8	.64	12A8	.79
1H5GT	.72	6BA6	.48	12AH7	.92
1H6	.69	6BD6	.74	12AL5	.54
1J6G	.79	6BE6	.46	12AT6	.42
1L4	.48	6BG6	1.24	12AT7	.68
1LA4	1.01	6BH6	.52	12AU7	.54
1LB4	1.09	6BJ6	.68	12AV6	.38
1LC6	.89	6BK7A	1.11	12AW6	.84
1LD5	.98	6BL7	.97	12AX7	.58
1LE3	.99	6BN6	1.19	12AY7	.68
1LH4	1.01	6BQ6	.96	12BA6	.52
1LN5	.78	6C4	.38	12BA7	.94
1P5	.78	6C5	.68	12BE6	.62
1Q5	1.19	6C8	.82	12BH7	.69
1R4	.96	6CB6	.52	12C8	.62
1R5	.52	6CD6	1.08	12H6	.48
1S4	.88	6D6	.84	12J5	.48
1S5	.42	6D8	.81	12K8	.48

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1T4	.52	6E5	1.09	12SC7	.78
1T5	.98	6F6	.76	12SF7	.78
1U4	.46	6F8	.86	12SH7	.62
1U5	.48	6G6	.92	12SJ7	.54
1V2	.62	6H6	.57	12SK7	.48
1X2A	.62	6J4	4.59	12SL7	.56
2A4	2.37	6J5	.42	12SQ7	.54
2A5	.78	6J6	.48	12SR7	.46
2A6	1.49	6J7	.72	12Z3	.89
2A7	.89	6K6	.49	14A7	.89
2B7	.89	6K7	.46	19BG6	1.38
2E5	.92	6L5	1.09	19T8	1.49
2V3	2.90	6L6	.98	19V8	1.96
2X2A	1.15	6L7	.80	24A	.92
3A4	.48	6N7	.80	25A6	1.79
3B4	2.70	6P5	.99	25BQ6	.99
3B7	.56	6Q7	.81	25L6	.42
3Q4	.46	6R8	7.44	25Y5	.84
3Q5	.68	6S4	.48	26	.79
3S4	.46	6S7	1.30	28D7	1.29
3V4	.79	6S8	.92	34	.69
5AX4	1.22	6SA7	.54	35A5	.71
5AZ4	.54	6SC7	.74	35B5	.54
5R4GY	.96	6SF7	.74	35C5	.71
5T4	1.48	6SG7	.62	35Y4	.68
5U4G	.46	6SH7	.42	35Z3	.69
5V4	1.28	6SJ7	.69	35Z5	.46
5X4G	.78	6SK7	.52	39/44	.56
5Y3	.36	6SL7	.56	45Z3	.66
5Y4	.62	6SN7	.56	49	1.29
6A3	1.29	6SQ7	.56	50A5	.54
6A5	2.98	6SS7	.89	50C5	.52
6A6	.81	6T7	1.27	50L6	.60
6A7	1.09	6T8	.78	71A	.74
6A8GT	1.09	6U5	.99	75	.82
6AB4	.42	6U7	.64	76	.68
6AB7	.78	6V6GT	.56	77	.68
6AC5	1.19	6W4	.38	83V	1.22
6AC7	.68	6X4	.42	117Z3	.68

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Same Deal on All CBS Receiving Tubes

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3AU6	.87	5U8	1.37
3BC5	1.00	5V6GT	.95
3BN6	1.35	5X8	1.35
3CB6	1.00	6AW8	1.55
4BQ7A	1.62	6SN7GTB	1.57
4BZ7	1.72	12AX4GTA	1.20
5AM8	1.42	12BH7A	1.27
5AN8	1.42	12BY7A	1.32
5AT8	1.32	12CU6	1.77
5AV8	1.47	12L6GT	.95

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RPJ010A Dual(S) .001&.003 GE....$ 1.98
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Finest Tape
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Inbuilt network, 2 wires needed for HF & Low Response. Famous Hi-Fi Speaker mfgs.
15" Coaxial PM & 5" Tweeter 25 Watt/20-17500 cycles. Model P25CO $19.50
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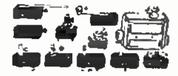

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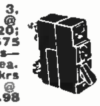

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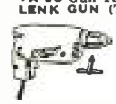
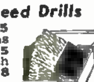
Thor Electric Speed Drills



201J ¼" Electric Speed Drill w/Jacobs Chuck. 2400 RPM/115VAC..."TAB" @ $14.95
325 ⅜" Electric Speed Drill w/geared chuck. 1000 RPM/115 VAC.......Only $23.25

Chrome Vanadium Speed Drills



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29 Pcs 1/16" to ½" by 64ths ¼" shank. Wood Case..$9.95
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5 Pcs Wood Bit Set ¼" shank.................$1.98

TABTRON

NEW HIGH CURRENT POWER SUPPLIES—ONE YEAR GTD

Variable 0-28 VDC. Completely Built. Full Wave Selenium Rectifier. Transformer, Variac, Volt & Amp Meters, Switch, Terminals & Fuse. In Hvy Duty Steel Cabinet. Std 115V/60cy In. 110 or 220V† and 3 phase to order. Specify.

Stk No.	Cont. Rating	W/Meters
T28V5A	0-28WVDC @ 5 amp.	$ 45
T28V5ACC	5 Amp (1% Ripple)..	$ 75
T28V12A	0-28 VDC at 12 Amp.	$108
T28V12ACC	12 Amp (1% Ripple).	$145
T28V24A†	0-28 VDC at 24 Amp.	$135
T28V24ACC†	24 Amp (1% Ripple).	$195
T28V50A†	0-28 VDC at 50 Amp.	$260
T28V50ACC†	50 Amp (1% Ripple).	$370

New! Basic Supplies, 115VAC In

B115P5A 115 WVDC at 5 Amp...$ 90
B115P10A 115 WVDC at 10 Amp..$190
B230P5A 230 WVDC at 5 Amp...$188
B230P10A† 230 WVDC at 10 Amp..$283
Less Meters. †115 & 230 VAC and 3 phase.

NEW "TABTRON" SELENIUM BRIDGE RECTIFIERS DATED & YR GTD

We mfg. Power Rectifiers to your specs. From 1 Amp up to and above 1000 Amps. Following List. Full Wave Bridge.

Curr. Cont.	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1AMP	$1.40	$2.35	$3.75	$8.25
2AMP	2.10	2.95	5.35	10.00
3AMP	3.00	4.15	5.85	12.75
4AMP	3.70	7.35	11.35	24.75
6AMP	4.45	8.75	12.85	32.00
10AMP	6.50	12.50	19.50	41.35
12AMP	8.00	15.75	22.10	44.25
20AMP	13.05	25.05	37.25	78.50
24AMP	16.00	31.95	44.50	85.00
30AMP	19.75	33.50	56.50	109.00
36AMP	24.75	47.50	65.00	134.00
50AMP	29.50	54.35	97.35	174.00

RECTIFIER & XFMR COMBO, Up to 28VDC at 24 Amps Cont. Duty.............$60

HEAVY DUTY BATTERY "FAST" CHARGER RECTIFIER

13-0-13V (CT) 100 Amp Fan Cooled or 34 Amp Air Cooled. Repl'mt 6V Fast Charger. Model CR16 $10; 3/$27. 16-0-16V (CT) Fan Cooled. For 12V/60A and 6V/100A Fast Charger. Model CR30.......$11; 3/$30

New Rectifier Xfmrs

Primary 115V 60 Cyc
5 Amp†....$8.65; 2/$15.75
12 Amp†...$16.65; 2/$29.95
24 Amp†...$35.75; 2/$69.95
50 Amp*.....$59.00; 2/$112
100 Amp*...$108.00; 2/$210
18 Volt 2 Amps .....$1.98; 2 for $3.50
Sec (Dual †) 18-15-9-0:0-9-15-18 Volts
†Wndgs in Series at ratings shown; Parallel 2X Amps, Voltage One-half Max.
*Dual Pri 115 & 220V 60 cy; Tapped 36 VCT

New Rectifier Chokes

CR6001/1AMP/0.1HY/1.4R/3# ...$3.95
CR6002/2AMP/0.1HY/.67R/3# ...$5.95
CR6003/5AMP/.07HY/.6R/10# ...$7.95
CR6004/12AMP/.01HY/.1R/12# .$14.95
CR6005/24A/.004HY/.025R/20# .$29.95

New Variable 0 to 6 & 12 Volt/12A DC Power Supply

Battery Eliminator, Charger, Model RR, Plater, Aircraft, Marine or any DC Req. Extra Hvy Dty Selenium Rectifier, 2 Meters V & A. Designed for cont. service & up to 20 Amps intermittent overload.
Model T612V12AC....$31.95

New Variable Voltage Xfmrs

SUPERIOR—GR—STACO—UTC

0-132V 1.23A $7.99
0-135V 3A 11.99
Cased 0-135V 7.5A.......21.95
Uncased 0-135V 7.5A....17.25
Cased 0-270V 3A 24.95
Uncased 0-270V 3A................18.95
Cased 0-135V 15A.................41.98
Cased 0-270V 9A..................41.98
Six or More 10% Disc.

SPECIAL "TAB" BARGAINS

GIANT CLOSEOUT! "GIVE-AWAY" LO PRICES

BIRTCHER TUBE CLAMPS, Asst'd............6 for $1
POWER RHEOSTAT, 250 Ohm 25 Watt............ea .69; 10 for $5
866A KIT (2) 866A Tubes, Sockets & Transformer............Special @ $4.98
FEELER GAUGE, Precision made, .003 to .055............@ .69; 2 for .98
HOOK UP WIRE, Asst'd 5 Colors, 100 ft/roll; 500 ft @ $1.98 ea; ....6 for $10
SOUND POWER HEADSET, Chest & Throat Mike U.S.N............Per Pair @ $30
PLANETARY DRIVE, 5:1 & 1 to 1............ea $2; 3 for $5
MICROSWITCH KIT, Assorted Types............@ 4/$1; 20/$4
GTD VINYL ELECTRIC TAPE, HiVolt ¾"x30 ft............ea .40; 6 for $2
TV CERAMIC CAP, 500 mfd/20 KV............@ .49; 20 for $10
TUBETESTER SOCKET SAVER, 7-8-9 Pins............@ $1.60 ea; 3/$4.50
PLASTIC UTILITY BOXES, Size 10¾"x6.4"x2¼". 1/12/18 Compartments @ $1.59 ea............Any Seven @ $10
ELECTROLYTIC COND. 50 mfd/350 VDC Gtd............5 for $1
ORSA WOOD SAW Swedish Steel, nonbreakable, double action cutting edge. Reg. $12 to $18 ea............@ $4; 6 for $18
1-222-A SIGNAL GENERATOR, Xtal Control............@ $69
CRYSTAL DIODE, 1N21............"TAB" Lo Priced @ .20 ea; 100/$5
CLAMP LAMP, Adjustable, w/bulb & Reflector............@ $1.57 ea; 7/$10
WRENCH, INCA QUICKIE, 10 Way ¼" to 9/16" Sq & Hex Head nuts & bolts. Rustproof, Brkproof............@ .69 10 for $6
VACUUM TIME DELAY RELAYS, Octal base 28 or 120V......@ $1.49; asst'd 10 @ $12
RG59U CABLE, 73 Ohm 100 ft @ $5; 500 ft............Special @ $22
300 OHM TWINEX, 65 Mil Hvy Dty 100 ft @ $1.19; 1000 ft............@ $10.25
AB "J" POTENTIOMETERS, Asst'd Kit 12 Popular values............@ 12/$4
GLOBAR RESISTOR T2FD/3500 Ohm/500W RF, w/clips............@ $2
SNOOPERSCOPE, Infra Red Tubes............@ $6.98 ea; 2 for $11
MICA CAPACITOR, .006 at 2500WVDC............@ .39; 4 for $1
MICROPOT, 10 Turn/0.1%/20000 Ohm Pot............@ $5; 2 for $8

RHEOSTAT BUY

15 Ohm 25W....98c; 12/$7
50 Ohm 25W..$1.10; 10/$7
75 Ohm 25W.$1.98; 10/$14
125 Ohm 25W.$1.10; 10/$7
250 Ohm 25W.$1.10; 10/$6
500 Ohm 25W.$1.10; 10/$7
1200 Ohm 225W $2.98; 2/$5
5000 Ohm 25W $1.25; 10/$9
Write for Quantity Prices

"GRAIN OF WHEAT" LAMPS

#323—3V Clear .....5/$1
#323—3V Red ....5/$1
#321R—28V & Shutter Red "TAB" Special @ 4 for $1
#321G— 28V & Shutter Green "TAB" Buy @...........4 for $1
Discount 100 Qtys 15%; Qtys 1000 @ 30%.

OIL CONDENSER BUY

4 MFD 1200 VDC or 10 MFD 600 VDC **$1.25** ea. LOTS OF 24
Or Any Assortment of 24
12 Lots @ $1.50 ea; Singly @ $1.79

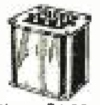
TRANSFORMER SPECIAL

6.3 Volt, 3¾ Amp. Continuous Duty

95c ea LOTS OF 25

115VAC IN. SIZE 2 5/16H/2L/1⅛W. Hvy Dty Channel Mtg, 8" Wire Leads. Lots of 12 @ $1.00 ea; Singly @ $1.25 ea

TRANSFORMERS



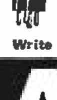
All 115V 60 Cyc. Input TV, & CR pwr. xfmr. up to 20" tubes. Hi Volts up to 20 Kv. (w/quadrupler ckt.) All tubes. PL & FIL wndgs. 5000 VDC/5MA. 300 VDC/275 MA Full-Wave; 6.4V/10.3A, 5.4V/8A. 2.5V/3A Hypersil Core. Oil Fill....$4.98
2500V/20MA, 6.3V/.6A, 2.5V/1.75A for BC412 Scope Replmt. $7.98
900V/35MA, 2x2.5V/2A Exclent 1800V Dbler. TWO 2x2 FIL WNDGS.....$1.98
778VCT/200MA, 5V/3A, 6.3VCT/5A THORDARSON $4.98; 2 for $9; 6 for $24
770V/2.5MA, 2.5V/3A, HMSLD FILTER PARTS 4/scope.......$3.69; 2 for $6.00
700VCT/70MA,5VCT/3A,6.3VCT/2.5A$3.95
600VCT/50MA, 6V/3A, 6V/1.5A, 5V/1A HALF SHELL.$2.49; 2 for $4.50; 10 for $20
550VCT/250MA, 5V/2A, 6.3VCT/2.5A, 12.6 V/3.5A, RCA CSD..........$4.50; 2/$8
500VCT/60MA, 6.3V/4A HMSLD....$2.98
420VCT/90MA, 6.3V/1.9A, W/INPUTS 6, 12, 24, 115VDC & 115 & 230VAC @ $1.49

NEW 212W/SEC PHOTOFLASH

AC & Dry Battery Kit

Includes four 525MFD/450V Condensers. Total 212w/sec'ds. Resistors, capacitors, rectifier, flash tube in indicating flash gun, guide ÷80 Daylight Kodachrome, 240 on Ektachrome. Less Batteries.
"TAB" Special.......AC Only @ $44.98
(5) 90V (N60) Batteries & Box @ $14.98
525MFD/450V/53W—Secs Cond. NEW lo leakage famous mfgr.........$8; 2/$15
16MFD/2500VDC/60W—Secds...$6; 2/$10

FOTO FLASH & STROBE LAMPS



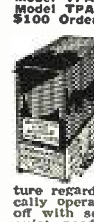
"TAB" No.	Replaces	W-Sec. Max.	Each
TLW	FA104/FT118	150	$5.98
THI	AMGL05804X	100	10.98
23ST	GE FT210	200	9.98
THVA	SYLV. 4330	200	9.98
V4X4	X400	200	10.98
TLX	DX&FA10Q	150	9.00
TDX	DXC/250-350	150	10.00
353GTQ	FT503	2000	49.98

Trigger coil for LO V.Flash.. 1.47
Write for "TAB" Flash Tube Data....50¢

230 to 115V Autoformers

For 220-240V/50-60 cy. in. To 110-120V or Step-up. W/ Cord, Plug & Receptacle†.
TPA050/50W* $2.55
TPA075/75W* $3.65
TPA100/100W† $4.00
TPA200/200W† $5.75
TPA250/250W† $6.75
TPA300/300W† $7.25
TPA500/500W† $8.25
TPA750/750W† $11.75
Model TPA1000/1000W/1 KW† ..$16.95
Model TPA2000/2000W/2 KW† ..$34.00
$100 Order Take 10% Disc. *Less C,P&R

NEW! Quality VOLTAGE REGULATOR



$ $ Popularly Priced $ $

Only $16.98

LINE VOLTAGE STABILIZER Automatically Regulates Line voltage for TV, RADIO or Industrial use. Insures full size, strength, & sync of TV picture regardless of line voltage. Automatically operated . . . regulator turns on & off with set or equipment. Trouble free, quiet, needs no adjustment. Universal use from 100 to 300 Watts. Input 100-125V/Output 115V ± 3% 50-60 cy.
SOLD WITH "TAB" MONEY BACK GTD. Order Six and take 10% Discount

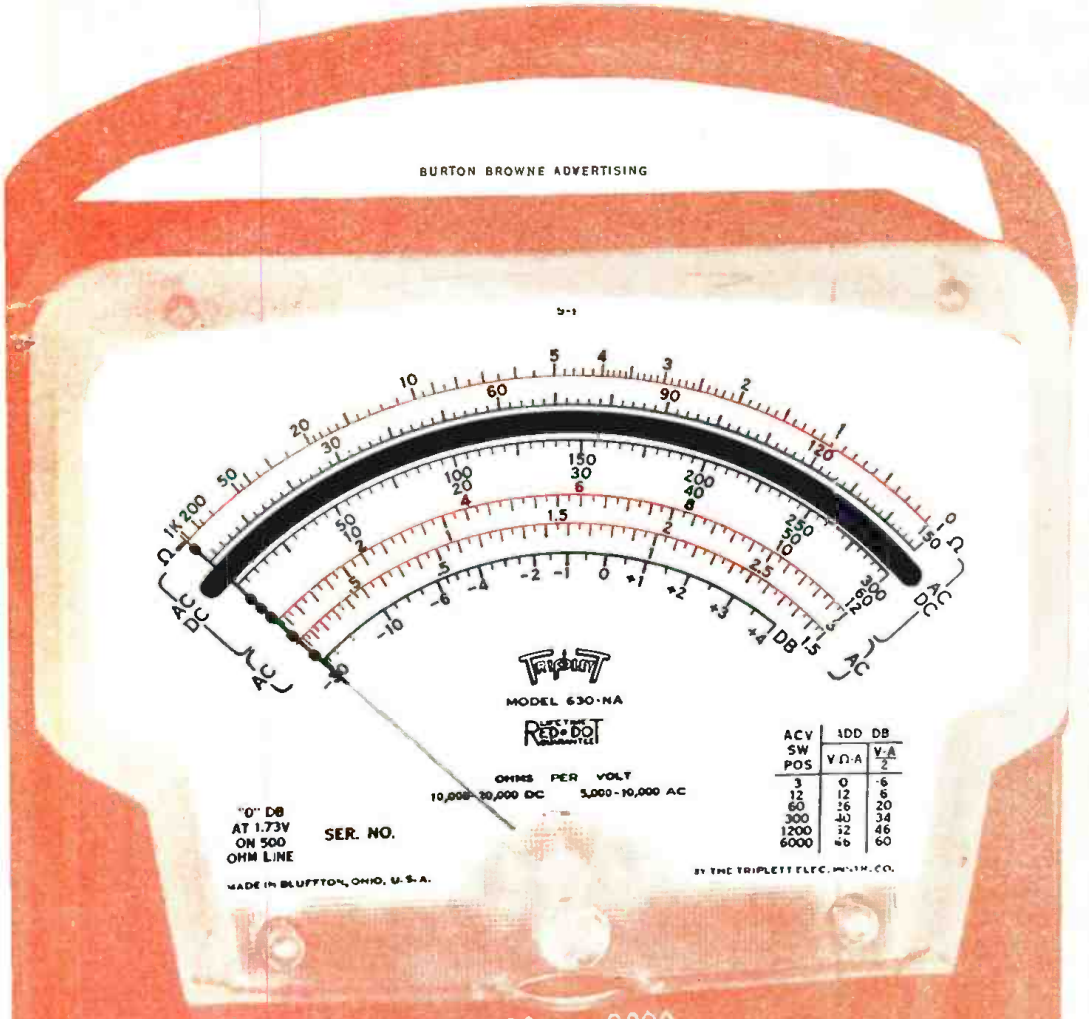
SPECIAL OFFER!!
TV TUBE TESTER & SHORTS
Specially Priced @ $4; 2 for $7

THAT'S A BUY "TAB" THAT'S A BUY

DEPT. 9RN5 111 LIBERTY STREET NEW YORK 6, N. Y., U. S. A.

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges or for C.O.D. 25% Dep. Tubes Gtd. via R-Exp. only. Prices subject to Change Without Notice.
Phone Rector 2-6245

FIRST V-O-M with ALL in ONE!



70 RANGES . . . nearly double those of conventional testers
FREQUENCY COMPENSATED . . .
for accurate readings over entire audio range
HIGH AC-DC ACCURACY ON SAME SCALE
ACCURACY: 1 1/2% DC to 1200 Volts, 3% AC to 1200 Volts
METER PROTECTION AGAINST OVERLOADS
TEMPERATURE COMPENSATED . . .
Accurate within a wide range of ambient temperatures
SIX RESISTANCE RANGES Including 100 Megohms
COMPLETELY INSULATED Black Molded Case
MIRROR SCALE And Knife-Edge Pointer

actual size

ALL TRIPLETT TESTERS APPROVED FOR COLOR see them at your distributors

TRIPLETT HAS THE MOST COMPLETE V-O-M LINE

MODEL 630-NA
Volt-Ohm-Mil-Ammeter
DEALER Net Price . . . $69.50

MODEL 630 Famous
Volt-Ohm-Mil-Ammeter $39.50
33 ranges and many other features making this the favorite in a popular V-O-M line

MODEL 630-A Laboratory Type
Volt-Ohm-Mil-Ammeter with mirror scales, 1-1/2% DC accuracy and special 1/2% resistors for greater accuracy. Found in the best laboratories and production lines. $49.50

MODEL 631 Combination
V-O-M and VTVM $59.50
This sensational 2-in-1 battery operated combination saves you money — will do all your work easier at half the price.

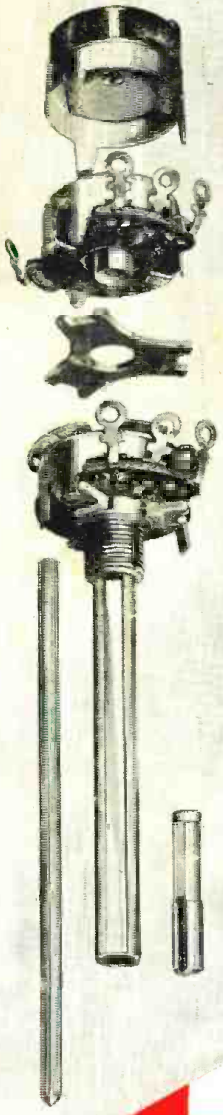
MODEL 666-R Pocket size
V-O-M. Practically a portable laboratory with self contained snap-in type batteries. $26.50

The above are examples of the complete Triplett V-O-M line in which 10,000 ohms per volt AC sensitivity has been featured for 10 years.

TRIPLETT ELECTRICAL INSTRUMENT CO.
Bluffton, Ohio

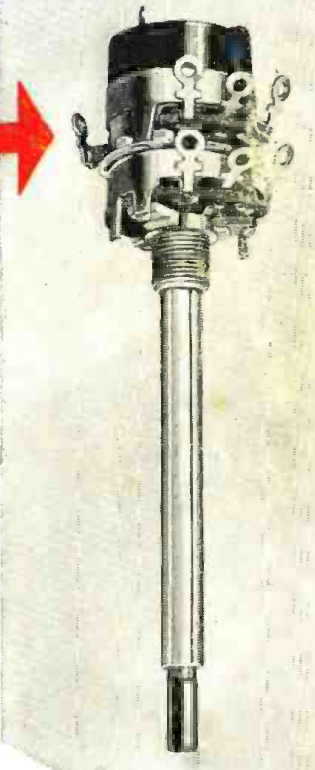
Always right ...either way

Whichever way you prefer Dual Controls, Mallory can supply you with Exact Duplicates.



GET THEM READY-TO-USE . . .

completely assembled in all the combinations of resistance values, tapers, taps, switches and shaft lengths to fit most of the popular TV sets.



GET THEM AS SUB-ASSEMBLIES . . .

and combine factory-made sections, switches and shaft tips to match the job at hand. You don't need much stock . . . a small inventory equips you to make 10,000 different combinations. And you don't need much time . . . assembly takes less than five minutes.

SUIT YOURSELF, AND SUIT YOUR CUSTOMERS

Either way, Mallory dual controls give you an exact match of the electrical and physical characteristics you need . . . plus qualities of precision, quiet operation and long life that equal or exceed the original equipment control.

Your Mallory distributor carries Mallory Exact Duplicate Dual Controls in the style you like. Order from him today.

P R MALLORY & CO. Inc.
MALLORY
CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES
APPROVED PRECISION PRODUCTS
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA