TV SERVICING VIA TEST POINTS

RADIO & TELEVISION NEWS

FEBRUARY
1955
35 CENTS
In U. S. and Canada

World's Leading Electronics Magazine

IN THIS ISSUE

RAYTHEON

Makes Long Lasting Aluminized Picture Tubes With RAYTHEON LUMILAC Exclusive Aluminizing Lacquer

Now you can get all the benefits of aluminized picture tubes — sharper picture, superior contrast, high light output — and *excellent picture tube life!*

Raytheon aluminized picture tubes are processed with the purest aluminum *plus* LUMILAC — a lacquer especially blended and used exclusively by Raytheon.

This lacquer produces an extra smooth unbroken surface for the aluminized coating, yet leaves no gas-producing residues which could impair cathode emission and hence shorten tube life.

Next time you replace a picture tube try a Raytheon LUMILAC Aluminized Picture Tube. You'll be delighted with its performance in any set — amazed at how it will improve the picture of a low cost, low voltage range TV receiver. And so will your customer. Ask your Raytheon Tube Distributor for Raytheon Aluminized Picture Tubes with LUMILAC. Like all Raytheon Picture Tubes they are Right for Sight, Right for You and Always New.

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Receiving and Cathode Ray Tube Operations

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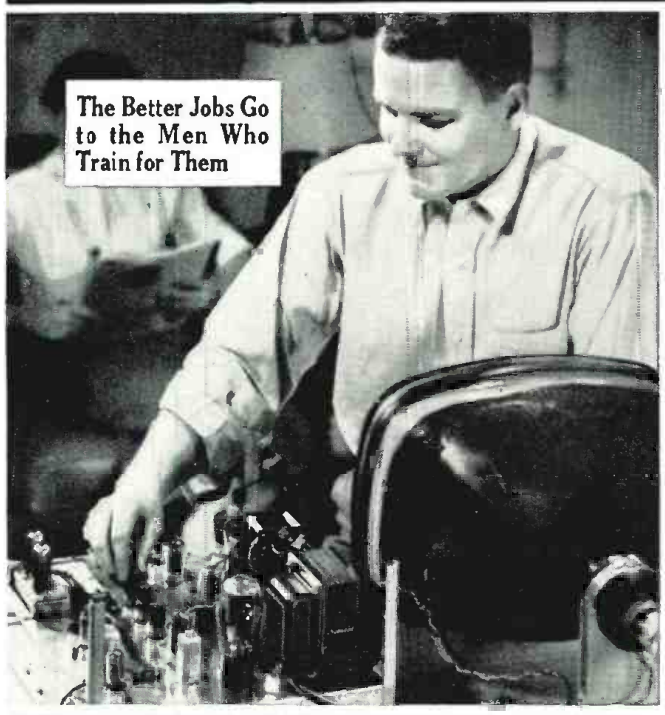
RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES

Why Guess? There's a Quick, Sure Way to Find TV Set Troubles



PUT YOURSELF IN THIS PICTURE, experimenting at home with equipment we furnish, getting set to go places in TV servicing. Speed in servicing TV sets means stepped up earnings, greater security for you.

NEW ALL-PRACTICE COURSE Shows How top TV servicemen fix ANY MAKE or model

Home Training includes 17" Picture Tube, components for a TV Receiver, Scope, Signal Generator, HF Probe, all for introductory price under $200 on easy terms.

ACQUIRE SUPERIOR SKILLS AT HOME IN SPARE TIME

TV Servicing . . . real, professional TV Servicing, pays good money to men with specialized knowledge and training. The exciting, expanding TV industry offers more than just good jobs. It offers success, a career to men qualified to render an essential community service.

Be one of these experienced TV Servicemen. NRI's new course is 100% learn-by-doing, practical training. We supply all the equipment plus comprehensive manuals covering a thoroughly planned program of practice. You learn how experts diagnose TV receiver defects quickly. You learn the causes of defects . . . audio and video . . . accurately, easily. And you learn how to fix them.

ALL LEARN BY DOING

You do more than just build circuits. You get experience aligning TV receivers, isolating complaints from scope patterns, eliminating interference, use germanium crystals to rectify the TV picture signal, adjust the ion trap and dozens of other professional TV Servicing techniques.

Many fellows "go around in circles" trying to isolate TV receiver defects. Don't guess! Learn professional techniques. Take this training now. If you want to go places in TV servicing you will act quickly to find out what you get, what you practice and how you can advance with better practical knowledge through NRI's new course in Professional Television Servicing. Accept this personal invitation to get a free copy of our booklet which describes this training in detail. Mail the coupon now. Remember, with this course you keep right on working, keep right on earning at your job while you learn through actual practice at home in your spare time.

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COVER PHOTO: "Television City," CBS's fantastic new programming center in Hollywood, offers every facility for televising both black-and-white and color programs. A special crane permits interesting TV effects. (Ektachrome by Peter J. Samerjan)

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RADIO & TELEVISION NEWS

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DEPARTMENTS

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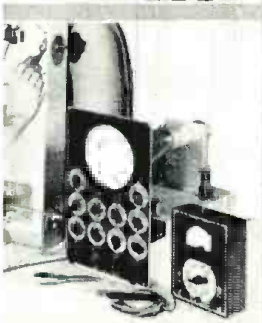

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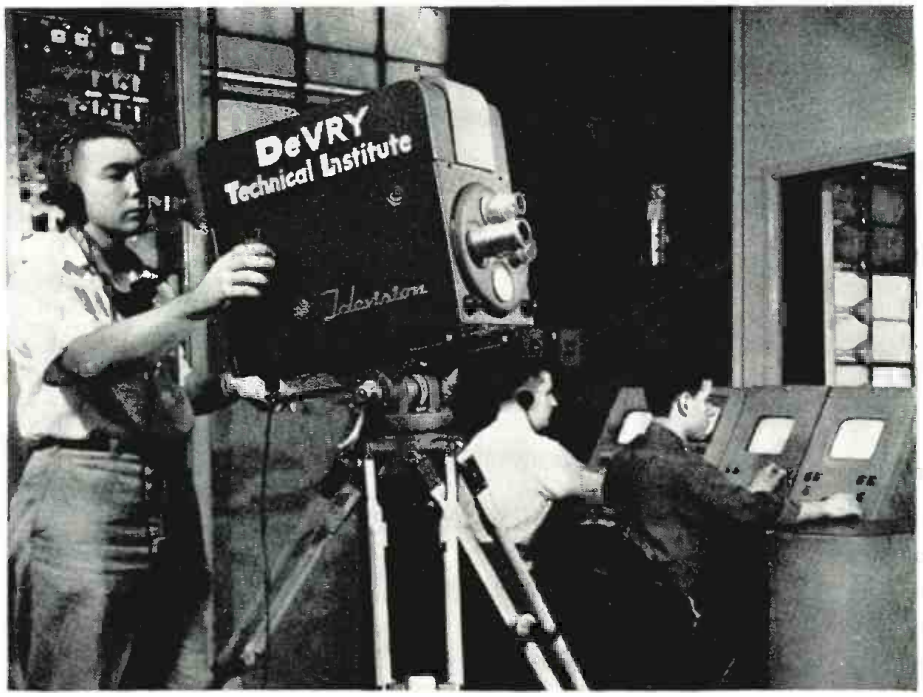

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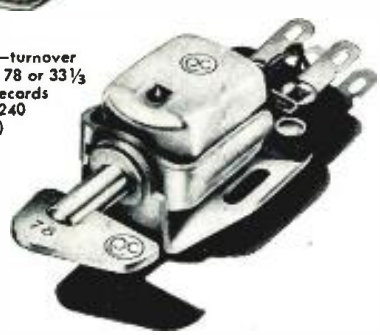

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*Trade Mark

For the RECORD

BY THE EDITOR

TAPE REMEMBERS ALMOST EVERYTHING

MAGNETIC tape is generally associated with record players as a medium for the recording and reproduction of sound. The ever-increasing popularity of recorded tapes for hi-fi results from its ability to accurately store information (wide-range music) so that such information may be played back and enjoyed through conventional hi-fi audio channels.

Not nearly as well known are the many applications and techniques for magnetic tape in the fields of instrumentation, control, medicine, and in military applications. Because tape can "remember" sounds better than other media, it provides a positive method of recording any phenomenon which may be "played back" as an electrical signal.

Magnetic tape can record temperatures, vibrations, forces, pressures, motions, numbers and video signals in almost any relation or in combination. And multiple phenomena taking place at the same time can be permanently recorded for future study or application. Information is recorded on a tape as a pattern of fluctuating magnetic current. The electrical characteristics comprising amplitude, frequency, phase, duration, wave shape, and relative timing are all "remembered" by the tape. And tape can speak a universal language by conveying its information of voltage patterns for recording, control, and instrumentation.

One of the most informative analysis of magnetic tape (*Ampex* bulletin D2-1) refers to tape patterns as the best "common denominator" in the fields of recording, instrumentation, and control. Mechanical vibrations, for example, can become voltage oscillations. Rises in temperature or changes in pressure can be translated to a scale of voltage amplitudes.

Information recorded on tape can be fed to any machine or instrument that can react to electrical signals. This may be done any number of times, at any place, and in any number of ways. Taped information may be fed to instruments that scan (the oscilloscope), to instruments that write (oscillographs and pen recorders), to machines that analyze (computers and data reducers), to machines that translate (card punch machines), and to machines that act (process controls and machine tools).

Applications for magnetic tape that are unfamiliar to the average technician include "flight testing" of both piloted aircraft and missiles, either in the air or on the ground. Tape is used in "telemetering" the data being transmitted from an airplane to a receiver-tape recorder on the ground. The data is thus "remembered" irrespective of the outcome of the flight.

Tape overcomes some of the problems of handling and analyzing the enormous quantities of data accumulated on test grounds. Tape is relatively compact and unlike film it requires no processing. Because data is in electrical form, it lends itself to rapid electronic scanning methods that locate maximum and minimum values, inflection points, and frequency components. Its electrical nature also for the first time makes possible automatic data reduction methods and high speed feed to electronic computers.

Recording shock and vibration aboard moving vehicles is done on specially designed recorders like one produced by *Ampex* for this special application. And tape is ideally suited to the control of machines. Relative movements of cutting tools and work can be controlled with precision by electrical signals from magnetic tape. Servo controls translate the signals to movements that can be repeated with accuracy, again and again.

Tape is now widely used in geophysical exploration. Review of key geophysical data may be done after crews return from the field. The FM carrier-type magnetic recording used in this work has less phase shift and distortion, wider frequency response, and greater signal-to-noise ratio than older oscillograph methods.

Electronic brains (computing devices) are using tape containing numbers, equations, and programming information. Because taped magnetic signals are largely free from inertia, they overcome the speed limitations of other media.

Magnetic tapes are also useful as internal elements to provide high capacity memory for any time duration from milliseconds on up.

Magnetic tape has been a most valuable tool in medical teaching and research. Heart disorders, for example, are studied by listening to recorded heart sounds. And basic studies of nerve and brain functions are made from taped information providing voltage change occurring with each nerve impulse. A large class of student doctors may, from a single tape, hear and observe the sounds of many individual patients.

These are only a few of many applications for magnetic tape, and its future possibilities are almost unlimited. . . . . O.R.

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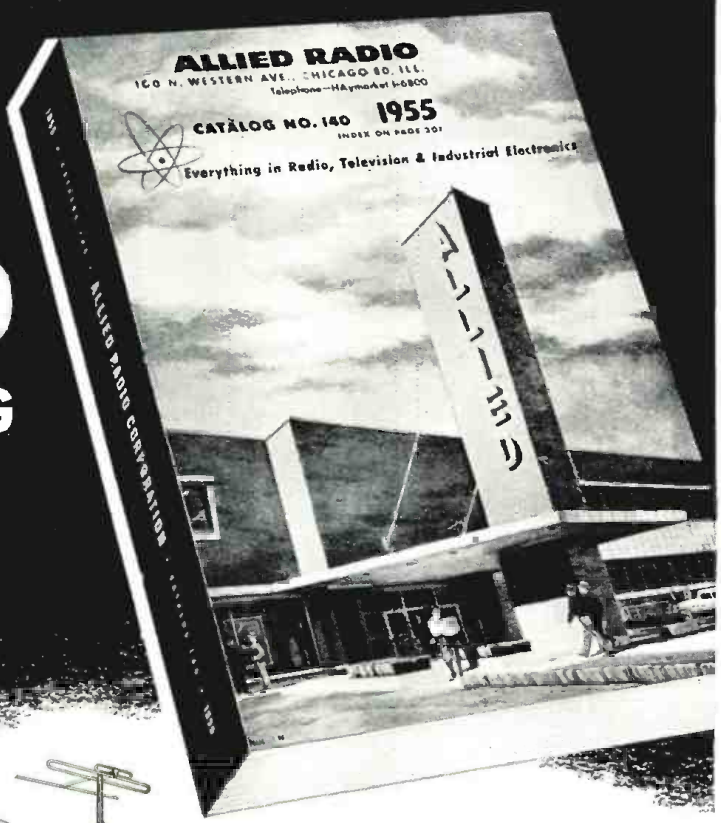

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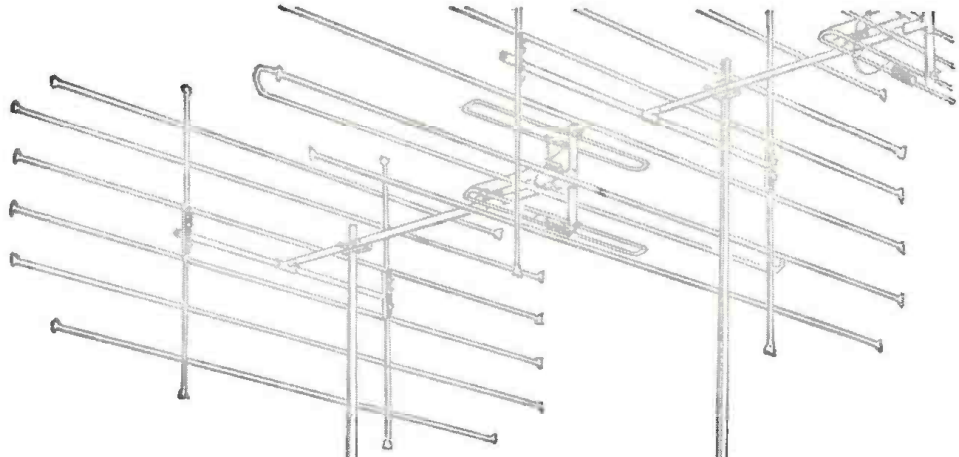

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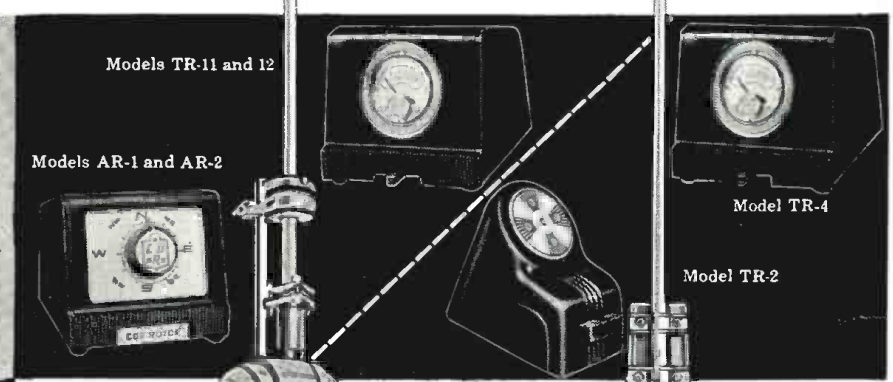

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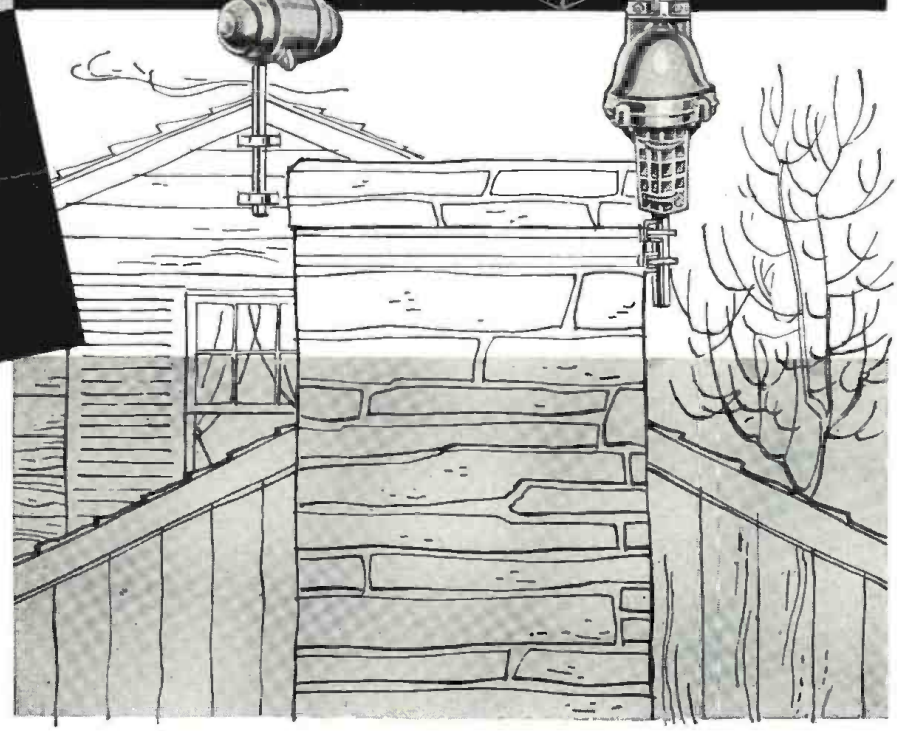

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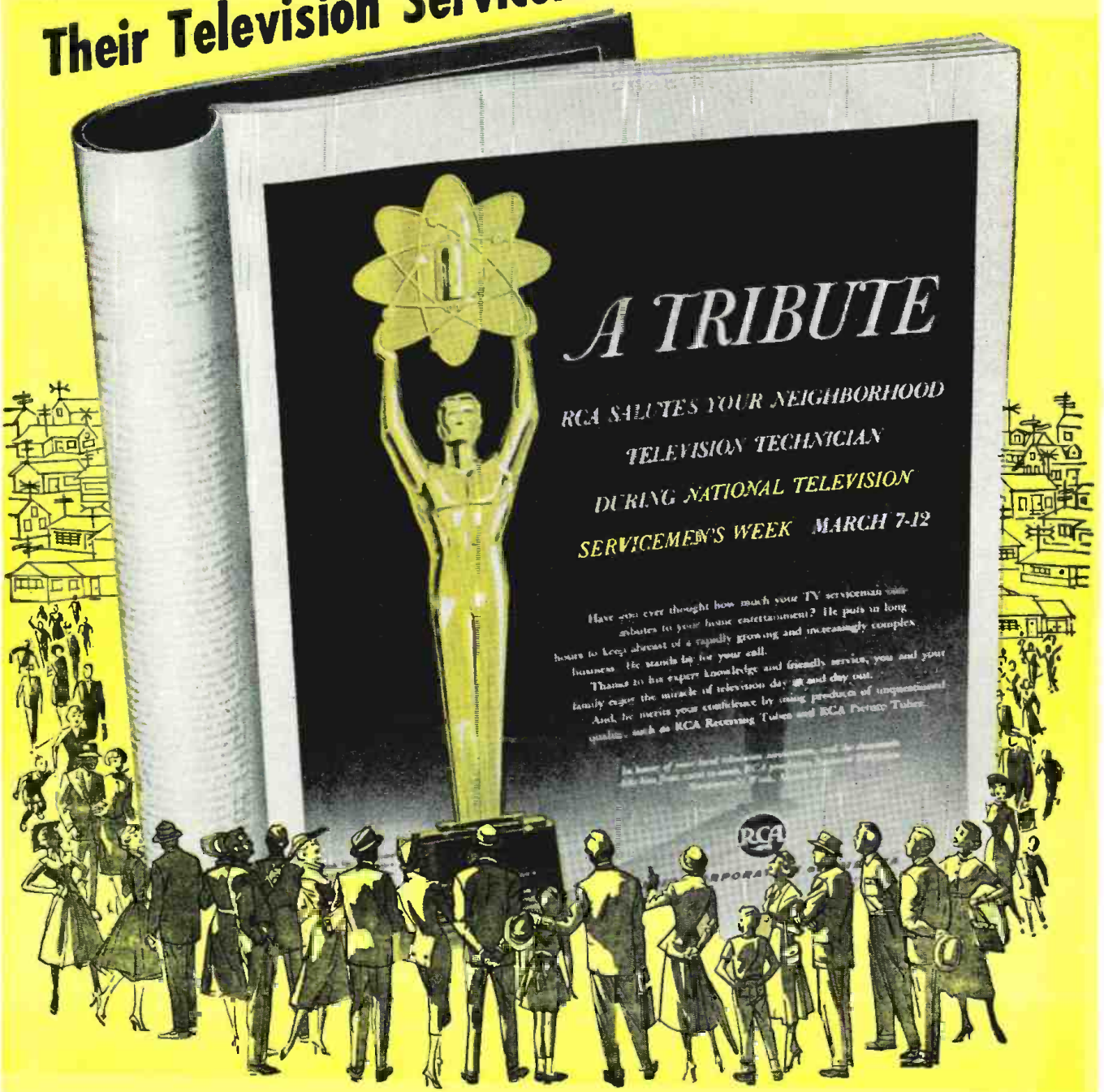

In the March 7th issue of LIFE magazine, readers all over America will see a special advertisement, sponsored by the RCA Tube Division, paying tribute to local television servicemen and dealers everywhere. This will mark the opening of the consumer phase of National Television Servicemen's Week—a perfect opportunity for you to tell your story to your community.

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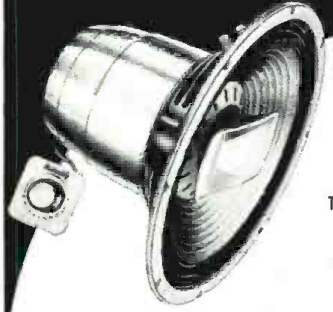
3 TRIAXIALS

BY University



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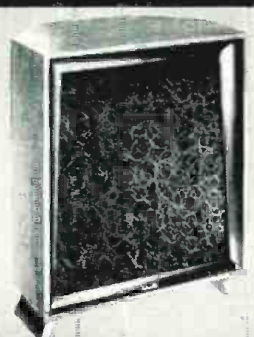

EN-15

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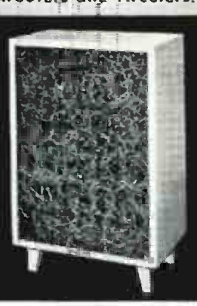

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Diffusicone—8" and 12" Coaxial Speakers

Exclusive patented "Diffusicone" design with 1000-cycle mechanical crossover results in full fidelity anywhere in the room . . . full undistorted response without loss of highs at listening points progressively off speaker axis. Eight ohms impedance, 25 watts power capacity.

Model 6201 Dual Range System

Acknowledged as the industry's finest value in a high quality 12" loudspeaker. Complete with coaxial tweeter driver and wide angle horn, it is one of the few true dual range systems in its price class. Built-in L/C network and balance control. Eight ohms impedance, 25 watts power capacity.

For complete information on the entire University high fidelity line, write Desk 55

University Loudspeakers INC.

80 SOUTH KENSICO AVENUE, WHITE PLAINS, NEW YORK

NEW PATENTED RADAR ANTENNA

OPENS NEW HORIZONS TO TV VIEWERS

ALL DIRECTIONS • ALL CHANNELS • 2—83

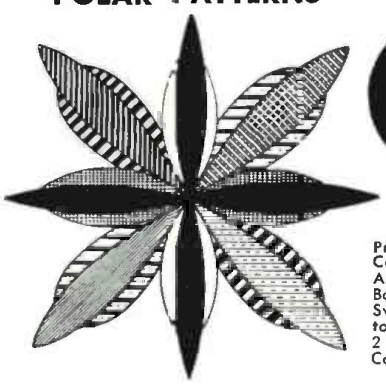
COLOR AND BLACK-WHITE *without* ANY ROTORMOTOR

These are the reasons why the "Riviera" is by far the most powerful VHF antenna on the market today!

1. Utilizes 16 elements 60" long, ½" diameter.
2. Utilizes a specially designed, extra low loss four conductor air-dielectric POLYMICALENE transmission line which has up to 50% less loss when wet than the finest conventional transmission lines.
3. The "Riviera" encompasses an electro-magnetic capture volume of well over 650 cubic feet, many times more than conventional antennas.
4. The antenna works on the revolutionary principle that the approaching wave front is elliptically rather than horizontally polarized.
5. The new specially designed 9 position electronic orientation switch, aside from changing directivity, maintains a consistently better impedance match over the entire UHF-VHF spectrum.
6. The above features combine to give the "Riviera" antenna greater usable gain at the TV set antenna terminals than the best of any competitive antennas using rotor motors.

This new wonder antenna, called the "Riviera", is already making history. Beyond any question of a doubt, and on an unconditional money back guarantee, it will positively outperform in the field under actual installation conditions, any and all competitive antennas on the VHF channels, with or without rotor motors.

POLAR PATTERNS



only **$49.50** LIST PRICE

Price includes: Complete Stacked Array • Stacking Bars • 9 Position Switch • Switch-to-set Coupler • 2 Stand-offs, 7½" • Complete instructions

The polar directivity response patterns show the major lobes of the "Riviera" antenna on VHF. It shows the fullness of coverage in all directions of this remarkable, patented antenna as it is 'tuned' through each of the nine switch positions. Each degree of shading constitutes a different switch position. This excellent directivity response, which can be switched at will, plus the extremely high gains, clearly indicate why the Riviera is such a superior performer.

ALL CHANNEL ANTENNA CORP.
47-39 49th STREET, WOODSIDE 77, N. Y. EXETER 2-1336

IN UHF-VHF DISTRICTS . . . USE
The NEW Super 60
100 MILES VHF • 60 MILES UHF

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

A HISTORIC CEREMONY marked the dedication of the western labs of the Bureau of Standards several months ago. Out in Boulder, Colorado, the new striking, extensive facilities of the Central Radio Propagation Laboratories received the full champagne treatment (electronically) from none other than the President.

Before a distinguished audience of scientists, educators, Congressmen, and Senators, President Eisenhower depressed a button which activated a tube-controlled relay chain, that released a veil over the building's cornerstone. Basing his dedicatory comments on a tour of the huge labs, the President said that it seemed to him that we now have a new type of frontier where the labs have been built.

"This spot," he declared, "only a few short decades ago was inhabited by Indians, and by buffalo, and, later, by trappers and miners. It became the center of a great mining and agricultural region, which has meant so much to the United States in the past, and indeed does now.

"But the frontier days when we could go out and discover new land, new wonders of geography and of nature have seemed largely in the past," the President added. "Here today," he said, "inside this building, we have a frontier of possibly even greater romantic value, as well as greater material value to us, than were some of the discoveries of those days."

Pointing out that we are all laboratories, the President reminded his listeners that it is up to each of us to . . . "discover what we can contribute toward the growth of that kind of spirit among men that will make all of the discoveries of . . . dedicated scientists become assets to us, as we try to develop for ourselves and our children a better life, a richer life, one that gives us more opportunity to grow intellectually and spiritually.

"It is then, in those terms," the President stressed, "that we should look on the growth of science, as we think of the men laboring in this building, of the scientists in our universities, in the National Bureau of Standards in Washington, and in the great laboratories and factories of our nation.

"And I think," he emphasized, "that if each one of us does his part, then we will steadily go down the ages as a people more prosperous, more happy, more secure, and more confident in peace."

A NUMBER OF SPECIAL features have been included in the new radio lab building, a reinforced concrete, wing-type structure featuring a four-story central spine, with one-story wings extending on either side at the second and third-floor levels.

Rooms in the labs have exact temperature and humidity controls to permit precision experiments. There are also radio-shielded rooms to minimize electrical interference, stable platforms for mounting delicate instruments, an open-roof laboratory for unconfined radio experiments, and access doors for bringing mobile radio test vehicles directly into the building for adjustment and control.

Actually, there are four scientific divisions at the Boulder Labs. The propagation lab, which previously had been a single division in Washington, now consists of three divisions, each representing a different phase of research; radio propagation physics, radio propagation engineering, and radio standards. In addition, there is a Cryogenic Engineering Lab, established in cooperation with the Atomic Energy Commission. This lab provides facilities for the development and evaluation of engineering materials and equipment for use at very low temperatures, temperatures which may be as low as —450° F, or several hundred degrees below the coldest ever observed in the most severe climates. Such temperatures, which are attained with liquefied gases (oxygen, hydrogen, nitrogen, and helium) are being used more and more in national defense and industry, and for laboratory research.

A TINY TRANSISTORIZED TRANSMITTER, known as the 20-mm "spin sonde," designed by the Naval Ordnance Laboratory for the study of projectiles using fins as a means of providing rotation, or spin, in flight, has gone to work for the Ballistics Ranges. The sender is so small it can fit into the nose of a 20-millimeter projectile and it's so rugged, that it will withstand acceleration shocks of over 30,000 *g*'s.

According to the Navy, the new device will assist in the problem of determining the spin rate, as it changes during the flight of these projectiles

PRODUCTION RATE TV PICTURE TUBES AS OF DEC. 1st = PLACES CBS-HYTRON IN "BIG THREE"

Another demonstration of confidence in CBS-Hytron advanced-engineering

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

from zero to a maximum. Such information, it was said, is essential to round out the data needed for calculating the aeroballistic constants of Navy weapons under development. Used with information on flight behavior, the constants serve as a guide to changes in design that may be required for improved flight performance.

Use of telemetering devices, such as the new transmitter, previously has been limited to projectiles larger than 20 millimeters. The new version actually fits inside a tapered plastic nose approximately one inch long. A tiny mercury battery, even smaller than a cuff link, is used for power; it has been tested for 200 hours of use.

In operation, the "spin sonde" transmits signals of uniform amplitude. However, the amplitude appears to vary because of changes in the orientation of a transmitter coil in relation to the antenna. The transmitter coil spins with the projectile. A receiving antenna, installed along the path of the projectile, picks up the signals and feeds them into an oscilloscope. The scope's traces are photographed at stations along the range.

SINCE THE EARLY '30's a number of systems for the activation of airport lights from aircraft have been devised and evaluated. Two general types were found to be most popular; one involving audio and the other radio. In the former, a microphone served to pick up sound of the aircraft engine and propeller. The microphone was connected to a suitable amplifier which actuated a relay for controlling the lights. The radio system featured transmissions (usually on 3105 kilocycles) picked up on a receiver on the ground. The output of the receiver operated a relay which, in turn, controlled airport lights, either directly or through additional relays.

In general, the records reveal, these systems functioned satisfactorily under favorable operating conditions, but under adverse conditions, they had some serious limitations. In the audio setup, sensitivity had to be set low enough to prevent triggering of the system by ground noises and by large aircraft passing over at en-route altitudes. This problem was found to make it necessary for small aircraft to pass directly over the microphone at low altitude with full power to activate the system. And even with this reduced sensitivity, the sound of thunder and of rain falling on or near the microphone had been found to actuate the audio chain and turn on the lights.

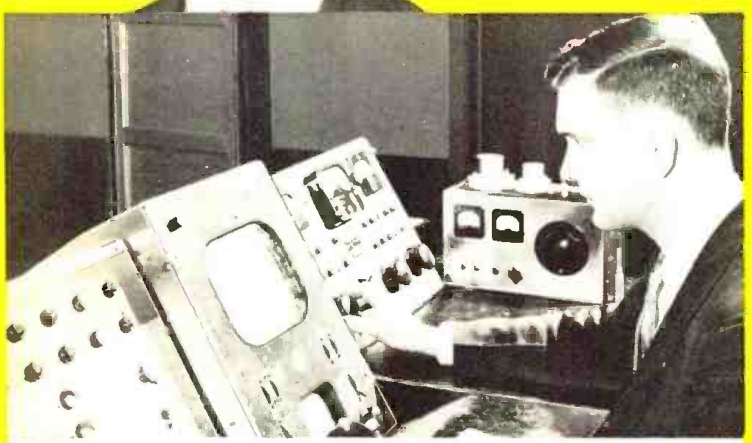
In the radio systems, the propagation characteristics of the frequency employed were found to be so variable that inadvertent operation of lights by aircraft hundreds of miles away occurred. In addition, the level of the noise created by abnormal atmospheric conditions was found, at times, sufficiently high to cause continuous operation of the lights.

Recently, a system activated by sig-

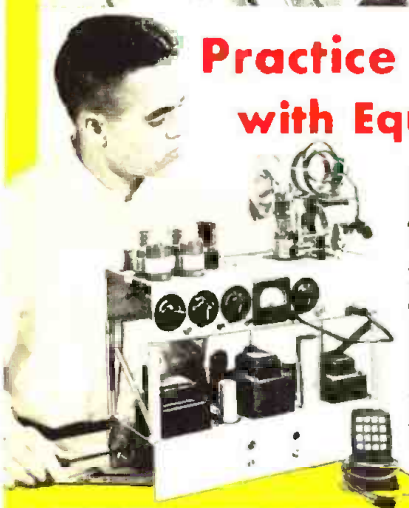
(*Continued on page* 155)

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

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



Practice Broadcasting with Equipment I Send



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 putting a station "on the air," 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.

Practice Servicing with Equipment I Send

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 which you use to help fix sets while training. Many students make $10, $15 a week extra 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.

Television is Growing Fast Making New Jobs, Prosperity

More than 25 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. About 200 television stations on the air with hundreds more being built. 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. OUR 40TH YEAR.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs, Good Pay, Success in Radio-TV! *SEE OTHER SIDE*

CUT OUT AND MAIL THIS CARD NOW

Sample Lesson & 64-Page Book
Both FREE

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.

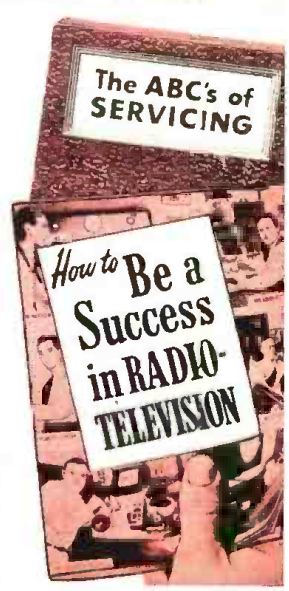
Mail me Lesson and Book. "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

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

ADDRESS .....

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

VETS write in date of discharge .....



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 you and your family 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. Then add Television. Television Broadcast Stations extend from coast to coast now with over 25 million Television sets already in use. There are channels for 1,800 more Television Stations. 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 Practicing

Get the benefit of my 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.

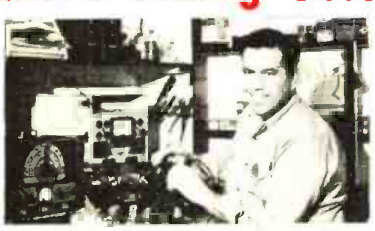
Naturally, my training includes Television. I have, over the years, added more and more Television information to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About the Tested Way to Better Pay

Read at the right how just a few of my students made out who acted to get the better things of life. 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 making your future successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. OUR 40TH YEAR.

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. I start sending you special booklets that show you how to fix sets, the day you enroll. The multitester you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

I TRAINED THESE MEN

Consultant on Antenna Systems
"I resigned as Chief Engineer. Now I am on my own as consultant on private and commercial antenna systems." R.J. Bailey, Weston, W. Va.

$10 a Week In Spare Time
"Before finishing, I earned as much as $10 a week in Radio servicing, in my spare time. I recommend NRI" S. J. Petruff, Miami, Fla.

Control Operator, Station WEAN
"I received my license and worked on ships. Now with WEAN as control operator. NRI course is complete." R. Arnold, Rumford, R. I.

Has Own Radio-Television Shop
"Doing Radio and Television servicing full time. Have my own shop. I owe my success to NRI." Curtis Stath, Fort Madison, Iowa.

Radio-Television Service Chief
"Am chief Radio and Television serviceman for large repair shop. Pay very good; working conditions pleasant." F. G. Brogan, Louisville, Ky.

Got First Job Thru NRI
"My first job was with KDLR. Now Chief Engr. of Radio Equipment for Police and Fire Dept." T. Norton, Hamilton, Ohio.

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

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SAMPLE LESSON and 64-PAGE BOOK Both FREE

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Permit No. 20-R
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BUSINESS REPLY CARD
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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."

Jerrold

TV *Multi-Outlet* SYSTEM

...for fast, low-cost installation in motels, apartments, clubs

DISTRIBUTION AMPLIFIER

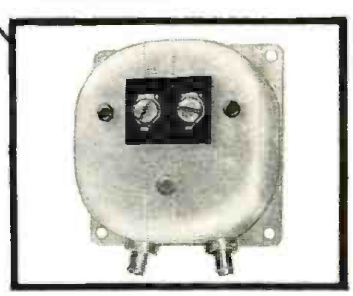
Type ABD-1—Amplifies antenna signal 25db, channels 2-13. Sensitive 5-tube cascode circuit. Exceptionally low noise—only 6db (approaching theoretical minimum). Mounts indoors. 115 volt operated. 72 or 300 ohm antenna input. 72 ohm output to "Splitter." Flat response for color.

LOW-NOISE COAX

Use any length to interconnect receivers. Amplifier and Line Tap compensate for line losses.

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
26TH. & DICKINSON STS.
PHILADELPHIA 46, PA.

the fabulous VHF-UHF antenna that actually *sells itself with performance!*

CHAMPION **RAINBOW***

What do America's servicemen think of Channel Master's RAINBOW antenna? Here are their very words†:

"The RAINBOW brings metropolitan reception to isolated areas."

"Gets more stations in this fringe area than any other antenna made."

"Just what our customers have been waiting for -- a powerful, sturdy, economical antenna."

†*Just a few of the many letters of praise we receive daily.*

LOOK at the RAINBOW'S unique design, so deceptively simple, yet so unbelievably efficient. ***LOOK*** at its advanced features: New *Spacing Formula*, new *Triple-Section* High Band elements, new full-efficiency *Intermix Design*, and the brilliant triple-power TRI-POLE! ***LOOK*** at its remarkable Yagi performance on every channel, its sharp single lobe. ***LOOK*** at its rugged, durable 100% aluminum construction, reinforced at all stress points. ***LOOK*** at its trigger-fast "Snap-Lock" Action, Channel Master's fabulous preassembly that snaps open, *locks* open, without hardware or tightening.

With every installation, Channel Master's RAINBOW again proves itself *the most powerful TV antenna yet developed by modern science*. Bay for bay, it out-performs every all-channel antenna on the market today!

Get In On This High-Powered Advertising Deal

Your Channel Master distributor offers you a hard-hitting promotion program which includes TV spot films, newspaper mat ads, radio ads, full-color display material, and consumer literature. *Advertise* and *install* America's best known, most wanted antenna.

Here's how the RAINBOW out-performs the famous Champion:

	CHANNEL	2	3	4	5	6	7	8	9	10	11	12	13
Gain Over 1-Bay Champion	1-Bay RAINBOW	0 DB	0 DB	0 DB	+1 DB	+2 DB	+3 DB	+2.5 DB	+1 DB	+.5 DB	+.5 DB	+1.5 DB	+2.5 DB
	1-Bay SUPER RAINBOW	+1 DB	+1 DB	+1.5 DB	+2.5 DB	+3.5 DB	+3.5 DB	+3 DB	+2 DB	+1.5 DB	+2 DB	+3.5 DB	+4.5 DB
	CHANNEL			4	5	6	7	8	9	10	11	12	13
Gain Over Stacked Champion	Stacked RAINBOW	+1.5 DB	+2 DB	+1.5 DB	+1.5 DB	+2 DB	+.5 DB	+.5 DB	+0 DB	+0 DB	+0 DB	+1 DB	+1.5 DB
	Stacked SUPER RAINBOW	+2 DB	+2.5 DB	+3 DB	+3 DB	+4 DB	+.5 DB	+1 DB	+1 DB	+2 DB	+2 DB	+2.5 DB	+3.5 DB

There's a RAINBOW model for every area . . . for every purse!

For fringe and super-fringe areas:

Super RAINBOW model no. 331, $37.50 list

stacked Super RAINBOW model no. 331-2, $75.70 list

For suburban and near-fringe areas:

Champion *RAINBOW model no. 330,* $23.60 list

stacked **Champion** *RAINBOW model no. 330-2,* $48.60 list

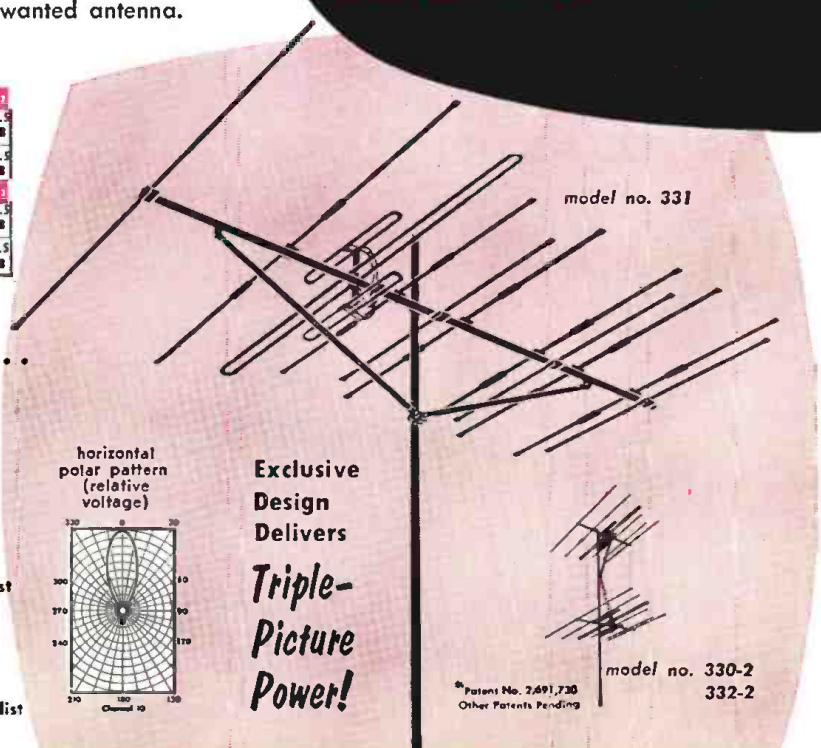
For economy installations:
(featuring butted tubing)

Challenger *RAINBOW model no. 332,* $18.06 list

stacked **Challenger** *RAINBOW model no. 332-2,* $37.50 list

don't kid me!

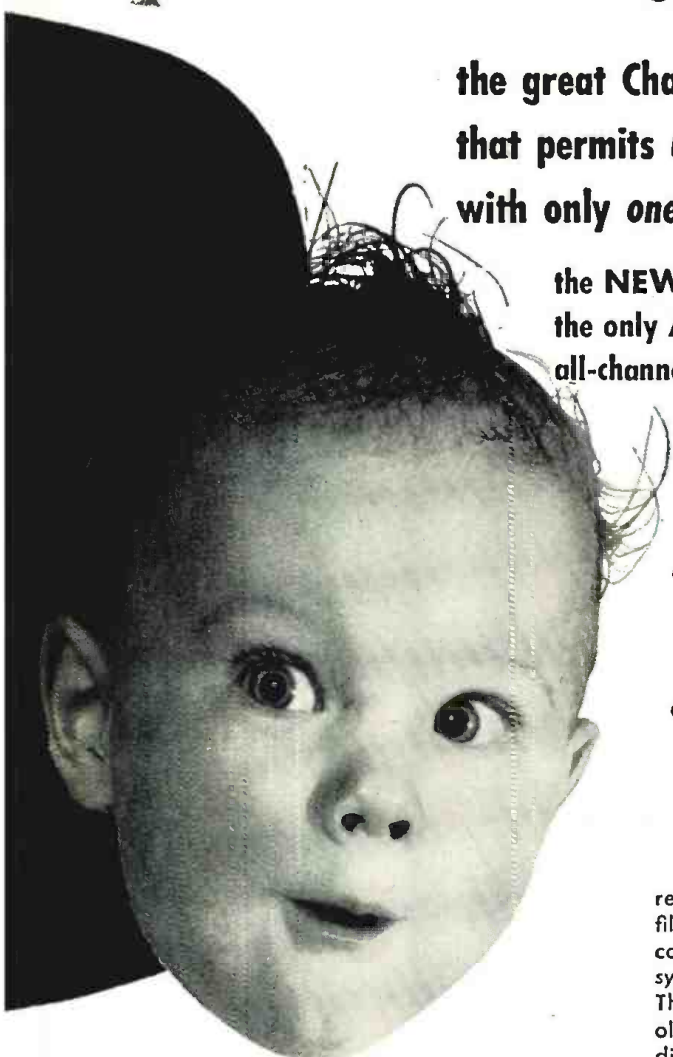
NOTHING outperforms CHANNEL MASTER



a major step forward in installation procedures —

CHANNEL MASTER'S SELECTENNA coupling system

the great Channel Master development that permits *unlimited antenna combinations* with only *one* transmission line to the set!



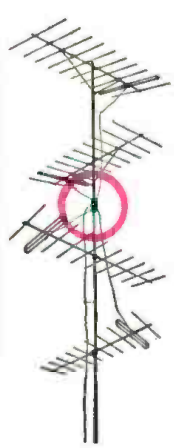
the NEW WAY, the BEST WAY, the only AUTOMATIC WAY to get all-channel, all-direction reception . . .

- ***Without rotators!***
  SelecTenna means: no extra control unit on the set; no moving parts to get out of order; antennas are always in perfect orientation.
- ***Without switches!***
  SelecTenna means: no manual switches to bother with; better performance because couplers have less insertion loss than switches.
- ***Without multiple lead-in wires!***
  SelecTenna means: neater, more professional installations, because no complicated wiring enters the home. Only *one lead* connects to the set.

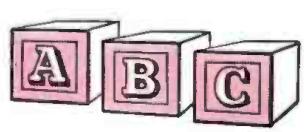
This modern way to obtain multi-directional reception — with its individual band-pass filter networks — offers the consumer great convenience advantages possible in no other system. There's never been anything like it! The SelecTenna System is rapidly replacing all older methods. Use it on your next "multi-direction" installation!

FREE TECHNICAL ADVISORY SERVICE

Our engineers will tell you the correct hook-up for your area. Merely list the channels you expect to receive, as well as the different antennas you would like to hook up. No charge or obligation.



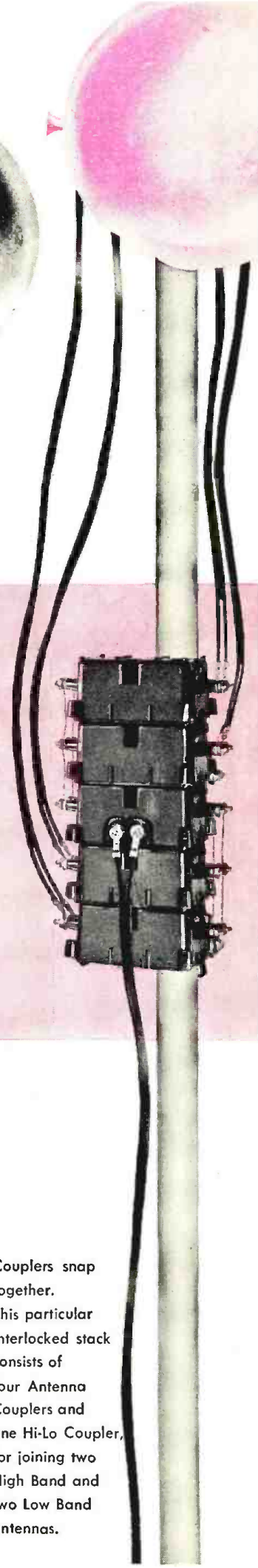
Simple as:



Simply select your channel on the set--- the right signal is always there!

list price: $5.42 each

including mounting hardware and connecting wire.



Couplers snap together. This particular interlocked stack consists of four Antenna Couplers and one Hi-Lo Coupler, for joining two High Band and two Low Band antennas.

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

The World's Largest Manufacturer of Television Antennas and Accessories.

Better for you

PLUS

Pyramid will now be listed in Photofact folders.

PHOTOFACT

Pyramid has joined the select group of manufacturers who participate in this most valuable of all service aids to make available to you an immediate cross reference between the set manufacturer's part and the part number of the exact Pyramid equivalent.

You will find Pyramid capacitors as original components in sets bearing such famous brand names as

RCA • GE • CBS • Arvin • DuMont • Zenith • Raytheon • Emerson
Motorola • Sylvania • Packard-Bell • Hallicrafters • Westinghouse • Hoffman

and at leading parts distributors everywhere.

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LOOKING FOR JOB SECURITY AND SUCCESS?

LET MY STUDENTS AND GRADUATES TELL YOU —

ABOUT MY TRAINING —

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

$60 A WEEK IN SPARE TIME

I have the skill and know-how to do the work I love best and to enjoy better things in life, thanks to RTTA. I am working at TV servicing and making $60 a week sparetime.

Harold Gimlen, Flint, Mich.

HAS OWN BUSINESS

I have a shop at home and have been working on radio and TV after working hours of my regular job. I average $50 a week for this part time work. RTTA training helped me in making extra money and giving me experience in the electronic field.

Richard Hennis, Little Rock, Ark.

AIRCRAFT INSPECTOR

With RTTA training and through repairing radios and televisions for the right people at the right price, I was able to make the right contacts. I am now an Inspector for Douglas Aircraft at about $125 a week.

Hugh Maddox, Los Angeles, Calif.

SERVICE MANAGER

I manage two radio and television shops, one here and one in Pompano Beach. RTTA training increased my knowledge of TV circuits and showed me new, quicker methods of repairing. Lessons as presented are very concise and clear.

William Phillips, Fort Lauderdale, Fla.

ELECTRICAL TESTER

RTTA training has helped me understand TV and many variations of simple circuits. The course covers all subjects very clearly. I am now an Electrical Tester for Western Electric Co. at $83.42 a week.

Raymond Lapan, Burlington, N. C.

REPAIRED EVERY SET

RTTA training helped me to understand TV more thoroughly. I have repaired every set that I was called on to repair.

Andrew Busi, Jr., Iselin, Pa.

— ABOUT MY EQUIPMENT

YOU GET ALL THIS EQUIPMENT AND MORE

". . . a money making little gem."

I have completed kit #6 and was amazed at how it works. I showed it to a friend of mine and he asked me to set it up for one of the picnics his social club was having. That sure is a money making little gem.

John Fernandez, Fresno, Calif.

"We get excellent pictures . . ."

I would like to compliment you on an excellent and complete course. We get excellent pictures on my TV set from WSYR (Syracuse, N.Y.), approximately 110 air miles away. The set is working good and I have had to replace only three tubes since I assembled it two years ago.

Larry H. Stafford, Kingston, Ont., Canada

". . . very good reception . . ."

I have really enjoyed the course and have come a long way in TV servicing. I am getting very good reception on my TV station considering that the nearest VHF station is 120 miles.

J. W. Hanlon, Jr., Henderson, Texas

YOU, TOO, CAN GET A BETTER-PAYING JOB IN THE EVER-EXPANDING RADIO-TELEVISION-ELECTRONICS FIELD

Why limit yourself and your earnings because of your lack of training. Learn AT HOME in your SPARE TIME to be an electronic technician, television repairman, or studio technician. You don't need any experience whatsoever. Many students earn up to $25 weekly in spare time while learning.

After you finish my Radio-FM Television Course or FM-Television Course you can have, if you want it, two weeks of laboratory training at my associate resident school in New York City—AT NO EXTRA COST.

If you have had previous radio and television experience you can take my practical TV Cameraman and Studio Technician Course to qualify for a good-paying job in a TV studio.

Write to me *today* and let me show you how you can begin now to put yourself on the road to a better future.

VETERANS!

My school fully approved to train veterans under new Korean G.I. Bill. Write discharge date on coupon.

YOU GET ALL FOUR FREE

MAIL THIS COUPON TODAY! NO SALESMAN WILL CALL

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION Dept. T-2
52 East 19th Street, New York 3, N. Y.

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

(PLEASE PRINT PLAINLY)

Name_____ Age_____

Address_____

City_____ Zone____ State_____

I AM INTERESTED IN:

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

VETERANS! Write discharge date

Radio Television Training Association

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

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

Within the INDUSTRY

HOWARD E. RIORDON has been appointed general manager of the Radio and Television Division of *Sylvania Electric Products Inc.* He has held executive posts with this firm and its subsidiary and predecessor companies for the past 23 years. He succeeds John K. McDonough, who recently resigned from the company.

Mr. Riordon joined the *Colonial Radio Corporation* of Buffalo in 1931 as assistant treasurer and in 1936 became secretary and controller. *Sylvania* purchased *Colonial* in 1944 and in that year Mr. Riordon was made vice-president of the subsidiary.

His most recent post was as president of *Sylvania Electric of Puerto Rico, Inc.*

* * *

ROBINS INDUSTRIES CORP. is the new name of **YALE INDUSTRIES CORP.**, manufacturers of the "Gibson Girl" tape splicers. The firm will continue business at 82-09 251st St., Bellerose 26, N. Y. . . . **THE FLEETWOOD CORPORATION** has been formed at 1037 Custer Drive, Toledo, Ohio to manufacture and supply television equipment for studio, remote, and closed-circuit use. The firm is headed by John W. McGee, former general manager of the Electronics Division of **WILLYS MOTORS, INC.**, Toledo . . . A new service for architects, engineers, and contractors has been established by **AUDIO EQUIPMENT COMPANY**, 15749 Wyoming Avenue, Detroit 38, Michigan . . . **HETHERINGTON, INC.** of Sharon Hill, Pa. has announced the establishment of a coil division which is prepared to handle the production of coils, solenoids, transformers, small motors, ignition coils for photoflash equipment, or gasoline engines . . . **TAPE RECORDERS INCORPORATED** has been established at 1501 W. Congress St., Chicago 7, to manufacture three new magnetic tape recorders which will be marketed as the "Tri Fy" line . . . **PRECISION TRANSFORMER CORPORATION**, 660 W. Grand Ave., Chicago 10, has set up a special department to produce transformers to custom specifications and assist manufacturers in the design of equipment requiring non-standard transformers.

* * *

COLONEL W. MACK THAMES has been appointed chief of the Signal Plans and Operations Division of the Office of the Chief Signal Officer, U. S. Army, succeeding **BRIG. GEN. REGINALD P. LYMAN**, who has retired . . . **DONALD W. JACKSON** has been appointed national merchandising manager for the *Dage Television Division* . . . The Tube Division of *Radio Corporation of America* has named **LEE F. HOLLERAN**, a 20-year veteran of *RCA* sales and product activities, to the post of general marketing manager . . . **LOUIS SILVER**, vice-president of *Wilcox-Gay Corporation*, has resigned that post to set up a manufacturer's sales representative office in New York City . . . **JACK WHITESIDE** has been appointed general manager of *Simpson Electric Co.* succeeding the late **H. A. BERNREUTER** . . . *Radio Receptor Company, Inc.* has named **J. J. CLARK**, retired admiral, USN, to the post of vice-president . . . **PATRICK E. LANNAN** has been promoted to the post of vice-president and project manager of electrical and electronic development at *Designers for Industry, Inc.*, Cleveland research and development firm . . . **ARNOLD DEUTSCHMANN** has been elected to the newly-created post of executive vice-president and **MORRIS M. NEWMAN** vice-president of *Radio Shack Corp.* of Boston . . . **MAJOR GEN. WILLIAM L. RICHARDSON**, U.S. Air Force (Ret.), has been named to the newly-created post of manager, Defense Projects Coordination for the Engineering Products Division of *Radio Corporation of America* . . . **ALEXANDER KIDD**, formerly vice-president of *The M. W. Kellogg Company*, was elected vice-president of *Stewart-Warner Corporation* of Chicago . . . **E. GORDON BURLINGHAM** has been named to the new post of sales service manager of *CBS-Hytron* with headquarters at the company's Danvers plant.

* * *

HORACE L. WHITE, veteran of 26 years of service with *Jensen Manufacturing Co.*, has been appointed industrial sales manager of the firm.

He will be in charge of the industrial activities of sales representatives and all sales liaison with industrial accounts, except where government contracts are involved.

For the past two and a half years, he has been in the industrial sales division and prior to that time he was traffic manager.

* * *

THE HIGH FIDELITY INSTITUTE, INC., a non-profit association dedicated to the promotion of high-fidelity products to the American public, is going ahead with plans for an educational program aimed at telling the "hi-fi story" to millions of music lovers and audio enthusiasts.

Jerome J. Kahn, commissioner of the Institute, revealed that some of

Home Study Courses in

TELEVISION SERVICING

offered by

RCA INSTITUTES

Study Television Servicing—from the very source of the latest, up-to-the-minute TV and Color TV developments. Train under the direction of men who are experts in this field. Take advantage of this opportunity to place yourself on the road to success in television. RCA Institutes, Inc. (A Service of Radio Corporation of America), thoroughly trains you in the "why" as well as the "how" of servicing television receivers.

FIRST HOME STUDY COURSE IN COLOR TV SERVICING

Now you can train yourself to take advantage of the big future in Color TV. RCA Institutes Home Study Course covers all phases of Color TV Servicing. It is a practical down-to-earth course in basic color theory as well as how-to-do-it servicing techniques.

This color television course was planned and developed through the combined efforts of instructors of RCA Institutes, engineers of RCA Laboratories, and training specialists of RCA Service Company. You get the benefit of years of RCA research and development in color television.

Because of its highly specialized nature, this course is offered only to those already experienced in radio-television servicing. Color TV Servicing will open the door to the big opportunity you've always hoped for. Find out how easy it is to cash in on color TV. *Mail coupon today.*

HOME STUDY COURSE IN BLACK-AND-WHITE TV SERVICING

Thousands of men in the radio-electronics industry have successfully trained themselves as qualified specialists for a good job or a business of their own—servicing television receivers. You can do this too.

This RCA Institutes TV Servicing course gives you up-to-the-minute training and information on the very latest developments in black-and-white television.

As you study at home, in your spare time, you progress rapidly. Hundreds of pictures and diagrams, easy-to-understand lessons help you to quickly become a qualified TV serviceman.

There are ample opportunities in TV, for radio servicemen who have expert training. Mail coupon today. Start on the road to success in TV Servicing.

SEND FOR FREE BOOKLET

Mail coupon in envelope or paste on postal card. Check course you are interested in. We will send you a booklet that gives you complete information. *No salesman will call.*

MAIL COUPON NOW

RCA INSTITUTES, INC.
Home Study Dept. RN 255
350 West Fourth Street, New York 14, N. Y.

Without obligation on my part, please send me copy of booklet on:

☐ Home Study Course in TELEVISION SERVICING.
☐ Home Study Course in COLOR TV SERVICING.

Name_____
(please print)

Address_____

City_____ Zone____ State_____

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

the industry's leading promotional, sales, and advertising authorities have been consulted with the result that the framework for an all-industry public educational program is being set up.

The Institute's Board of Governors include: Leonard Carduner, *British Industries Corp.;* Robert Newcomb, *Newcomb Audio Products;* Walter O. Stanton, *Pickering & Co.;* Sam Poncher, *Newark Electric Co.;* E. Berlant, *Berlant Associates;* and Theodore Rossman, *Pentron Corp.*

* * *

RICHARDS W. COTTON has been named assistant to the president of *National Company, Inc.*, Malden, Mass., engineers and manufacturers of communications receivers and audio equipment.

Mr. Cotton comes to the firm from *Philco Corporation* where he served in the same capacity. In his new post, he will assist the president in the executive administration of the company's program of development and expansion in the field of electronics.

Since 1953, he has also served as a consultant to the Secretary of Defense, the Office of Defense Mobilization, and the Electronics Division of the Department of Commerce.

He represented the U. S. at the NATO conference and was sent to Japan on a special government assignment last year.

* * *

SYLVANIA ELECTRIC PRODUCTS INC. has recently completed a new 51,000 square-foot building in Fullerton, California in order to meet the requirements of West Coast distributors and dealers for television picture tubes . . . **FEDERAL PACIFIC ELECTRIC COMPANY** of Newark, New Jersey has opened a new plant in Scranton, Pa. and completed construction of a new and modern warehouse at its Newark plant . . . Elaborate dedication ceremonies marked the opening of **HELIPOT CORPORATION'S** new Canadian plant at No. 3 Six Points Road, Toronto, Ontario . . . **PHILCO CORPORATION'S** Government and Industrial Division has moved to new and larger quarters at 10589 Santa Monica Boulevard in Los Angeles . . . **KEPCO LABORATORIES** has moved into the new addition to its Flushing, N. Y. plant at 131-38 Sanford Ave. The new addition triples the company's production area . . . A new research and product development center has been opened in Denver, Colorado by **MICRO SWITCH**, a division of **MINNEAPOLIS-HONEYWELL REGULATOR COMPANY.** The new center is located at 387 Corona Street . . . **SPRAGUE ELECTRIC COMPANY** has started construction of a 13,000 square foot, one-story building in the Venice section of Los Angeles to house all of its Southern California operations. Completion is expected in late Spring . . . **IMPERIAL RADAR AND WIRE CORPORATION** has

(*Continued on page* 176)

CREI prepares you quickly for success in

- BROADCASTING
- TELEVISION
- MANUFACTURING
- COMMUNICATIONS
- SERVICING
- AERONAUTICAL ELECTRONICS

The future is in your hands!

The signs are plain as to the future of the trained men in the electronics industry. It is a tremendous industry, and—at the *present time* there are more jobs than there are trained men to fill them. But—when there's a choice between a trained and untrained applicant, the trained man will get the job. Your biggest problem is to decide on—and begin the best possible training program.

CREI Home Study . . . The Quick Way to Get There.

Since 1927, CREI has given thousands of ambitious young men the technical knowledge that leads to more money and security. The time-tested CREI procedure can help *you*, too—if you really want to be helped. CREI lessons are prepared by experts in easy-to-understand form. There is a course of instruction geared to the field in which you want to specialize. You study at *your* convenience, at *your* rate of speed. Your CREI instructors guide you carefully through the material, and grade your written work personally (not by machine).

Industry Recognizes CREI Training.

CREI courses are prepared, and taught with an eye to the needs and demands of industry, so your CREI diploma can open many doors for you. Countless CREI graduates now enjoy important, good-paying positions with America's most important companies. Many famous organizations have arranged CREI group training for their radio-electronics-television personnel. To name a few: All America Cables and Radio, Inc.; Canadian Aviation Electronics, Ltd.; Canadian Broadcasting Co rporation; Columbia Broadcasting System; Canadian Marconi Company; Hoffman Radio Corporation; Machlett Laboratories; Glenn L. Martin Company; Magnavox Company; Pan American Airways, Atlantic Division; Radio Corporation of America, RCA Victor Division; Technical Appliance Corporation; Trans-Canada Air Lines; United Air Lines. Their choice for training of their own personnel is a good cue for *your* choice of a school.

Benefits Felt Right Away.

Almost immediately, you feel the benefits of CREI training. Your employer, when informed of your step toward advancement (only at your request), is certain to take new interest in you and in your future. What you learn in CREI Home Study can start helping you do a better job immediately.

CREI also offers Resident Instruction

at the same high technical level—day or night, in Washington, D. C. New classes start once a month. If this instruction meets your requirements, check the coupon for Residence School catalog.

INFORMATION FOR VETERANS

If you were discharged after June 27, 1950—let the new G. I. Bill of Rights help you obtain resident instruction. Check the coupon for full information.

Get this fact-packed booklet today. It's free.

Called "Your Future in the New World of Electronics," this free illustrated booklet gives you the latest picture of the growth and future of the gigantic electronics world. It includes a complete outline of the courses CREI offers (except Television and FM Servicing) together with all the facts you need to judge and compare. Take 2 minutes to send for this booklet right now. We'll promptly send your copy. The rest—your future—is up to you.

CAPITOL RADIO ENGINEERING INSTITUTE

Accredited Technical Institute Curricula • Founded in 1927

3224 16th Street, N. W.
Washington 10, D.C.

To help us answer your request intelligently, please give the following information:

EMPLOYED BY .....

TYPE OF PRESENT WORK .....

SCHOOL BACKGROUND .....

ELECTRONICS EXPERIENCE .....

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED? .....

MAIL COUPON TODAY

Capitol Radio Engineering Institute

Dept. 112-B, 3224 16th St., N. W., Washington 10, D. C.

Send booklet "Your Future in the New World of Electronics" and course outline.

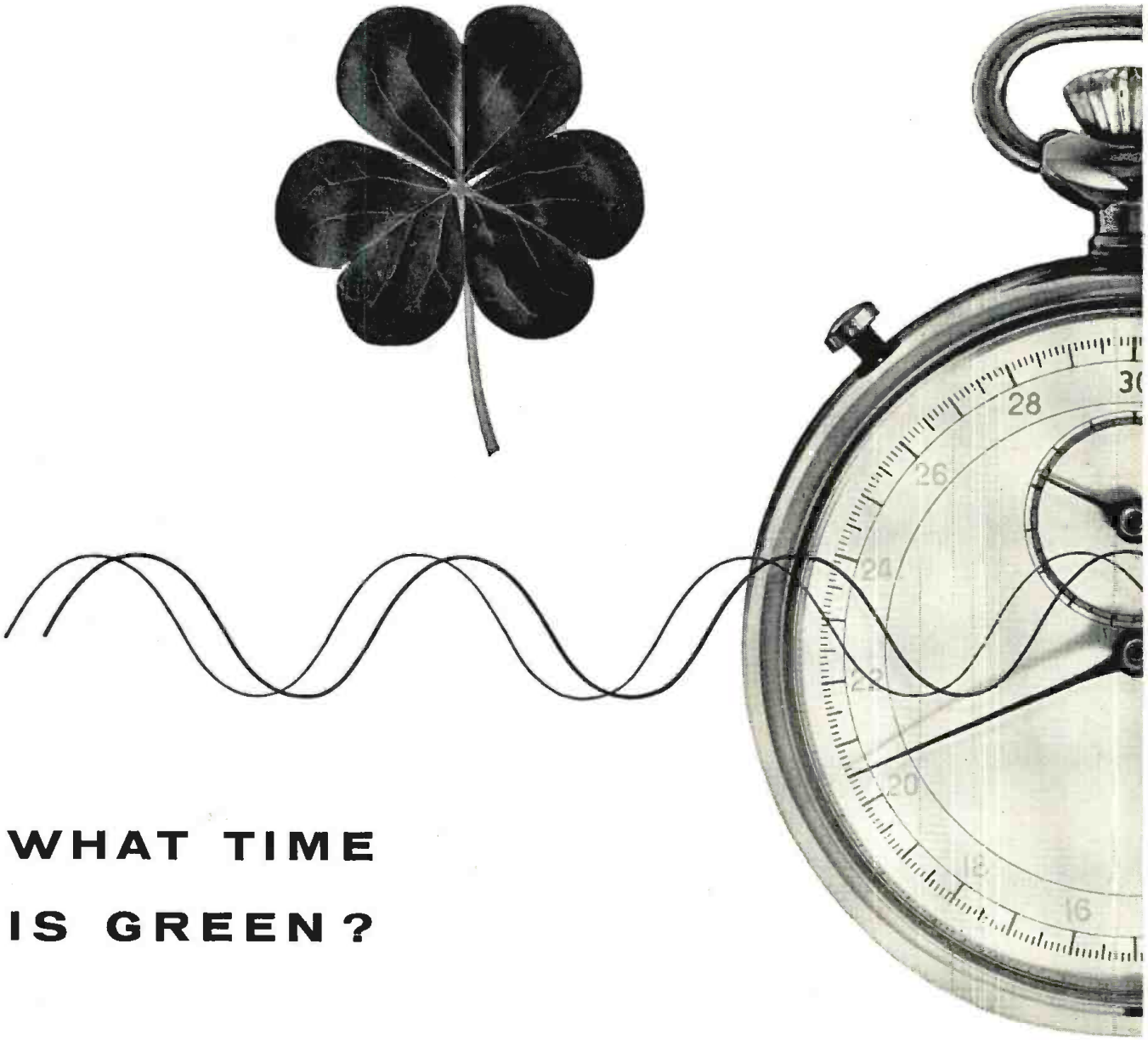
CHECK FIELD OF GREATEST INTEREST
- ☐ Practical Television Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Radio Engineering
- ☐ TV, FM & Advanced AM Servicing
- ☐ Aeronautical Radio Engineering

Name .....

Street .....

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

Check—☐ Residence School ☐ Veteran



WHAT TIME IS GREEN?

In color television, the colors on the screen are determined in a special way. A reference signal is sent and then the color signals are matched against it. For example, when the second signal is out of step by 50-billionths of a second, the color is green; 130-billionths means blue.

For colors to be true, the timing must be exact. An error of unbelievably small size can throw the entire picture off color. A delay of only a few billionths of a second can make a yellow dress appear green or a pale complexion look red.

To ready the Bell System's television network for color transmission, scientists at Bell Telephone Laboratories developed equipment which measures wave delay to one-billionth of a second. If the waves are off, as they wing their way across the country, they are corrected by equalizers placed at key points on the circuit.

This important contribution to color television is another example of the pioneer work done by Bell Telephone Laboratories to give America the finest communications in the world.

To keep colors true in television, signals must be kept on one of the world's strictest timetables. Equalizers that correct off-schedule waves are put into place at main repeater stations of the transcontinental radio-relay system.

BELL TELEPHONE LABORATORIES

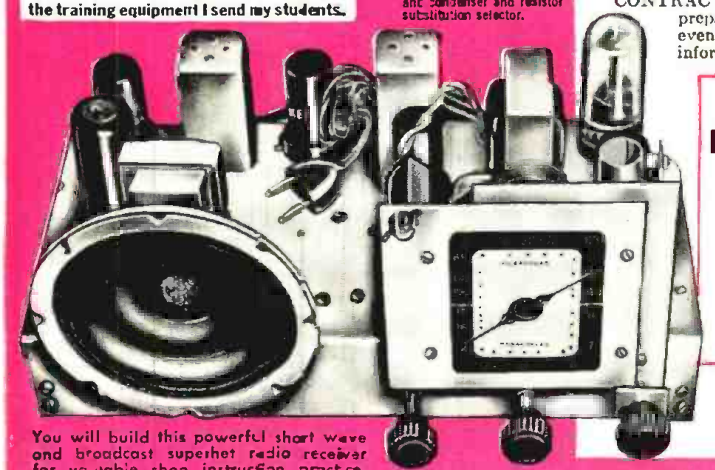
IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS.

It's New! 3 Years in Development —NOW READY FOR YOU!

This is the new Sprayberry Training Television receiver, built and tested in sections for greatest instruction value.

You build the new Sprayberry Tester . . . 18-range Volt-Ohm-Milliammeter readings plus output meter and condenser and resistor substitution selector.

These photos show only a small part of the training equipment I send my students.



You will build this powerful short wave and broadcast superhet radio receiver for valuable shop instruction practice.

New Equipment! New Lessons! Enlarged Course!

SPRAYBERRY PRACTICAL TRAINING IN

RADIO-TELEVISION

3 NO OBLIGATION TRAINING PLANS

Frank L. Sprayberry
President, Sprayberry Academy of Radio

You have NO MONTHLY PAYMENT CONTRACT to sign ...pay for this outstanding training as you learn!

The complete facts are so big and so important to any man seeking training in Radio-Television that I urge you to mail the coupon below at once for my big all-new 56 page FREE CATALOG and FREE Sample Lesson. Get the full story of this remarkable new and up-to-the-second Training Plan. You'll read about my 3 NO OBLIGATION PLANS or "packaged unit" instruction for both beginners and the experienced man. You'll learn how I can now prepare you in as little as 10 MONTHS to take your place in this fast moving big money industry as a Trained Radio-Television Technician. You'll see that you take no risk in enrolling for my Training because you DO NOT SIGN A BINDING TIME PAYMENT CONTRACT. I have been training successful Radio-TV technicians for 22 years . . . I can prepare you, too, to get into your own profitable Service Shop or a good paying job, even if you have no knowledge of Radio-Television. Mail the coupon . . . I rush full information FREE and without obligation. (No salesman will call.)

NEWEST DEVELOPMENTS

Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

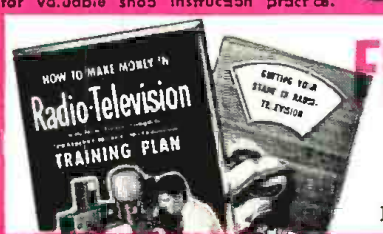
PRACTICE AND TRAIN AT HOME WITH 25 NEW KITS OF EQUIPMENT

You get valuable practical experience in construction, testing and shop practice. You build a powerful 2 band superhet radio, the all-new 18 range Sprayberry multitester, the new Sprayberry Training Television receiver, signal generator, signal tracer and many other projects. All equipment is yours to use and keep . . . and you have practically everything needed to set up a Radio-Television Service Shop.

All your training is IN YOUR HOME in spare hours. Keep on with your present job and income while learning. I help you earn extra spare time money while you learn. If you expect to be in the armed forces later, there is no better preparation than practical Sprayberry Radio-Television training. Rush coupon below for all the facts—*FREE!*

SPRAYBERRY ACADEMY OF RADIO

111 NORTH CANAL STREET, DEPT. 25-U, CHICAGO 6, ILLINOIS



FREE CATALOG AND SAMPLE LESSON

Rush coupon for my catalog "How to Make Money in Radio-Television". PLUS an actual sample Sprayberry Lesson without obligation—ALL FREE. Mail coupon NOW!

SPRAYBERRY ACADEMY OF RADIO
Dept. 25-U, 111 N. Canal St., Chicago 6, Ill.

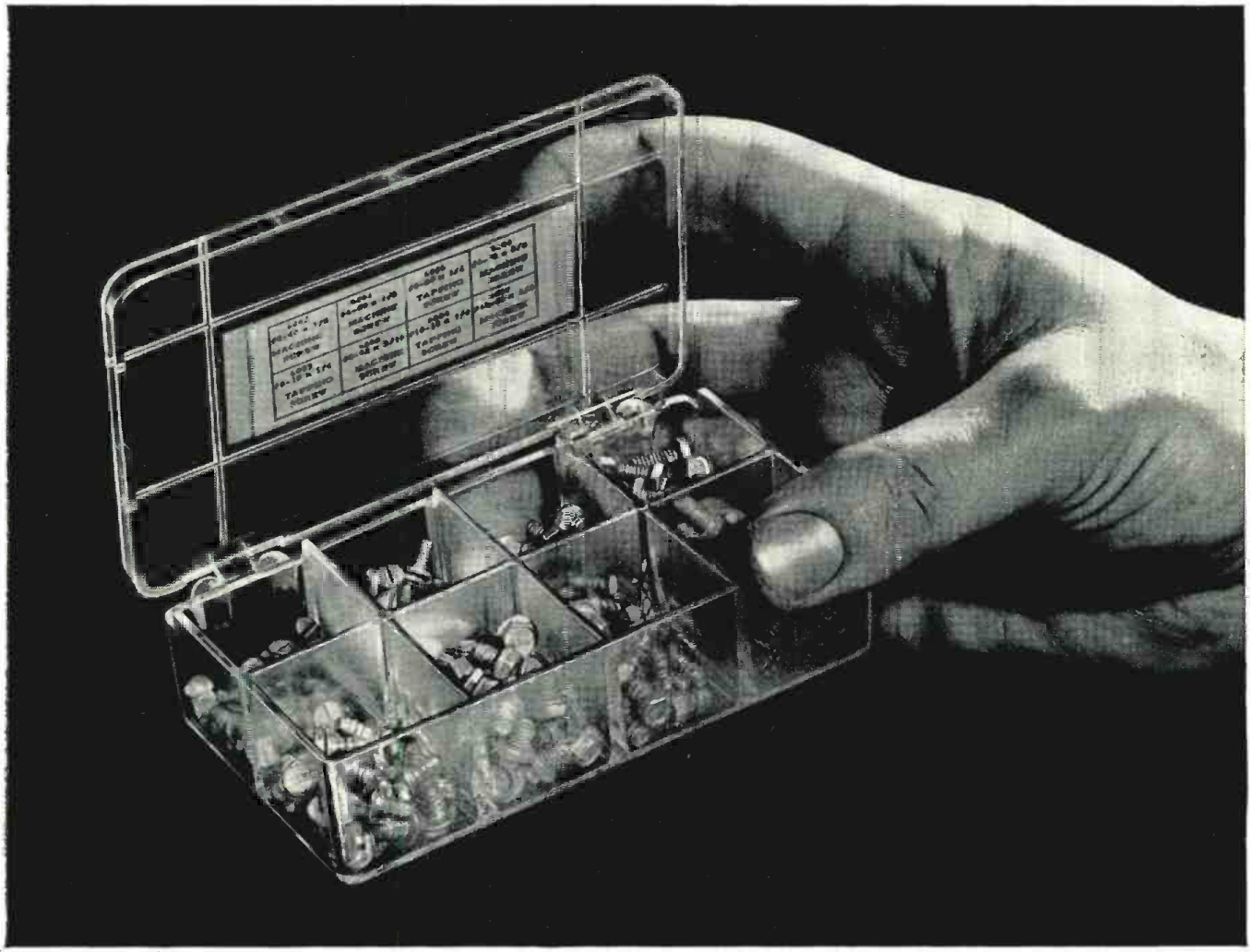
MAIL THIS COUPON FOR FREE FACTS AND SAMPLE LESSON

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

Name_____ Age_____

Address_____

City_____ Zone_____ State_____



Now... Delco offers **POCKET-SIZE** kits that keep replacement hardware at your fingertips

A GREAT NEW CONVENIENCE FOR AUTO RADIO TECHNICIANS!

For quicker, easier servicing of Delco auto radios, a large assortment of replacement hardware—from tuner bearings to case screws—is now available in *four* clear polystyrene kits.

There's no more fumbling in a dark drawer when you need a hardware replacement part. You can see it immediately in these transparent kits. And each part fits your repair need exactly.

A handy chart attached to the inside cover of the box shows the contents of each of the eight compartments—a convenience when ordering refills for the compartments in plastic bags.

You can obtain these convenient pocket-size kits through your UMS Delco Electronics Parts Distributor today.

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

DISTRIBUTED BY ELECTRONICS DISTRIBUTORS EVERYWHERE

DELCO RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

Depend on the COMPLETE line of ROHN

"SUPERIOR DESIGN" towers and accessories

for LARGER PROFITS MORE SATISFACTION GREATER EASE IN HANDLING

3 added towers to solve ALL your needs

no. 6 tower

"All-Purpose" tower.

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

Package Tower

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

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

Both Towers Feature

THE ROHN MAGIC TRIANGLE

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

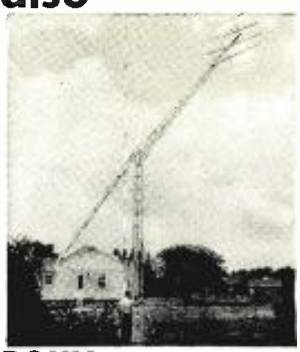
no. 30 tower

Heights up to 200' or more when guyed

Self-supporting up to 60'

Sturdy communication or TV tower that "stands up" to *all* the stresses of weather and climatic conditions . . . will withstand heavy wind and ice loading. Heavy gauge tubular steel, electrically welded throughout. Weather resistant, non-corrosive *double* coating provides durable finish. All sections in 10' lengths. Only 2-4 manhours required for installing 50' tower!

also



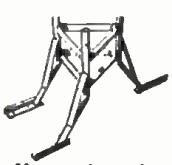
ROHN Fold-over tower

For experimenters, TV service departments and retailers. Use this kit with regular Rohn tower sections. Simple and easy to use.

ROHN Telescoping Masts

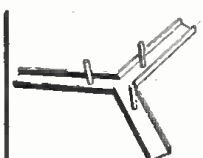
Heavy-duty hot-dipped galvanized steel tubing and rigid joints give extraordinary strength. *Quick installation* . . . mast attached to base—antenna fixed, then mast hoisted quickly to desired height. Utilizes special clamp and guy ring arrangement. Flanged interior section; crimped exterior section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

and a complete line of ROHN accessories —*all galvanized*



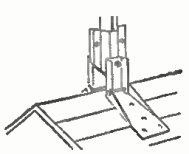
PEAK ROOF MOUNT

Heavy duty for quick, secure mounting of tower to top of peak roof. Flanges hinged, fastened to roof with 2 lag screws in each flange.



FLAT ROOF MOUNT

For all types flat surfaces. 3-1" solid steel projections permit first section of tower to be mounted directly on roof mount by inserting usual ⅜" bolts.



MAST BASES

Complete line of telescoping mast bases for every requirement, accommodating masts from 1"-2¼" diameter. Also available—drive-in mast bases.

MAST 'N TV TUBING

Heavy-duty, hot-dipped galvanized steel tubing. Machined to perfection. Extra sturdy joints slotted for full, perfect coupling.

PEAK and WALL MOUNTS

For mounting of mast or pole to roof or wall. Heavy-duty steel. Variable sizes. Models for most every need.

DRIVE-IN BASE

Set on top of ground . . . 3-4' drive rods driven through base into ground. First tower section secured to rods with single bolt in each leg. Instant erection.

SERVICE TABLE

Perfect answer for television servicing, display and storage. Truly one of the finest of its kind in economy price range.

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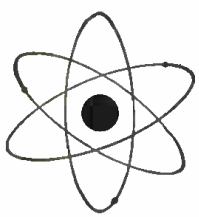

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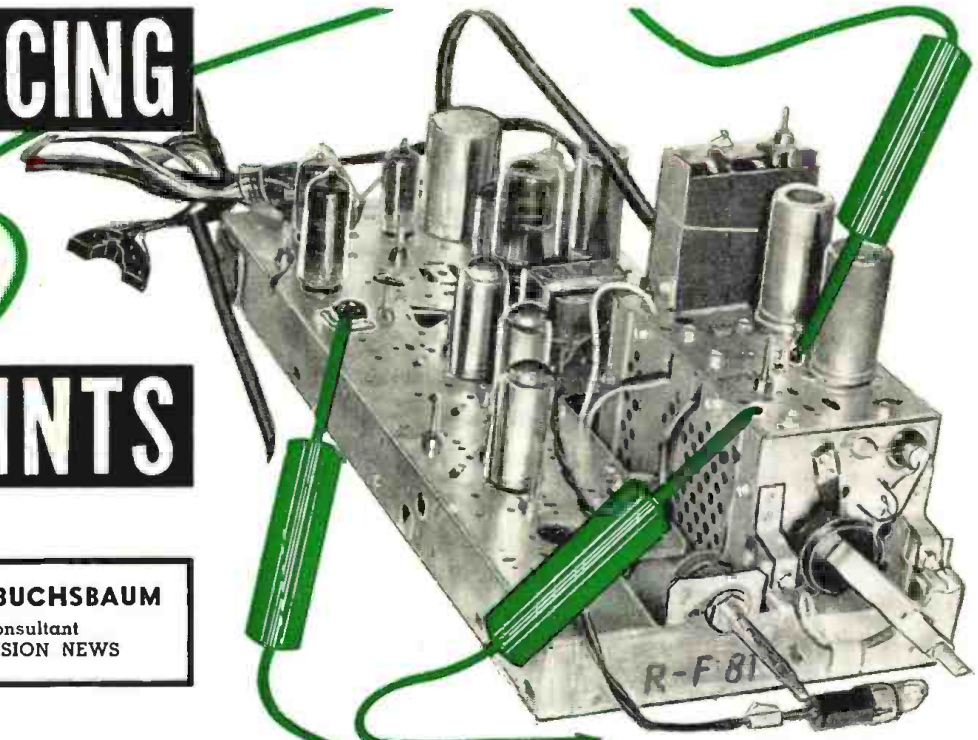
TV SERVICING VIA TEST POINTS

By **WALTER H. BUCHSBAUM**
Television Consultant
RADIO & TELEVISION NEWS



View of a Philco r.f. chassis indicating the test points available for faster servicing.

For faster TV servicing in the home and the shop, and for more accurate estimates, use chassis test points.

THE TV technician has, when checking a defective set, certain check points available which give him an indication of at least the section of the receiver where the defect lies and some idea as to the complexity of the job.

In older TV receivers, few "hot" points were accessible at the top of the chassis or could be reached without removing the chassis from the cabinet. The latest model TV receivers, however, have either a chassis design which makes much of the circuitry accessible from the back of the cabinet or else they use certain test points brought out to sockets, plug-in adapters, etc. The vertically-mounted chassis is a "natural" for allowing simple tests to be made with the set in the cabinet. Another type of receiver suitable for such testing is one which uses printed wiring.

Where none of these features is found, it is possible to perform many checks with the chassis in the cabinet by using tube socket adapters, such as the series currently made by *CBS-Hytron.* These adapters are plugged into the tube socket and then the tube is plugged into the adapter. Each tube pin connects to a little terminal on the periphery of the adapter making the various tube-pin voltages and signals available for test purposes while the set is operating with all of its tubes.

As every technician knows, it is most efficient, both for the customer and the service technician, to perform a repair right in the home, if it is at all possible. Certainly it is important to be able to tell the set owner directly and positively if it is necessary to pull the set out and take it to the shop and also to give him an estimate on the spot as to the repair cost. Troubleshooting a TV set in the home by the use of test points determines quickly where the defect can be.

Most of the test instruments used for such servicing already are part of the standard equipment carried by most TV service technicians on house calls. The first item which is absolutely necessary is a good vacuum-tube voltmeter. This meter should have voltage ranges from 0 to 5 volts up to about 1000 volts. In addition, several ohmmeter ranges should also be available and a bleeder type high-voltage probe should be taken along for high-voltage tests.

TV technicians don't usually pay much attention to the type of test prods they use. Frequently, the meter leads end in alligator or crocodile clips or else in broken off test prods which have been resoldered, etc., until their test points are not very reliable. For efficient troubleshooting in the home, a choice of test prods, preferably of the type that can be plugged into each other, is recommended. One particularly useful type of test prod which allows both clipping on to a wire and plugging into a socket hole is sold under the tradename *"Klipzon."*

Although an oscilloscope is not generally carried on outside calls, for efficient troubleshooting by the method outlined here a small scope would come in very handy. With both scope and v.t.v.m. several special probes should be carried. A probe using a 1-megohm series resistor is essential for measuring voltages and observing signals without loading down the circuit. Another useful probe is a crystal detector and filter for measuring r.f. An adjustable-type voltage regulator will also come in handy in low line-voltage cases.

The last group of items needed, other than usual hand tools, is the tube socket adapters mentioned before. It is usually sufficient to carry one adapter each for 7-pin, 9-pin, octal, and loctal tube sockets. The economy-minded service technician can make his own adapters by connecting a male and female tube socket together with bus bar and providing little solder lugs for each pin at the female end of the adapter.

Isolating the Section

For operational and troubleshooting purposes, any TV receiver is usually divided into certain sections as shown in Fig. 1. Trouble in a particular section can be isolated and then the guilty component in that section located. Before each section is examined in detail, however, certain symptoms give a definite clue as to the trouble area. For example, if the picture is good, but no sound is heard, the defect obviously will not be due to some component in the deflection circuit. We would look first in the sound section. Similarly, if there is no raster but good sound, there would be little point to troubleshooting the sound section.

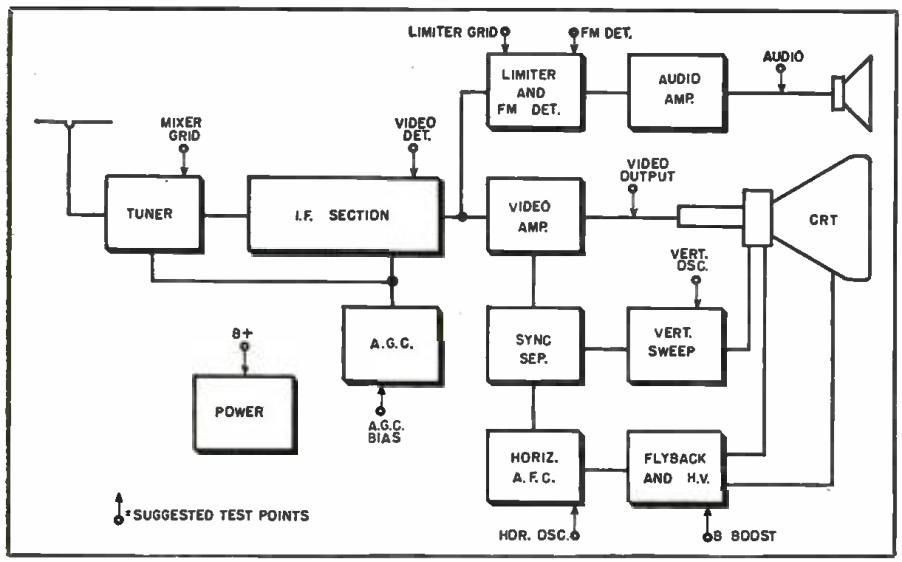


Fig. 1. Block diagram of a typical black-and-white TV receiver indicating the general location of test points for observing the various circuits at work.

A typical sequence of checks of a delinquent receiver which produces sound but no picture would be as follows:

1. Check if all tube heaters are lighted.

2. Adjust brightness, contrast, and a.g.c. control.

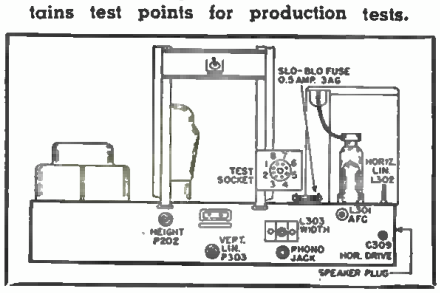
3. Measure "B+". If more than one "B+" voltage is used, measure each one in turn.

4. Measure a.g.c. bias. Excessive bias can cut off the signal so that nothing reaches the video stages.

5. Measure and, if possible, observe the output of the video detector. If a signal is present at that point, a voltage of usually 1 to 5 volts negative will be measured and a video signal will be observed with the scope. If a signal is detected, the defect must be in the subsequent video section. If no signal is detected, the defect must be in the i.f. or tuner or possibly, in the antenna and lead-in.

These simple tests can usually be made in a few minutes without removing the chassis from the cabinet. Fig. 2 shows the rear view of a *CBS-Columbia* chassis with a test socket. This is a regular octal socket and is used in the production testing of the receiver where a special metering set-up is connected to it. This metering arrangement allows the tester to see at a glance if all important voltages are correct. Any defect is localized at once to its originating receiver section. The connections of this octal socket to the various points in the set are shown in Fig. 4. In this receiver, the first video amplifier is directly coupled to the video detector, therefore, the grid bias at the video amplifier is a function of the detected signal. To avoid loading down that stage, a 22,000-ohm resistor is connected in series with pin 5 on the test socket.

Fig. 2. Back view of a CBS-Columbia TV chassis showing the socket which contains test points for production tests.



To troubleshoot this particular set, simply plug an octal adapter into the test socket and connect the meter ground to pin 4, which is the chassis ground. Then measure each signal or voltage in turn. This receiver uses 260-volt "B+" for most stages, but also has a 130-volt bus which is connected through a dropping resistor to the 260-volt line. On the test socket only the 260-volt "B+" is available.

In the previous example, we assumed that there were a raster and sound, but no picture. Let us now consider the instance where there is sound, but no raster. The following procedure will quickly locate the defect:

1. Adjust brightness control for midpoint setting.

2. Try adjusting the ion-trap magnet for different positions.

3. Turn the set off, remove the high-voltage lead from the picture tube, and connect it to a meter with a high-voltage probe.

4. Turn the receiver on and measure the high voltage. If it is lower than 9 kv., or does not register at all, the trouble is caused by something in the high-voltage or horizontal-sweep section. If the high-voltage is close to correct, the defect may be in the brightness circuit, the video output stage, or possibly, the picture tube.

5. Assuming there is no high-voltage, check the grid of the horizontal-output amplifier. In Fig. 4 this corresponds to pin 1, the horizontal drive control point. At that point, there should be a strong negative bias ranging from 18 to 35 volts. The oscilloscope should show a saw-tooth like the one in Fig. 3 with at least 40 to 60 volts peak-to-peak amplitude. If such a drive signal is present, the defect lies between the grid of the output amplifier and the high-voltage lead. In other words, in such an instance, the first step will be to change each of the tubes in this section in turn. If new output amplifier, damper, and high-voltage rectifier tubes do not cure the trouble, check the "B+" voltage at the boost side of the damper tube by using an octal socket adapter. A few old-type receivers use a 5V4 damper which requires a 5-prong socket adapter. Occasionally, the fuse or pilot light fusing circuit used in the "B+" boost section is open. If none of these caused the trouble, it may be the flyback transformer and, most likely, the receiver will have to be taken to the shop for repair.

6. If no signal is present at the grid of the output amplifier, the horizontal oscillator tube and "B+" voltage at that point should be checked next. Failure to find the defect in this manner indicates that some part in the horizontal oscillator section is defective and that under-chassis measurements, parts checking, and eventual repair will be required which can best be done in the shop.

The last of the basic defects is the instance where good picture but no sound is obtained. If an intercarrier sound system is used, the defect is automatically localized between the loudspeaker and the sound take-off point at the video section. If a split-sound type circuit is used, then the trouble can occur anywhere back to the i.f. sound take-off point. Referring back to the *CBS-Columbia* receiver discussed before, note that in Fig. 4 the test socket contains three sound check points. If there is an audio signal at pin 7 (as shown on a scope or read on the v.t.v.m. with an a.c. probe) this would indicate that the defect lies in the speaker cable, output transformer, or the speaker itself. If no audio signal appears at this point, the defect must be traced back further. In general, the following method of rapid testing for "no sound" complaints is recommended.

1. Tune in a good picture and adjust the volume control towards maximum. If nothing at all is heard, check the speaker cable for an open lead or a short circuit. If only a hum or buzz is heard, the speaker and cable are good.

2. If connection to the audio amplifier plate is available at a test point, check it for signal. In some receivers using printed circuits and an upright chassis, like the *Admiral* 18XP4BZ, all tube pins are accessible at the printed board. In other sets, a tube socket adapter can be used. The oscilloscope or the a.c. probe and output meter scale of the v.t.v.m. can be used to trace the audio signal back to the ratio detector or discriminator output. In the instance of the *CBS-Columbia* receiver, two points in the

ratio detector circuit are available at the test socket.

3. Measure d.c. voltage at the detector output. As the station is switched, the voltage should drop. Adjusting the fine tuning control should also have some effect on the d.c. output of the FM detector. If no detector output is observed, the defect probably lies in the i.f. or limiter stage. Replacement of these tubes may clear up the trouble. If not, the set has to be taken to the shop for detailed troubleshooting.

Locating Complex Troubles

Up to now we have only considered the use of test points for locating troubles of a very basic nature. Although the test-point method is not always as decisive and rapid in more complex cases, it will often give a very good indication of the trouble area and, frequently, may even allow a quick repair on the spot.

Many intermittent defects are found to be due to line voltage variations, made worse by low "B+" or weak tubes in some sections. Whenever such a possibility is indicated, connect the receiver to a line-voltage regulating transformer and measure the "B+" at the test point or through an adapter at the "B+" rectifier. Where selenium rectifiers are used, the "B+" voltage is not accessible from the top of the chassis in some instances and then it is possible to get at this voltage at the screen of the audio output tube or some similar point.

Another access point for "B+" voltage is shown in Fig. 5, the power supply connections for the *RCA* model 21S519N chassis. Here the octal plug connecting the deflection yoke to the main chassis also acts as "B+" interlock and by inserting an adapter at this point, the "B+" as well as the rectifier voltage can be readily measured.

For locating intermittent defects due to voltage variations, adjust the line voltage regulator to 117 volts and check the "B+" voltage. Next, reduce the line voltage to 95 volts and again measure the "B+". This corresponds to about a 20 per-cent reduction in voltage and should be accompanied by a 20 per-cent reduction in "B+". In other words, a 250 volt "B+" supply at 117 volts a.c. line voltage should give about 200 volts for 95 volts a.c. When the "B+" drops much lower than that, say to 160 volts, the rectifier tubes are probably weak and should be replaced.

Unstable horizontal or vertical sync is not always due to bad tubes in the sync separator or the sweep section, but can be caused by a defect in the video or i.f. section. To determine this quickly without removing the chassis, just measure or better still observe, the video signals at the detector test point.

In addition to the voltage measurements, many defects can be located by ohmmeter measurements directly at the accessible test points. One good example is the tracing of a "B+" short. Measuring between the "B+" test point and ground with an ohmmeter will show a momentary short and then an increase in resistance until at least 5000 ohms are measured. If the final resistance is measured at once without this charging up, the electrolytic capacitors are open or disconnected. If a short or a very low resistance is measured, one of the capacitors is shorted. Referring back to Fig. 5, we can determine which of the two capacitors is shorted by measuring first at pin 7 and then at pin 1. If we read zero resistance at pin 7 and 60 to 100 ohms at pin 1 then the filter input capacitor, 80 μfd., is shorted. If the readings are the opposite, chances are that the output capacitor, 100 μfd., is shorted, although the short could be in some other part of the "B+" bus.

Finding Test Points

The method of quickly locating troubles in the home by using test points above the chassis can be extended by the ability of the individual service technician. A great deal depends on the availability of such test points at the TV set, and many manufacturers have come to recognize the need for these points on their latest model receivers. Of course, many manufacturers have made provisions for test points for quite a while.

In color TV the design slate is still fresh and a good start has been made by the major manufacturers to include accessible test points. The *Motorola* 19-inch color receiver uses a 5-prong test receptacle which makes the video detector signal, a.g.c. bias, heater, and two "B+" voltages available to the service technician. Similarly, the *CBS-Columbia* 19-inch color set also has a test socket mounted on the back of the chassis featuring the same voltages as their monochrome receiver test point of Fig. 4.

The best known test point probably is the one found on most v.h.f. TV tuners and which is used for alignment of the r.f. stage. Similar points are also used on u.h.f. tuners.

In the *Emerson* model 760 three important test points are located on the top of the chassis. These are shown in Fig. 6. The two points brought out for the horizontal oscillator coil serve to short circuit this coil during adjustment of the horizontal balance control. During that process the grid of the preceding control triode is grounded. Another test point brought out in the *Emerson* models is the video detector output.

In the 1954 and 1955 *General Electric* TV receivers using printed circuits, a total of 10 test points has been designated, all accessible from the back. These allow very extensive troubleshooting without having to remove the chassis. These points are listed below and are all part of the printed wiring:

1, Converter grid (tuner); 2, 1st i.f. grid; 3, sync amplifier grid; 4, video-detector output; 5, kinescope grid; 6, limiter grid; 7, ratio-detector output; 8, a.g.c. to i.f. section; 9, sync amplifier plate; and 10, a.g.c. to tuner.

A note of caution should be included here as concerns working with printed wiring. Do not use any sharp test prods, and avoid scratching or forcing

(*Continued on page* 86)

Fig. 3. Waveform at the grid of the horizontal output amplifier tube of a TV set; its amplitude is 40 to 60 volts.

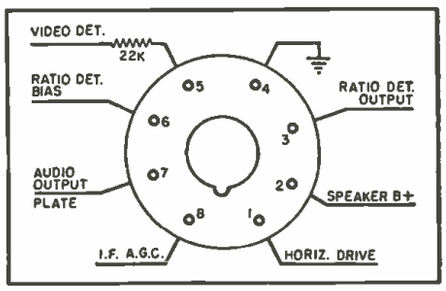


Fig. 4. Detailed drawing of the test socket shown on the chassis in Fig. 2.

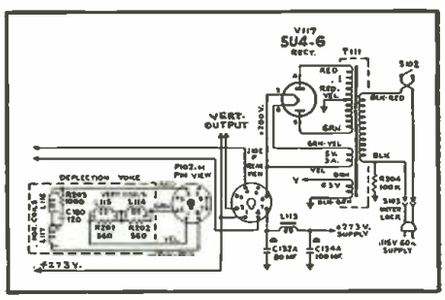


Fig. 5. Typical low-voltage power supply circuit of a television receiver.

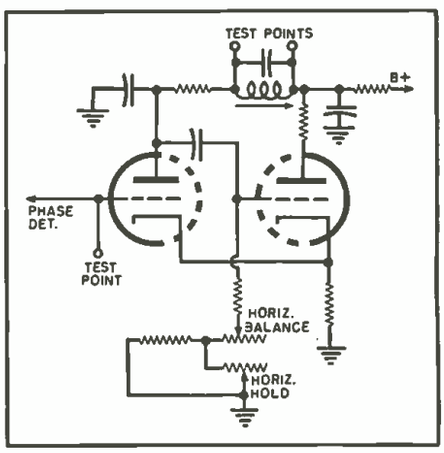
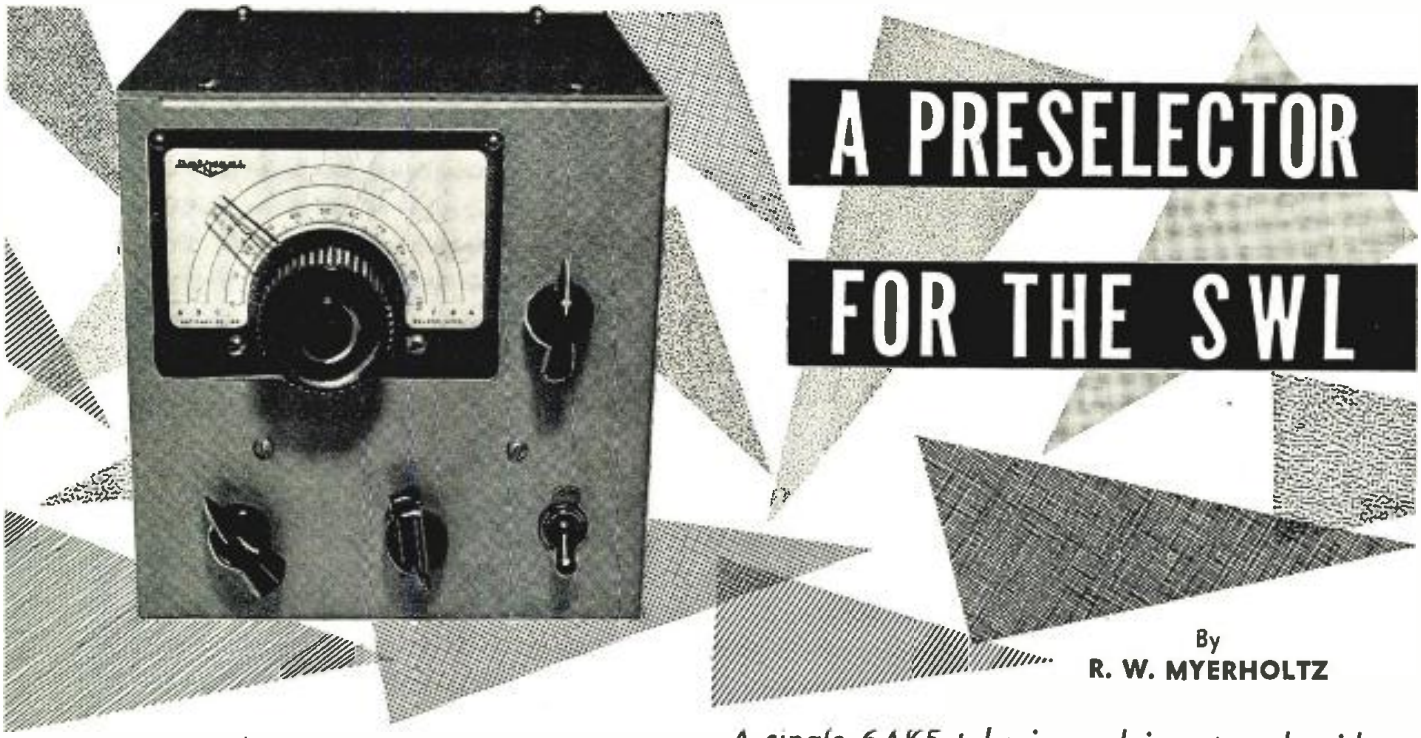


Fig. 6. The circuit location of three important test points for the horizontal oscillator circuit of Emerson sets.



A PRESELECTOR FOR THE SWL

By
R. W. MYERHOLTZ

Over-all view of SWL preselector.

A single 6AK5 tube is used in a tuned grid amplifier circuit. It covers 5.5 to 21 mc.

THE SWL using one of the less expensive receivers which does not have an r.f. amplifier stage misses a lot of interesting "contacts" simply because his receiver lacks sufficient sensitivity to "pull in" the many weak signals he encounters. A preselector used ahead of the receiver, however, will boost many of those barely readable signals to the "loud and clear" classification.

The preselector described herein consists of a single tuned stage of r.f. amplification which amplifies the signal from the antenna before it is presented to the mixer tube of the receiver. The frequency range of 5.5 to 21 mc. covers the wavelengths used by the principal short-wave stations of the world as well as the 40, 20, and 15 meter amateur bands.

Circuit Description

A single 6AK5 is used in a straightforward tuned grid amplifier circuit. A tuned grid—tuned plate circuit would undoubtedly have greater selectivity, but the need for ganged tuning capacitors and an additional set of coils would increase the cost, necessitate a larger cabinet, and introduce a tracking problem.

Instead of using choke-capacitor coupling to the receiver, it is possible to connect the primary of the receiver antenna coil directly into the plate circuit of the 6AK5. The choke-capacitor coupling, however, has the advantage that it may be employed with receivers not designed for use with doublet antennas without digging into the receiver to unsolder the grounded end of the primary winding. Furthermore, one will not be breaking the 6AK5 plate circuit each time the receiver bandswitch is turned, an act which might eventually lead to fouling of the bandswitch contacts.

A self-contained power supply was used to make the unit completely independent of the receiver with which it is employed. Transformer operation was chosen in order to permit operation with a.c.-d.c. receivers without the problem of wondering which way to insert the line plug and the coincident danger of a "hot" chassis. Since the current drain of the 6AK5 heater is considerably less than the rated value of the transformer filament winding, the filament voltage was a little too high. To reduce it to a more suitable value, a 3.3-ohm resistor was inserted in one lead.

A 10,000-ohm wirewound potentiometer in the cathode circuit provides a means for reducing the gain to prevent cross modulation effects when strong signals are encountered. The 10-ohm resistor, R_1, was found to be necessary to prevent oscillation under certain tuning conditions when the gain was run "wide open."

A three-lug terminal strip permits the use of a doublet or single wire antenna. In the latter case it is only necessary to connect a jumper between two of the lugs as shown by the dotted line in the schematic diagram. One position of the selector switch is used for "straight-through" operation with single wire antennas, permitting the unit to be bypassed when it is desired to tune the receiver to frequencies not covered by the preselector. Two other positions are used for bandswitching, while the two remaining positions are unused.

With the coils wound according to the data given in the parts list, the first band should cover about 5.5 to 11 mc. and the second, 10 to 21 mc. Slight differences in distributed capacitances arising from arrangement of leads and parts different from those used by the author may alter the coverage somewhat. If it is desired to raise the upper frequency limit, simply remove one-half to one turn from the grid winding. To lower the frequency limit, the reverse applies.

Since the tuning action of the preselector is somewhat broad, the vernier action of the MCN dial permits sufficiently precise adjustment of the tuned circuit at the lower frequencies. At the upper end of the frequency range, however, stations will be crowded closer together on the dial and the bandspread action of C_2 permits more critical peaking of the signal being received.

Construction

A 6" x 6" x 6" aluminum utility cabinet houses all of the components without undue crowding. A sheet aluminum "deck" mounted 2⅜ inches from the bottom edge of the cabinet serves as a chassis and provides good shielding between components mounted above and below it. The paint on the inside of the cabinet should be scraped away to permit good electrical bonding between the chassis and cabinet.

Before fashioning the deck, the inside dimensions of the cabinet should be carefully measured in order to assure a snug fit. It will be necessary to file a shallow notch in two corners of the deck in order to clear overlapped portions of the cabinet sides. Since the dial mechanism extends behind the panel, C_1 was mounted on an "L" bracket attached to the deck. C_2,

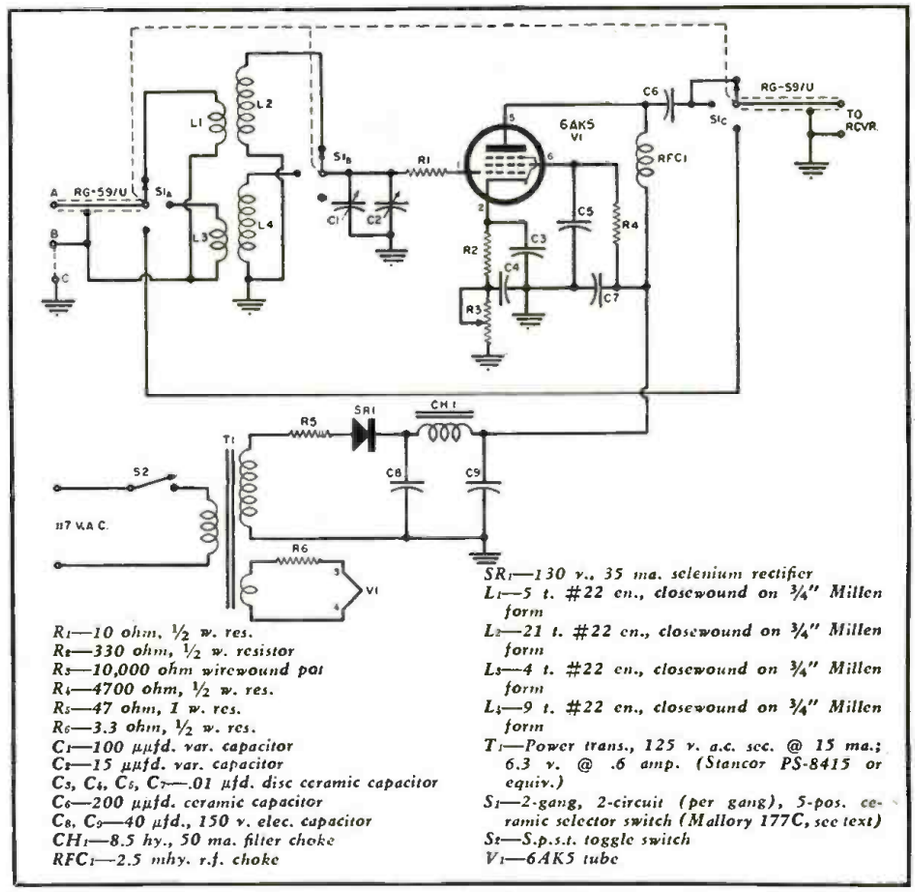
however, was mounted directly on the panel.

Incidentally, for those who find sheet aluminum for construction purposes difficult to obtain, the author suggests the use of aluminum cookie sheets available in most department stores.

The *Mallory* 177C ceramic selector switch is modified by placing a shield between the two gangs to prevent coupling between the input and output circuits. The procedure is quite simple. First remove the nuts and lock washers holding the last gang in place. By removing the cotter pin at the shaft, this gang may now be slipped off. Discard the two spacers found on the screws. In their place thread two 6-32 nuts onto each screw. A piece of sheet aluminum drilled to clear the two screws and the shaft is then slipped on, followed by two more nuts to act as spacers. The last gang is then replaced. A small shield should also be fashioned to straddle the tube socket in order to isolate the input and output circuits of the tube.

The coils are wound on *Millen* ¾ inch forms and mounted with 6-32 screws. It is important that the grid and antenna windings be wound in the same direction. The primary windings should be spaced ⅛ inch from the secondary in both coils. After the coils are wound, they should be coated with coil dope to keep the turns rigidly in place. Lacking coil dope, clear fingernail polish will make a good substitute.

The coils may be wound more neatly if one end of the necessary length of wire is first clamped in a vise and the wire is then stretched about ¼" with a pair of pliers. This will serve both to remove kinks and to stiffen the wire for easier winding.



R1—10 ohm, ½ w. res.
R2—330 ohm, ½ w. resistor
R3—10,000 ohm wirewound pot
R4—4700 ohm, ½ w. res.
R5—47 ohm, 1 w. res.
R6—3.3 ohm, ½ w. res.
C1—100 μμfd. var. capacitor
C2—15 μμfd. var. capacitor
C3, C4, C5, C7—.01 μfd. disc ceramic capacitor
C6—200 μμfd. ceramic capacitor
C8, C9—40 μfd., 150 v. elec. capacitor
CH1—8.5 hy., 50 ma. filter choke
RFC1—2.5 mhy. r.f. choke
SR1—130 v., 35 ma. selenium rectifier
L1—5 t. #22 en., closewound on ¾" Millen form
L2—21 t. #22 en., closewound on ¾" Millen form
L3—4 t. #22 en., closewound on ¾" Millen form
L4—9 t. #22 en., closewound on ¾" Millen form
T1—Power trans., 125 v. a.c. sec. @ 15 ma.; 6.3 v. @ .6 amp. (Stancor PS-8415 or equiv.)
S1—2-gang, 2-circuit (per gang), 5-pos. ceramic selector switch (Mallory 177C, see text)
S2—S.p.s.t. toggle switch
V1—6AK5 tube

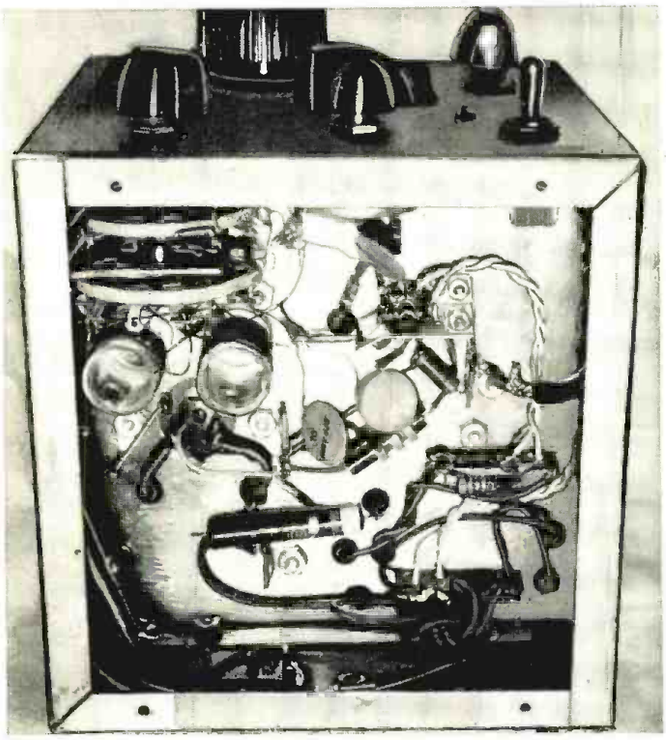
As shown in diagram, a 6AK5 is the only tube required in assembling this unit.

In wiring the unit one should follow the usual practice of keeping all leads as short as possible and taking care to keep grid and plate leads well separated. Be sure to twist together the filament leads from the transformer to pins 3 and 4 of the 6AK5, as well as the leads to the "on-off" switch. This will prevent the pickup of a.c. hum by other nearby wiring.

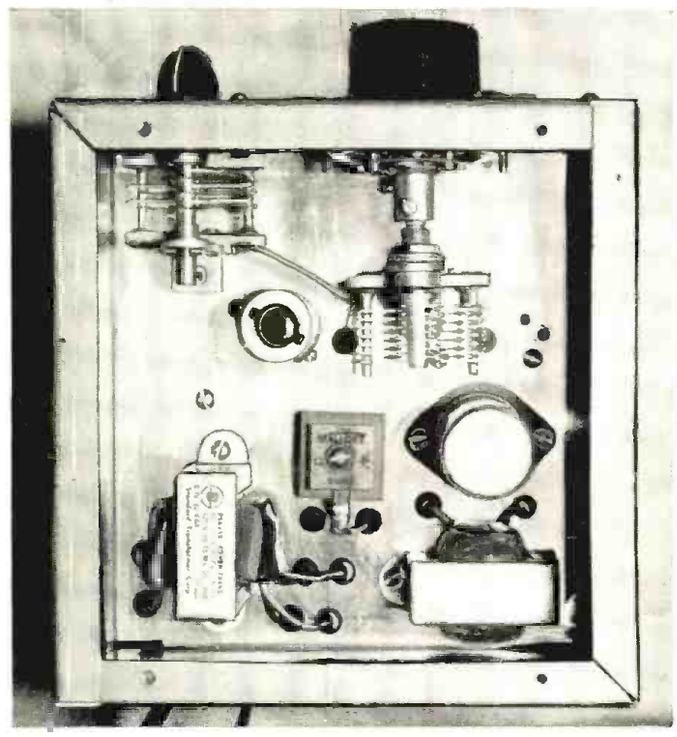
All grounded leads in the r.f. portion of the circuit should be grounded at a common point to prevent ground

(*Continued on page* 106)

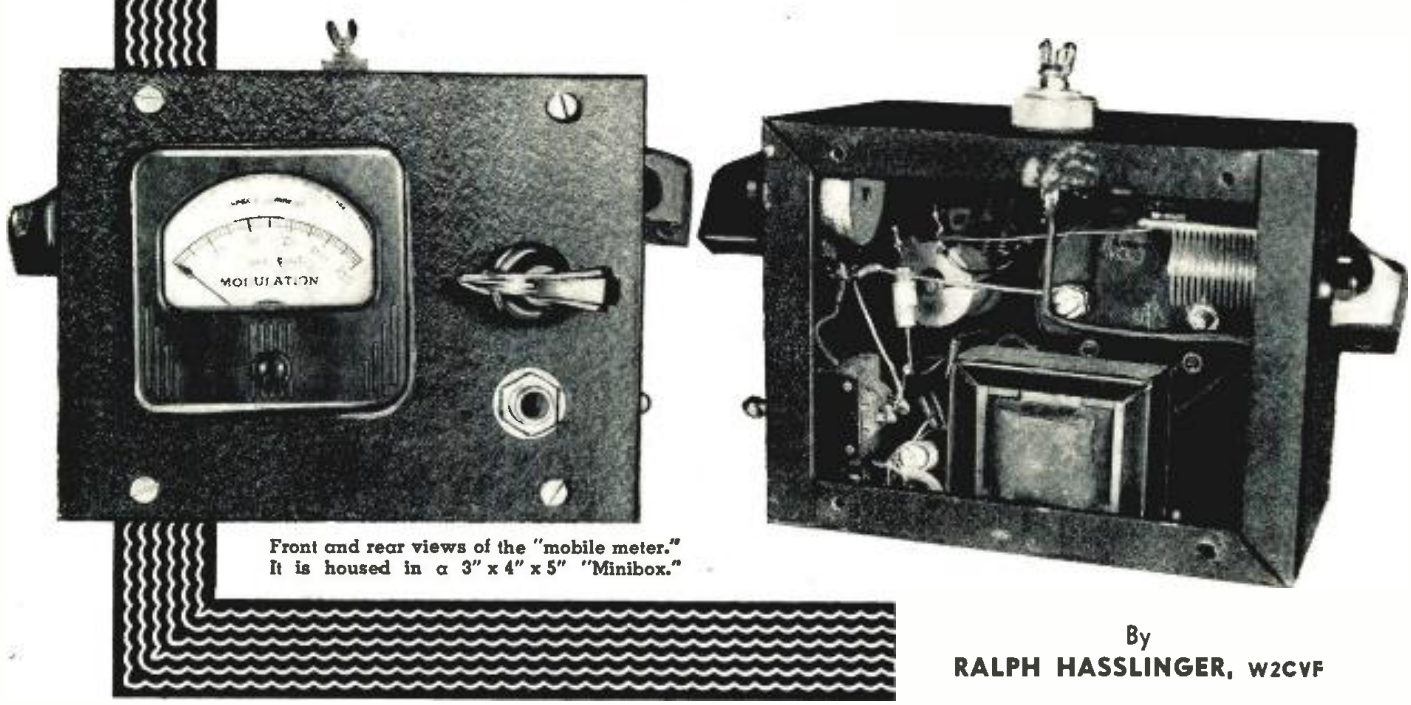
Below chassis view of preselector. Note particularly the metal shields across the tube socket and between switch sections.



Top view of the preselector showing general layout of major components. The actual assembly is simple and straightforward.



"MOBILE METER" OF MANY USES



Front and rear views of the "mobile meter." It is housed in a 3" x 4" x 5" "Minibox."

By
RALPH HASSLINGER, W2CVF

Details on a useful instrument which reads modulation directly in per-cent, acts as an audio monitor using headphones, as a field strength meter, a carrier shift indicator, a calibrated receiving "S" meter, as well as a 0-12½ or 0-1250 volt direct-current voltmeter.

ONE of the major problems in mobile operation, where the transmitter is located in the trunk, is the question of knowing up front, just what is going on in the transmitter behind.

The dash-mounted meter to be described was constructed to solve this problem and has done an excellent job for mobile W2CVF. It indicates r.f. (field strength), reads modulation directly in per-cent, monitors the transmitted voice with headphones, and can even be used as an "S" meter—no more reporting—*"if I had an 'S' meter in the car you'd be S9."*

The main feature is its ability to read modulation directly in per-cent. Mobile operation, with its high noise level from both ignition and mechanical sources, makes high level modulation mandatory. The writer attributes his success in working 10-meter mobiles all over the New York metropolitan area, up into Connecticut and out on Long Island, from the home station in West Englewood, mainly to the high level of modulation maintained. Although the power is only 75 watts and the location is average, the modulation is kept at a high level with the aid of a large 5" modulation meter directly in front of the operating position. It is regrettable that the outputs of crystal mikes change under humid conditions and carbon granules tend to pack.

The intelligence in voice transmission is in the modulation, not the carrier. A 10-watt carrier, 100% modulated will get through better than 100 watts, 50% modulated. With the transmitter located out of sight, modulation percentage becomes mere guesswork unless some type of indicator is used.

The circuitry of the instrument to be described is ordinary, being that of the usual field strength meter, which all of us have constructed at one time or other, with an added audio rectifier circuit for the modulation metering.

The audio transformer enables the audio portion to function with less r.f. energy input. The particular nondescript transformer used came out of the junk box, but any interstage audio transformer can be used. It should be noted that the primary and secondary windings are reversed in the circuit.

One of the first requirements of a dash mount instrument is that it be as small as reasonably possible. A 3"x4"x 5" standard black box was selected to house the 2-inch 1 ma. meter which we happened to have on hand. The meter, M_1, frequency tuning capacitor C_2, and monitoring jack J_1 are mounted on the 4"x5" cover. Before mounting the meter, the meter case should be removed and 25, 50, 75, 100, and 125 marked over the .2, .4, .6, .8, and 1, which appear on the scale. A neater and more commercial looking job can be done by cutting these numbers out of the text of any handbook and pasting them in place with rubber cement.

The tuning coil is mounted directly on the capacitor terminals. These components are wired before placing the cover on the box. Two 5" pieces of wire should be soldered to the ungrounded terminals of the jack to be connected in the circuit when the cover and box is finally assembled.

The "S" meter and voltmeter feature, involving components J_2, J_3, J_4, J_5, P_1, S_2, and R_2 were not incorporated in the unit pictured. If desired, these can be added and parts can be mounted on the side panel.

L_1-C_2 should be capable of tuning to the transmitted frequency. Coil details on L_1 are given only for the ten meter band. If the transmitter is to be operated on other bands it will be necessary to make L_1 a plug-in coil, or coil switching may be used for multi-band operation.

To calibrate the modulation meter it will be necessary to use a scope or a transmitter with a meter that has already been calibrated.

Place the meter near the transmitter. Attach a short piece of wire (about 3 or 4 feet) to the pickup terminal on the meter. S_1 should be set for r.f. reading. R_1 should be adjusted to have about 30,000 ohms in the circuit. C_1 and C_2 should be set at minimum capacity.

Turn on the transmitter and tune C_2 for resonance as indicated by maximum meter reading. Increase C_1 capacity and retune C_2 and keep repeat-

ing until the meter reads 100 at resonance. Throw S_1 to audio position and modulate transmitter to 100% as shown on the scope, or previously calibrated meter.

If the meter being calibrated reads low, the resistance at R_1 is too low and should be increased. If the meter reads too high, resistance R_1 is too high and should be decreased. Each time R_1 is changed S_1 should be changed back to the r.f. position and r.f. coupling tuning procedure should be repeated to obtain a 100% reading with C_2 tuned to *resonance*.

When R_1 has finally been set it should never be changed. If no accurate means of calibration is available, the meter may still be used as an arbitrary modulation indicator.

If the meter is also to be used as an "S" meter R_1 should be replaced with a fixed carbon ½ watt resistor of the same resistance obtaining in the calibrated circuit. The mounting hole for R_1 may now be used to mount R_2.

"S" Meter

The a.v.c. action of the car broadcast receiver furnishes the basis for using this instrument as a direct reading "S" meter. The a.v.c. negative i.f. grid voltage is developed in proportion to the strength of the signal received. As the bias increases, the i.f. plate current decreases.

It will be necessary to open the cathode circuit of the car radio i.f. tube. A jack mounted on the car b.c. receiver and connected as shown in the diagram will not inactivate the car receiver when the "S" meter is not plugged in.

The meter should be calibrated as follows: Cut out a strip of blank index card to fit the glass contour of the meter above the needle point, and paste to outside face of glass. Set S_1 at "S" position. Set R_2 at *dead short*. Plug the meter into the car's broadcast receiver. Remove antenna from converter to obtain a no-signal, no-noise condition. Back off on R_2 until meter reads full scale. This will be "S" zero.

If converter does not have an r.f. gain control it will be necessary to temporarily insert some means of controlling the amount of signal at the converter antenna terminal. This can be accomplished by an input circuit pot.

Tune in a friend's signal—one who can vary his transmitter on a 1 to 4 power ratio. The amount of power is immaterial, it can be ¼ watt to 1 watt, or 250 watts to 1000 watts. However, the lower the power the closer one will have to be to the transmitter.

For explanatory purposes we will assume that the transmitter power will be 25 and 100 watts. Proceed as follows:

1. Transmitter at 25 watts. Adjust converter input gain control so that meter shows a slight deflection from "S" zero. Mark S1 on the scale at this point.

2. Transmitter power increased by four times to 100 watts. Needle will move up. Mark S2 at this needle position.

3. Transmitter power 25 watts. Needle will return to S1. Increase r.f. gain control on converter so that the needle will rest where you have marked S2.

4. Transmitter power 100 watts. Needle will again move up. This should be marked S3.

5. Transmitter power 25 watts. Increase converter r.f. gain control so needle points to S3.

6. Transmitter power 100 watts. Needle will move up again. This will be S4.

Continue this procedure until entire scale is calibrated. When completed the meter will be a really accurate one, with each S unit equaling 6 db or four times power—the generally accepted standard. Also it will be accurate, 6 db to the S unit, regardless of frequency or band being tuned by converter!

Any signal generator or oscillator that can be varied on a 1 to 4 power ratio may also be used with the aforementioned instructions still obtaining.

The r.f. or antenna input control may now be removed from the converter if it was a temporary addition. In my own installation I would not be without the r.f. gain control. It enables working mobiles or fixed stations in close proximity without having the front end of the converter blocked.

Most commercial receiver "S" meters indicate nothing more than arbitrary readings. If you have no means of calibrating in this manner arbitrary "S" markings maybe employed, but when the other chap increases power it's nice to be able to tell approximately how much before he tells you. Also if he makes a change of antennas, or what have you, it is invaluable to know just how much change in power it would take to make an equal change in signal strength. This cannot be done unless the meter is accurately calibrated.

Mounting in Car

The meter should be mounted, and case grounded, on the dash as nearly in front of the driver as possible in order to avoid the necessity of taking eyes off the road. A source of r.f. pick-up will be necessary of course. In most cases this may be left to experimentation, however a surefire method is to run a small wire in close proximity to the base of the whip. A slight amount of coupling only, will be necessary.

After you have used this instrument in your car a short time you will wonder how you ever operated without it.

While this instrument was designed primarily for mobile service it also makes an excellent fixed station or portable meter.

For those who desire a final touch, positive or negative peaks may be read by the addition of another d.p.d.t. switch inserted to reverse the audio transformer connections of either the primary or secondary.

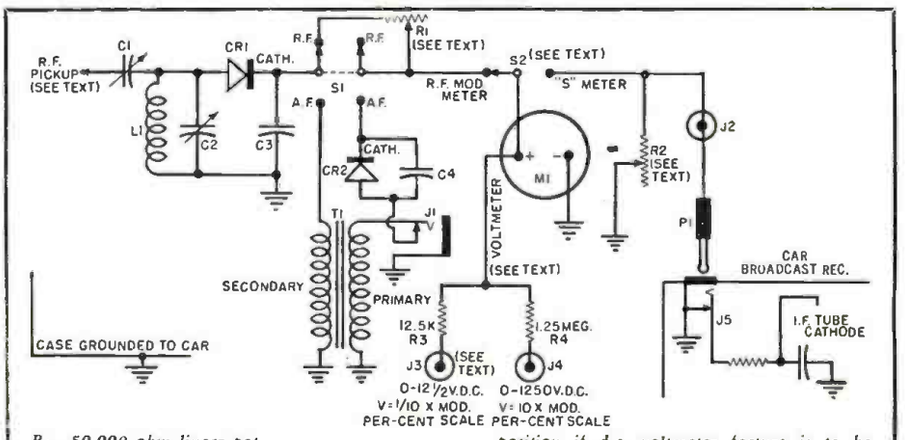
A pin jack and 1.25 megohm resistor may be connected in series with the positive terminal of the milliammeter to read the percentage scale as d.c. volts X 10. To operate as a d.c. voltmeter, however, S_2 must have a neutral position and be so set or damage to the instrument will result.

If battery *negative* is grounded, a 12,500 ohm resistor may also be used to obtain a 12½ v. full-scale reading.

With the voltmeter feature, genemotor input and output voltages may be checked, as well as general receiver and transmitter voltages.

Many other uses for this multipurpose instrument will undoubtedly come to mind. -30-

Schematic diagram covering the "mobile meter." If the meter is to be used as a voltmeter, S_2 must have an "open center" position. Low voltage reading cannot be used if the car's battery positive terminal is grounded. See discussion in text.



R_1—50,000 ohm linear pot
R_2—75 ohm wirewound pot
R_3—12,500 ohm, ½ w. res.
R_4—1.25 megohm res.
C_1—50 μμfd. var. capacitor (APC type with knob shaft)
C_2—100 μμfd. var. capacitor (APC type with knob shaft)
C_3, C_4—500 μμfd. mica capacitor
S_1—D.p.d.t. toggle switch
S_2—S.p.d.t. toggle switch (must have neutral position if d.c. voltmeter feature is to be used)
T_1—Interstage audio transformer (see text)
L_1—28 mc.—9 t. #18 en. closewound, 7/16" i.d.
CR_1, CR_2—1N34 crystal
P_1—Phone plug
J_1, J_2—Closed circuit jack
J_3, J_4, J_5—Tip jack
M_1—0-1 ma. d.c. milliammeter
1—Antenna feedthrough insulator
1—3" x 4" x 5" metal box

TROUBLESHOOTING

RADIO INTERMITTENTS

By JAMES A. McROBERTS

Intermittent radio troubles are servicing time wasters. Here's a new slant on how to track down such troubles and still work other service jobs at the same time.

THE intermittent short circuit presents the technician with some of his most baffling jobs. Unfortunately, he can not use his ohmmeter in the majority of these cases since the trouble is not permanent, but only happens after some time of operation. Even to try to use the ohmmeter may not be too desirable since the possibility exists that the trouble will be cured temporarily. Neither is the tube tester satisfactory for finding short-circuited tubes of the intermittent variety; the short may not occur while the tube is in the tester but may occur only under dynamic conditions of operation of the device. The apparatus may have entirely different voltages and operational conditions, such as high surrounding temperatures during operation as contrasted with the standard conditions of the tube checker. Furthermore, the intermittent "dog" is a time-consuming, unprofitable proposition unless some monitoring system is employed so that the troubleshooter can spend most of his time on other work with only occasional inspection of the "dog" and its monitors.

This article presents a method which frees the technician from constant watching, which protects—partially at least—the components from damage, which does not risk a curing of the trouble before its cause can be discovered, which allows normal operation of the circuit, and which provides a visual monitor. The method is applicable to all types of electrical and electronic circuits.

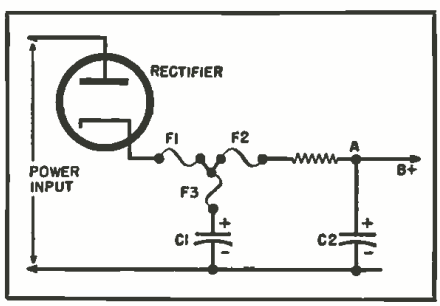


Fig. 1. Simplified schematic diagram of part of the rectifier circuit of a typical a.c.-d.c. table radio showing the fuses inserted for the first step in monitoring an intermittent.

Basically the method entails breaking up the circuit into separate sections and inserting a fuse or fuse-like device into each branch with another fuse or fuse-like device in the main or feeder line. The device (radio, TV, amplifier, recorder, etc.) is now operated until one of the fuses blows. This yields information for the next test, or for the repair. The method is most easily illustrated by an example such as the checking of the "B" circuit of an ordinary a.c.-d.c. midget radio set.

Assume that you have to repair an a.c.-d.c. set in which the complaint is that it blows a rectifier tube after an hour or so of operation. Such a job would be rather profitless if someone had to watch the rectifier tube until it glowed red hot and then quickly cut off the power. Even so, the short circuit might be caused by the audio output transformer which expanded with the heating of the set and rapidly cooled off again—an ohmmeter test would be hard to use quickly enough in such a case; or suppose the output tube shorted when it became sufficiently heated in operation. Proper fusing of the branch circuits gives the answer for perhaps a quarter's worth of fuses and old fuseholders from the junk pile, and the time is about the same as any other repair job.

The schematic of the first step is shown in Fig. 1. Fuses F_1, F_2, and F_3 are employed in this case as the first test. Fuse F_1 is the line fuse—do not omit this fuse; if desired, the line fuse may be placed in series with the power supply line thereby eliminating the need for fuse F_1, if you remember to put in the proper value of fuse at the start of each job. The proper value is that which will blow on the slightest overload.

With the device turned on, if a short circuit develops subsequent to fuse F_1, either fuse F_2 or F_3 will blow, assuming that F_2 and F_3 are of low enough rating. If F_2 blows, the circuit is broken and re-fused subsequent to the resistor, say at point "A." If fuse F_3 blows, then capacitor C_1 must be replaced irrespective of any test on an ohmmeter or capacitor tester.

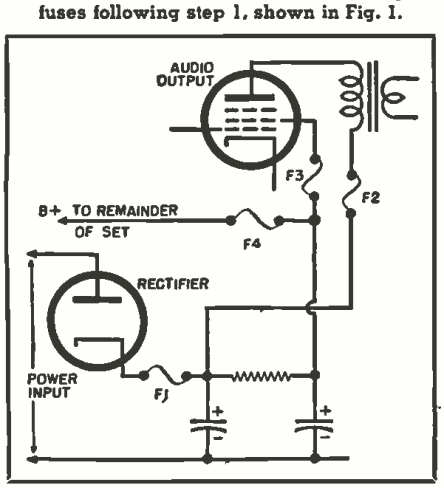
Assume that F_2 blows and the circuit is re-fused again with F_2 in the "B+" line after the resistor and F_3 in series with capacitor C_2. If F_1 is left where it was (as it should be) and F_1 blows, then the trouble is in the resistor. If F_3 blows, replace C_2; if F_2 blows, then the "B+" line must be fused again elsewhere, as in Fig. 2, for more testing.

Fig. 2 shows the next major step in testing. The fuse F_1 still guards the power supply, while F_2 now is in the "B" feed to the audio output plate. F_3 is in the screen grid circuit, and F_4 is in series with the remainder of the "B" feeder bus. In practice, this hookup could have been made immediately following the first test with the setup of Fig. 1, although a short circuit blowing F_1 in such a case would necessitate the return to point "A" of Fig. 1 for further testing.

If F_2 or F_3 of Fig. 2 blows with the set working, then the audio stage must be broken down into pieces and all leads and parts tested or replaced. If F_4 blows, then the remainder of the "B" feeder bus must be broken into sections with a fuse in each. Ordinarily, only three or four blown fuses nar-

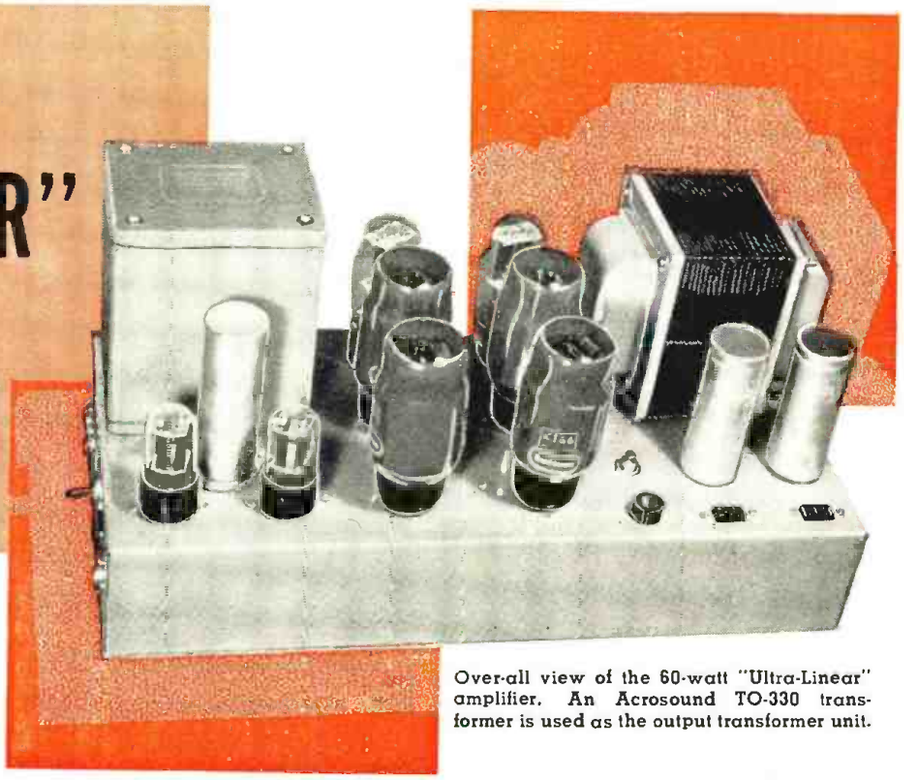
(*Continued on page* 164)

Fig. 2. Redistribution of monitoring fuses following step 1, shown in Fig. 1.



A 60-WATT "ULTRA-LINEAR" AMPLIFIER

By
DAVID HAFLER
Acro Products Company



Over-all view of the 60-watt "Ultra-Linear" amplifier. An Acrosound TO-330 transformer is used as the output transformer unit.

Construction details on a commercially-designed, high-power amplifier for the serious audiophile. It uses four KT66's.

MANY high fidelity amplifier circuits have been made available in the low and medium power brackets. However, there has been very little activity in development and public dissemination of high powered amplifier circuits in the power range over 50 watts.

There are many applications in which high powered, high fidelity amplifier capabilities are desirable or even mandatory. In addition to non-sound reproducing functions in laboratory and industrial applications, high powered audio units find application in recording work, in auditorium and amphitheater work, and in systems where power is divided over many different speakers in different rooms or areas. There is also a school of thought which believes that high power is required in home high fidelity installations for the ultimate in realistic reproduction.

The necessity for high power in home use has been doubted by some authorities, but its proponents have several valid arguments which must be given some weight. They claim that high power is required for proper reproduction of musical transients since transient waveforms require more power than the sine waves which are used as the basis for conventional amplifier ratings. For example, reproduction of a square wave of given amplitude requires *twice* the power of a sine wave of the same amplitude.

Another cogent argument for high power is that amplifiers have to work into loudspeaker loads of widely varying impedance. At the bass resonant frequency a loudspeaker might show an impedance of many times the nominal value. No amplifier can deliver its rated undistorted power into a load which represents such a severe mismatch. A wide reserve of power capability is thus required to maintain high fidelity operation under normal listening conditions. The argument, which always is used as a "clincher" for high power, claims that like a high powered car, a high powered amplifier is smoother at all levels because it operates at only a fraction of its potentialities and is rarely pushed to the limit.

On the other hand, many experiments have been made to demonstrate that only a few watts are needed in home installations. This is generally done by measuring the *average* power used in a specific installation and allowing for an estimated ratio of peak to average power. This type of test indicates the *customary* listening level at a specific audio installation. It does not actually indicate how much power would be required to simulate the *realistic* auditory loudness of live music. Few people are interested in reproducing the full acoustic power of an orchestra in their living rooms. However, many want to have the same sound pressure at their ears that they would get in the concert hall. Anybody who has listened to a full scale symphonic orchestra, or even a large dance band, is immediately aware that it takes tremendous power to duplicate the same sound intensity even in a smaller room where power requirements are far below those of the concert hall.

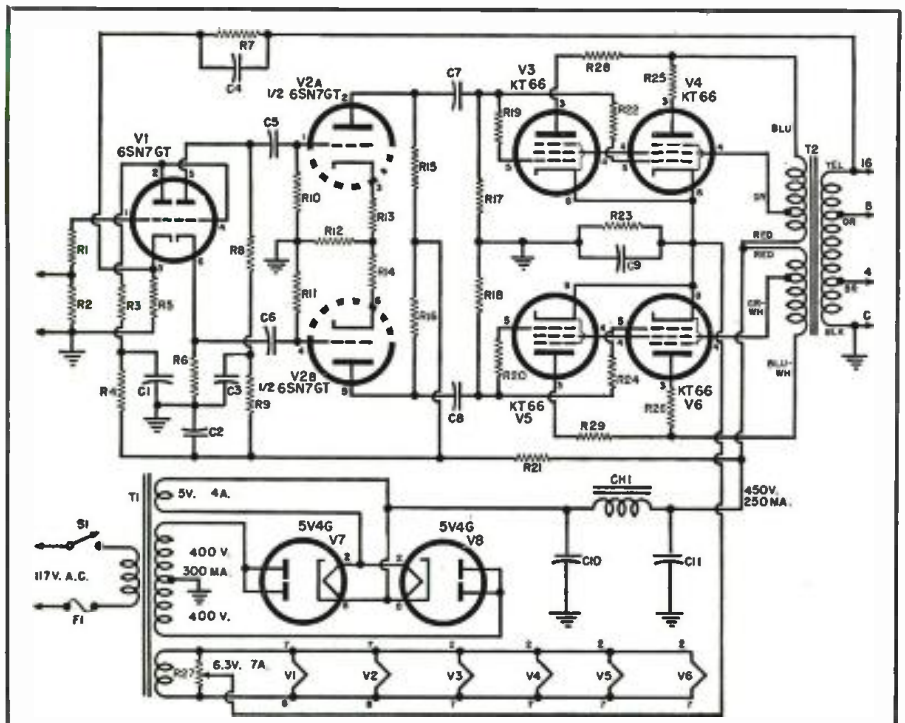
If the goal of high fidelity is "concert hall realism in the home" as many people agree, then a lot of power is required. Estimates of requirements run extremely high. One published figure [1] calls for 100 watts of clean power. In contrast, estimates based on average usage generally run about 10 watts. Superficially, this divergence of opinion looks extreme. However, the range of 10 to 100 watts is only 10 decibels wide —approximately 10 audible steps of difference. The extremes are not as far apart as it appears on the surface, and it is probable that an intermediate rating will serve the needs of the most critical home installations. However, it is difficult to achieve intermediate power levels of 50 watts or more using conventional parts and conventional circuitry.

Approaches to High Power

There are many designs available for powers up to about 25 watts. When this point is passed, ordinary operating conditions and circuits are not directly applicable. When it is desired to exceed 50 watts of clean power and still preserve high quality, the problems of design are rather acute. There are several possible approaches which warrant consideration:

1. *Class B* (overbiased operation) provides high efficiency and delivers high power at low operating cost. However, overbiased operation causes excessive distortion at lower levels even though high level distortion can be made relatively low. A Class B amplifier with 1 per-cent distortion at 50 watts may have ½ per-cent at 1 watt—an excessive amount for high fidelity standards. Class B amplifiers also have inherently poor regulation, and careful attention must be paid to the design of power and bias voltage supplies or peaks of operation will shift voltages and operating conditions causing transient distortion.

2. *Class AB_2* operation provides high power by driving the output stage into



R1—10,000 ohm, ½ w. res.
R2—1 megohm, ½ w. res.
R3—47,000 ohm, 1 w. res.
R4—33,000 ohm, 1 w. res.
R5, R18—470 ohm, ½ w. res.
R6, R8—22,000 ohm, 1 w. res. (matched pair)
R7—12,000 ohm, ½ w. res.
R9—22,000 ohm, 1 w. res.
R10, R12—470,000 ohm, ½ w. res.
R13, R14—220 ohm, ½ w. res.
R15, R16—47,000 ohm, 2 w. res. (matched pair)
R17, R18—100,000 ohm, ½ w. res.
R19, R20, R22, R24—1000 ohm, ½ w. res.
R21—2500 ohm, 5 w. wirewound res.
R23—150 ohm, 20 w. wirewound res.
R25, R26, R28, R29—27 ohm, ½ w. res.
R27—100 ohm wirewound pot.
C1, C3—20 μfd., 450 v. elec. capacitor.
C2—30 μfd., 450 v. elec. capacitor.
C4—82 μμfd. mica capacitor.
C5, C6, C7, C8—.25 μfd., 400 v. capacitor.
C9—250 μfd., 50 v. elec. capacitor.
C10, C11—16 μfd., 600 v. elec. capacitor.
T1—Power trans., 400-0-400 v. @ 300 ma., 5 v. @ 4 amps., 6.3 v. @ 7 amps. (Thordarson No. 22R35 can be used).
T2—Output trans., (Acro Sound TO-330).
CH1—Filter choke, 4 hy., 250 ma., 60 ohms. (Stancor No. C1412 can be used).
S1—S.p.s.t. toggle switch.
F1—Line fuse, 5 amps.
V1, V2—6SN7GT tube.
V3, V4, V5, V6—KT66 tube.
V7, V8—5V4G tube.

Complete schematic diagram of the Acro-designed 60-watt "Ultra-Linear" amplifier.

the grid current region. The driving stage must be able to deliver power at low distortion into the output grids. These grids present a low impedance when they are driven positive, and distortion is created in the driving stage unless transformer coupling or other involved and expensive circuitry is utilized. This mode of operation also has poor inherent regulation as the Class B stage with consequent problems of power supply design. Lastly, it utilizes a lowered plate to plate impedance to get higher output, and this creates high distortion at low levels similar to what happens with a Class B stage.

3. *High voltage transmitting tubes* can be used for high power output. However, the associated voltages are in the lethal range of 1000 volts or over, which is definitely undesirable. In addition, the tubes and necessary power supply make the amplifier quite costly.

4. *There are "hot" tubes* on the market such as the *RCA* 6146 (and the *Tung-Sol* 6550 which will be available shortly) which can provide high power at reasonable supply voltages. Experiments with these tubes for high fidelity circuits are being carried out, and results will be made available eventually. Present efforts have not surmounted all the problems of using these tubes in reasonably-priced, efficient circuitry.

5. *Parallel operation* of tubes is relatively inefficient and requires careful design to avoid parasitic oscillations. However, there can hardly be a better way of getting high power than by taking a stage of desirable characteristics and paralleling it with another stage. Williamson mentions using sufficient pairs of output tubes in his famous circuit to achieve 70 watts of output. The inefficiency of this arrangement renders it rather impractical; but if the basic stage is efficient and can do better than 25 watts, parallel operation with two pairs of tubes will produce the desired output power and will still be practical.

Circuit Considerations

Consideration of the various alternatives for getting high power and high fidelity simultaneously points to the paralleled stage as being the simplest and most foolproof and bug free. It is not efficient, but this means merely that a slightly higher drain is put on the electric meter than would exist with Class B or Class AB_2 operation. Efficiency is of minor importance unless portable operation is required where power is costly.

The choice of type of output stage to parallel is restricted. There are no triode stages with conventional receiving tubes which provide sufficient output. Tetrode stages have excessive low level distortion, are very sensitive to impedance mismatch and, therefore, are subject to nonlinearity using speaker loads since these have a reactive component and an impedance which varies with frequency. The choices left are the Ultra-Linear stage or the tetrode with local feedback such as is achieved with a cathode winding on the output transformer. This latter circuit has had a recent revival of popularity after favorable comment by Williamson.

Obviously, the use of local feedback will improve the characteristics of the output stage and seems to be an attractive arrangement. However, there is a penalty attached to the use of feedback. Sensitivity is reduced in proportion to the amount of feedback. This puts a severe limitation on the use of feedback over an output stage alone. In the circuitry under consideration, the driver stage must supply about 30 volts r.m.s. to each output grid. If 6 db of local feedback is used on the output stage, the driving requirement is 60 volts r.m.s., or about 88 volts peak, for each grid. This brings the driver stage to the point where its distortion becomes significant.

Good design calls for integrated performance of an amplifier, and the driver and output stage must be considered as a unit. On this basis, a conventional type of *RC* coupled driver combined with an Ultra-Linear output stage will give less distortion than the same driver and a tetrode stage with cathode feedback. Therefore, Ultra-Linear operation has been selected for the paralleled output stage. The justification of this choice is shown by the extremely low distortion characteristics of the push-pull parallel amplifier.

Experience with paralleled output tubes has indicated that some parasitic oscillation is probable unless "stoppers" are used for partial isolation of paralleled elements. The present design, therefore, uses grid stoppers of 1000 ohms each and plate stoppers of 27 ohms each. These eliminate the usual difficulties encountered when tubes are paralleled.

The four tube output stage requires the same signal drive at the grids as is needed in a two tube circuit. Therefore, a push-pull driver stage similar to that of the Williamson circuit will handle the drive requirements adequately and with low distortion. This, in turn, can be preceded by any high quality phase inverter. Again the Williamson arrangement of voltage amplifier directly coupled to the cathodyne inverter is satisfactory.

The basic tube alignment described must be powered by a fairly heavy

power supply. The use of four output tubes doubles the normal current consumption of the Ultra-Linear output stage, and the B+ requirement is about 250 ma. To exceed 50 watts of clean output, the B+ voltage should be in excess of 425 volts. A 300 ma. transformer of 400 volt rating, along with two 5V4G's paralleled, and capacitor input can supply the amplifier with the desired requirements. There is no need for choke input or other means of improving power supply regulation because the amplifier has good inherent regulation with practically no change in current drain as the output level is varied. This good regulation is a very desirable characteristic of the amplifier as it obviates the possibility of transient distortion caused by momentary changes in tube operating conditions. It makes the use of cathode bias practical, just as with Class A triode stages, since the constancy of cathode current in the output tubes maintains a corresponding constancy of bias, with a fixed drop across the cathode resistor.

The final element in the design of the amplifier, and a very important element, is the feedback circuit. In a circuit of the quality sought, it is desirable to utilize about 20 db of negative feedback in order to provide the well known advantages of lowered distortion, reduced hum and noise, and improved damping of the loudspeaker. However, feedback must be integrated into the design and cannot be added haphazardly or indiscriminately with the expectation of experiencing no difficulty. It is probable that the uninformed use of feedback will result in the degraded performance of most circuits since the feedback may not be stable, and *regeneration* rather than *degeneration* will be experienced. This can cause increased distortion, hangover, boom, and screechy effects caused by high frequency ringing. Even if the amplifier is stable under quiescent conditions, it is possible for instability to occur momentarily under some operating conditions. This transient instability is one of the factors which makes for discrepancy between the measured performance of an amplifier and its listening characteristics. They can measure well and not sound well.

Considerations of Feedback Stability

In any feedback amplifier, regeneration will occur if the phase shift reaches 180 degrees before the amplifier gain has dropped by an amount equal to the amount of feedback. For example, if it is desired to use 20 db of feedback, the 180 degree phase shift points at high and low frequencies should not be reached until the gain of the amplifier without feedback has decreased by at least 20 db. In other words, phase shift must be kept down until the normal roll-off of the stages has taken effect.

A quick appreciation of the design problems involved can be had by observing the problems of feedback design at low frequencies. If there are two *RC* stages and the output transformer included in the feedback loop (as is true in the Williamson type of circuit), there are three sources of low frequency phase shift. If each of these has the same time constant, the 180 degree point is reached when each of these three sources contributes 60 degrees of phase shift. In this hypothetical case, the gain has decreased 18 db at the critical phase shift point, since 60 degrees of phase shift corresponds to 6 db of gain reduction in a single stage, and there are three such stages involved. Thus 18 db is the limit to the permissible feedback if instability is to be avoided.

How can 20 db of feedback be run if the amplifier goes unstable with 18 db? The answer is that the phase shift must be reduced. This can be accomplished by introducing *phase shifting networks* or by *staggering* the time constants of the various stages so that a given gain reduction is accompanied by less phase shift.

The low frequency stability of the original Williamson circuit was dependent on two *RC* networks with equal time constants and the output transformer time constant. When the inductance of the transformer made its time constant equal to that of the interstage networks, 20 db of feedback could not be accomplished with the desired degree of stability. Since the transformer's time constant is variable depending on the d.c. balance of the output tubes, a.c. excitation level of the output stage, variability in core material, production quality control, etc., there was always the possibility of running into instability either continuously or during some intervals of use. This is certainly an undesirable condition which caused many Williamson amplifiers to have low frequency instability.

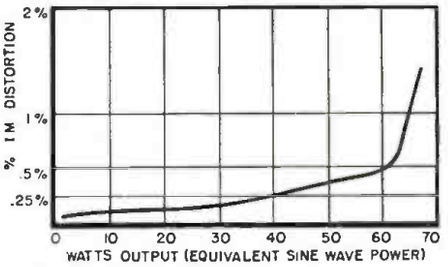
When the Ultra-Linear version of the Williamson type circuit was designed, this problem of low frequency stability was investigated, and steps were taken to extend the margin of stability. This was done by *staggering* the interstage *RC* networks by lengthening one of them. The same expedient has proven beneficial in the push-pull parallel version of this circuit and has, therefore, been included in the design.

The high frequency stability problem is not as simple to analyze because of the fact that the performance of the output transformer at high frequencies is more complex than that of a simple *RC* network. As a general rule, the amount of feedback obtainable at high frequencies for a given circuit is directly dependent on the quality of the output transformer which must have both low and smooth phase characteristics over a very wide bandpass. Many criticisms leveled at feedback circuits made condemnations

(*Continued on page* 100)

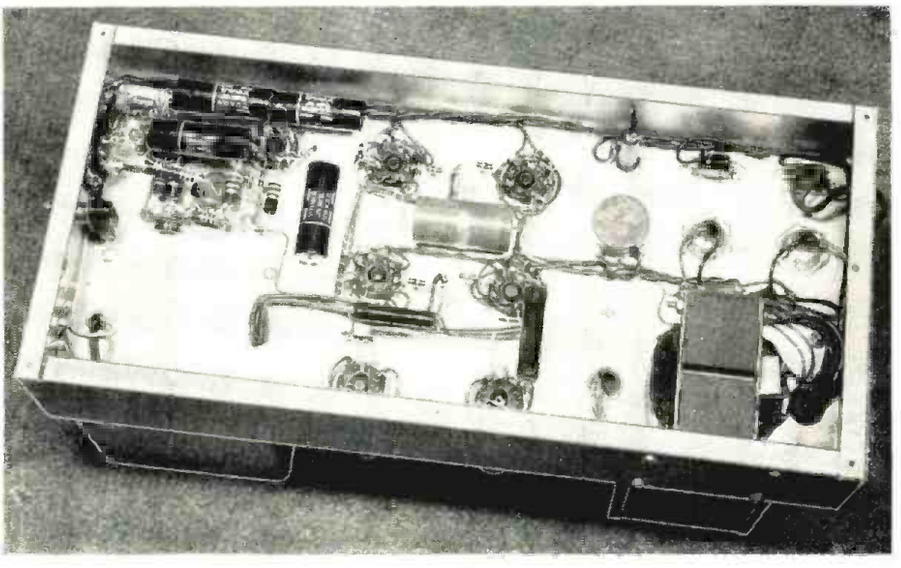
AMPLIFIER SPECIFICATIONS

POWER RATING	60 watts at not over 1 per-cent IM distortion
SENSITIVITY	1.3 volts r.m.s. for 60 watts output
FREQUENCY RESPONSE	@ 1 watt plus or minus 1 db; 2 cps to 200 kc.
	@ 20 watts plus or minus 1 db; 10 cps to 100 kc.
	@ 60 watts plus or minus 1 db; 20 cps to 20 kc.
DAMPING FACTOR	16



Intermodulation distortion vs power output (40 and 60 cps mixed at ratio 4:1)

Underchassis view of the 60-watt amplifier. Parts layout eliminates hum problems.



By **BERT WHYTE**

THE New Year is the traditional time to make resolutions, and I have a whole passel of them. One of the most important concerns you, dear reader! You see, a great many of you nice people have been writing me letters about records, equipment, etc., and I have been most remiss in my answering. Nothing deliberate, you understand. Your letters are always sincerely apperciated, but it has been difficult to find the time to take care of much of the correspondence. Not having a secretary makes it doubly tough to get my mail out as fast as I would like. However, I hereby resolve that in this year of 1955, your letters will receive prompt attention and I hope no one will have to wait for an answer more than two weeks.

A recent article in a contemporary publication, dealing with the foibles and failings of record critics, makes necessary a re-statement of one of the basic policies of this review column. In the magazine world, space is all important. A given number of editorial pages must be supported by a certain minimum of advertising pages. Any expansion in an article or of a department, invariably calls for increased advertising revenues. In short . . . space is very, very precious. It therefore behooves one to use the available space with discretion . . . to achieve maximum utility. I have said it before, and although I may be wrong . . . I'll say it again; what is the use of filling up this precious space with reviews of *poor recordings*, when there are so many *good* recordings to bring to your attention? Naturally, there is flexibility in this operation. An outstanding work of music, like a Beethoven "9th," or a Brahms "Requiem," coming from a major company, with an important conductor and orchestra . . . *must be reviewed* whether the recording is good, bad, or indifferent. But this is the exception that proves the rule. By and large, I try to confine the contents of this column to those recordings which seem to be musically and technically acceptable to my ear, and which I think will be of interest to you. Once again let me state that I do not imply that a recording which doesn't appear in this column, is categorically, "no good." It is obvious that the LP output is so great, no critic can cope with all the releases, and some good recordings are bound to get overlooked. So that's it, friends. As long as the record companies keep on turning out enough *good recordings* each month, this is the kind that will be reviewed in these pages.

Equipment used this month: *Weathers* arm, oscillator and cartridge; two *McIntosh* M30 amplifiers; *McIntosh* C8P audio compensator; *Components Corporation* turntable; *Jim Lansing* D34001 horn speaker; *Electro-Voice* "Georgian" speaker; tape equipment: *Ampex* 600.

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 publisher of this magazine.

BERLIOZ
SYMPHONIE FANTASTIQUE
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG50034, RIAA curve. Price $5.95.

In a year of notable recordings of Berlioz works, this is easily one of the most outstanding. Dorati brings to this symphony a new approach which is quite a refreshing change. He treats the work in a more integrated fashion than other conductors who seem in a hurry to get through with the early movements, so they can land with both feet on the "March to the Gallows" and the "Witches Sabbath." Dorati's handling of these last two movements is hair-raising, for the passionate intensity and propulsive energy with which he imbues them. Yet, the earlier movements are not glossed over, nor made subsidiary to the ensuing "fire-breathers." Dorati's tempi are generally straight-forward, perhaps a mite slower than some recent performances I have heard, notably Charles Munch's. While Mr. Dorati hews to the broad line throughout the work, he has not neglected to use his extraordinary talents for dynamic expression. This is certainly the most colorful version of this score on records, and in the matter of sound, it wins hands down. Strings are silky smooth, brass is ultra-bright, with the brass choirs in superb balance, and the woodwinds have a remarkable "liveness" and purity of tone. The tremendous impact of bass drum and tympani in the last two movements, has to be heard to be believed. Couple all this wide range, distortion-free sound with an incredible range of dynamics and the "just right" acoustic perspective, and you have an absolutely stunning recording. The surfaces in my copy were quiet and the RIAA curve was improved by a little bass boost.

HANDEL
THE WATER MUSIC
The Hewitt Orchestra conducted by Maurice Hewitt. Haydn Society HSL-107, NARTB curve. Price $5.95.

This is the third recording of the complete "Water Music," and by far the best. The earlier efforts by Bales on the *WCFM* label and by Lehmann on the *Decca* label were fair representations of the work, but the sound is now somewhat dated. I must admit that while I have heard of the Hewitt Orchestra, I know very little about its background or accomplishment. From what I have heard on this disc, it seems a better than average orchestra of the type usually employed in European recording. If the ensemble work is a little sloppy at times, they make up for it in the spritely performance. Hewitt is quite apparently an old hand with this score and his reading is to be preferred over the earlier recordings. Soundwise, this has no competition from either the *WCFM* or the *Decca* versions. String tone is generally good, and the all important horns are splendidly reproduced. If you want the best available of one of the most interesting and enjoyable of Handel's scores, this is the recording of choice. The disc conformed to the NARTB curve.

FRANCK
SYMPHONIC VARIATIONS
D'INDY
SYMPHONY ON A MOUNTAIN AIR
Aldo Ciccolini, pianist, Orchestre de la Societe des Concerts du Conservatoire conducted by Andre Cluytens. Angel 35104. RIAA curve. Price $5.95.

These works should be better known than they are. The average audiophile will give you a blank stare if you mention D'Indy's name, yet his "Symphony on a Mountain Air" is certainly the colorful type of thing that they like. Perhaps it is because there have been few recordings of the work and up to this present version, none that was really "hi-fi" in sound. At any rate, the D'Indy and the Franck works are here afforded the proper recording. The piano is beautifully reproduced, a very liquid type of sound; the strings are quite clean and the woodwinds, so important in the D'Indy, are of exceptional clarity. It is unfortunate that there are a few faults which may negate the value of the recording to some. One thing is the "dead" acoustics, which are most annoying in the 2nd movement of the D'Indy. The other is the somewhat lackluster performance of Ciccolini. His tempi are quite slow and the music has none of the zip and sparkle of the old Casadesus-Munch recording. No adjustment of the RIAA curve was necessary and surfaces were exceptionally quiet.

SHOWPIECES FOR ORCHESTRA
RIAS Symphony Orchestra, Berlin, and the Berlin Philharmonic Orchestra conducted by Ferenc Fricsay. Decca DL-9738, NARTB curve. Price $5.95.

Ferenc Fricsay is one of the most acclaimed of post-war European conductors. Here, in this potpourri of standard works, he gives considerable evidence to support this reputation. His readings are well balanced, nicely paced, and his dynamic shadings are quite impressive. I find the work of the RIAS Symphony a notch or two higher than the Berlin Philharmonic, possibly due to the closer association of conductor and orchestra. The "1812 Overture" of Tchaikovsky is heard on this disc in the seldom-performed choral arrangement, an interesting novelty which collectors will want. The sound on this disc is quite variable. In the "1812 Overture" and "Bohemia's Woods and Fields," the sound is fairly wide range, clean but not outstanding. In the preludes to Acts 1 and 3 of "La Traviata," there is some magnificent string work of beautiful quality. And in Johann Strauss, Sr's. "Radetzky March" some really ripsnortin' brass and a big bass drum sound of noble proportions. If you own a king-size speaker system, this March is worth the price.

MASSENET
SCENES PITTORESQUES
SCENES ALSACIENNES
Orchestra de Concerts Lamoureux conducted by Jean Fournet. Epic LC3053, NARTB curve. Price $5.95.

These colorful and charming orchestral suites have long been relegated to the "pop concert" repertoire, but not without a struggle. They are still occasionally programmed in symphony concerts (mostly in Europe) and fare very well. While this present recording has a few faults, it is far beyond the old Mitropoulos-*Columbia,* especially in the sound department. Fournet gives the works a spirited and ingratiating reading and gets some fine playing from his orchestra. Sound is moderately wide-range, with naught but infre-

(*Continued on page* 114)

SERVICING COLOR TV

By MILTON S. KIVER *

Removing a Westinghouse color TV receiver chassis from its cabinet. Not all color TV sets consist of a single chassis as this one does for easy removal.

Part 2. A practical time-saving approach to servicing color TV sets which show no color or unstable color.

LAST month we considered two major aspects of color TV servicing: checking the raster and viewing the black-and-white picture to see whether any extraneous color appears. These two checks would always be made in the sequence given, in order to isolate a disturbance to a specific section of the receiver. We have reference here to defects whose origins are not immediately recognizable from an initial inspection of the screen. However, if no picture at all can be obtained on the screen, then obviously raster inspection would hardly be necessary. In this instance, the best approach would be to trace the signal with an oscilloscope, starting perhaps at the video second detector. On the other hand, if we do obtain a picture on the screen and it is distorted, either in shape or in color, then the testing procedure outlined in Part 1 would be entirely in order.

We come now to those color troubles which have their origins in the color sections of the receiver. Analysis reveals that these color defects will generally fall into one of three categories.

1. No color at all, when we know that there should be color
2. Incorrect color rendition
3. Color instability

Once a specific trouble is categorized, the technician is then able to proceed in a logical manner to narrow down further the location of the defect. The rewards of a systematic procedure include not only shorter servicing time and the assurance of doing the job correctly the first time, but also the self satisfaction and pride that every successful technician feels from the knowledge of a job well done.

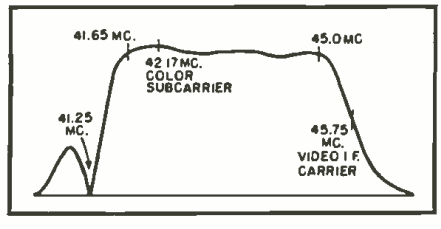
Complete Lack of Color

There are a number of reasons why a color set will not develop a color picture when it is definitely known that a color signal is being received.

One possibility which immediately suggests itself is misadjustment of the fine-tuning control. To appreciate the reason for this, let us consider the action of this control in its relation to the manner in which the set treats the signal.

In the incoming signal the picture carrier is always below the sound carrier. On channel 3 (60-66 mc.), for example, the picture r.f. carrier is positioned at 61.25 mc. and the sound r.f. carrier is at 65.75 mc. These signals mix with the output of an r.f. oscillator to produce the desired i.f. frequencies. In almost all designs the oscillator frequency is above any of the frequencies of the incoming signal. For the example chosen, channel 3, the r.f. oscillator frequency would be 107 mc.

Fig. 1. Over-all i.f. response curve of a color TV receiver indicating the need for a really broadband response.



The result of mixing the oscillator and r.f. carriers, is to produce a video i.f. carrier signal at 45.75 mc. (107-61.25 mc.) and a sound i.f. carrier at 41.25 mc. (107-65.75 mc.). On the response curve of the video i.f. system, these carriers would appear in the positions shown in Fig. 1.

The color subcarrier of the signal is positioned 3.58 mc. above the picture r.f. frequency. Its i.f., then, would be 42.17 mc. and it would occupy the position shown in Fig. 1. The left-hand edge of the response curve should extend to at least 41.65 mc., this being the end frequency of the video signal with its color sideband components. (41.65 mc. is 4.1 mc. from the video i.f. carrier of 45.75 mc.)

All of the foregoing signals will fall at the points designated in Fig. 1 *if* (and here is the crux of this discussion) the oscillator frequency is set at exactly 107 mc. This, in turn, depends upon the setting of the fine-tuning control.

Now let us see what happens if the control is rotated too far to one side or the other of this correct position. The viewer who thinks he is tuning his set for best picture by striving for high contrast, is in error because he will adjust the fine tuning control until the video carrier is on the flat portion of the response curve and not at the 50 per-cent point. With this situation, the high end of the signal spectrum, where the color information exists, will be pushed down the oppo-

* Author of "Television Simplified," "Television and FM Receiver Servicing," and other books.

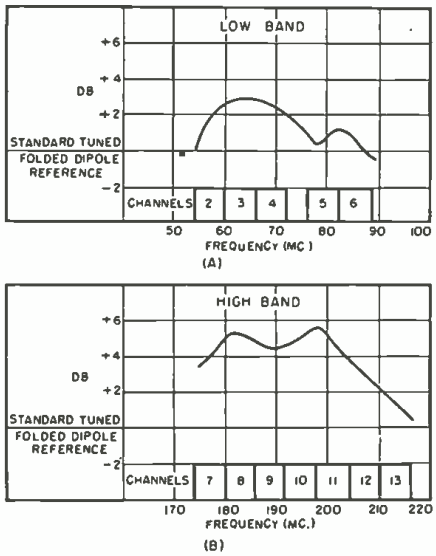


Fig. 2. Gain curves for a popular TV antenna. (A) is the low band; (B) is the high band. The flatter these curves are the better for color reception.

site side of the response curve. This will usually attenuate the color burst to such an extent that not enough will get through to activate the various color circuits. The result is that there is no color on the screen.

Rotation of the fine-tuning control in the opposite direction will lead to the loss (or attenuation) of the video carrier and its companion low video frequencies and will produce either a negative picture (as in black-and-white sets) or no picture at all. Present, too, will be sound bars because of the increased amplification accorded the sound signal.

Thus, adjustment of the fine-tuning control in present color television receivers is a more critical operation than in monochrome receivers and this fact must be carefully impressed upon the viewer. An excellent adjustment sequence for obtaining a good color picture is as follows:

1. Adjust the receiver in the usual manner for a black-and-white picture.
2. Advance the color control approximately two-thirds from its maximum counterclockwise position.
3. Carefully advance the fine tuning control clockwise until the picture just begins to disappear, then turn counterclockwise slowly to the position where the sound bars just disappear and color is in the picture.
4. Adjust the color control for the desired saturation or strength of color.
5. Adjust the hue control to achieve the most pleasing flesh tones or color of some familiar object.

Another method of adjusting correctly the fine-tuning control which the service technician can use is to rotate this control to the point where the visible 920 kc. beat pattern (between the 4.5 mc. sound carrier and the 3.58 mc. color subcarrier) on the CRT screen is minimized. This is a more precise method, particularly when the low end of the i.f. response curve has a steep roll-off.

The importance of having the color end of the video signal receive sufficient amplification—as indicated by the foregoing discussion — will also point out to the service technician other causes for poor or no color rendition in the picture. For example, a video i.f. response curve which falls off too rapidly at its low end, or an r.f. bandpass which is too narrow will produce the same results as misadjustment of the fine-tuning control.

In black-and-white receivers, the extent of the circuit's bandpass, while important, is nowhere near as critical as it is in a color receiver. In a monochrome set we might possibly lose some detail, a fact which very few observers could detect. In a color set, the picture will still be seen, but all semblance of color would be absent.

The critical dependence of color on bandwidth can conceivably force circuit realignment of the r.f. and video i.f. systems every time a tube is changed. Different interelectrode capacitances in tubes, even of the same type, will have marked effects on the bandpass of the fairly high frequency circuits now common in r.f. and i.f. systems. It may be that methods will be found to overcome this very evident weak point, but until that happens there is likely to be some difficulty even if it is encountered only part of the time.

In this same vein, it has been found that poor color in a picture or no color at all may also stem from inadequate bandwidth of the antenna system. This would encompass the antenna and any r.f. boosters and/or distribution amplifiers that may be employed. Particularly important is the response to those frequencies clustered around the color subcarrier. Ideally, gain or loss should not vary more than 1 db from 1.5 mc. below to .6 mc. above the color subcarrier. Now let us apply these suggested limits to a popular antenna operating over the 12 v.h.f. channels. The gain curves are shown in Fig. 2. Over the low band, the response falls within the limits specified. On channel 2, the gain variation from the low to the high end is greater than 2 db. However, in its favor is the fact that the high end receives more gain than the low end, thereby tending to accentuate the color signals. Furthermore, the gain variation around the color subcarrier frequency (near the upper end of the channel) is less than 1 db.

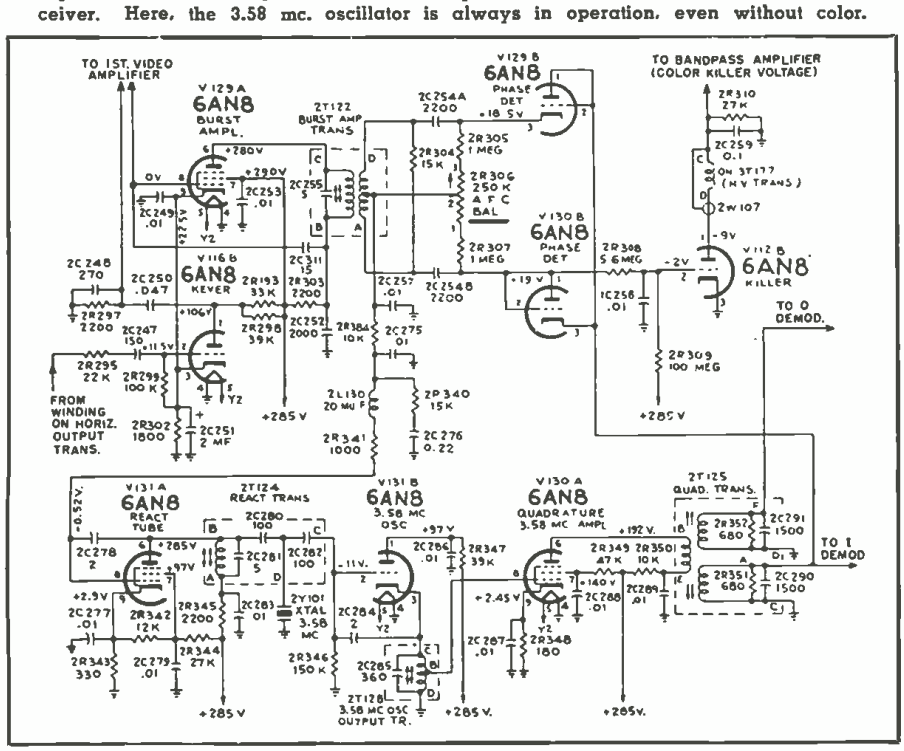
On the high band, the response is excellent for channels 7, 8, 9, and 10. On channel 11, gain variation near the upper end is quite marked and could lead to trouble. This is particularly true since the gain is decreasing here. Channels 12 and 13 are subject to an even greater drop-off in gain and the performance of a color receiver on these channels could be expected to be poorer.

High gain, narrow-band antennas such as the multi-element yagi may be especially troublesome in this respect.

Another item that is frequently found in the antenna system is an r.f. booster. If this is of the untuned wide-band variety, then it probably would not attenuate the color subcarrier any more than it might affect the video carrier. However, in an adjustable booster, where each channel is tuned in separately, narrow bandwidth is a distinct possibility. Also, it is well to remember that while one item, by itself, may not cause too much damage, the combined attenuation of several components can prove decisive.

What has been said with regard to

Fig. 3. Schematic diagram of the color sync section of an RCA CT-100 color receiver. Here, the 3.58 mc. oscillator is always in operation, even without color.



boosters applies with equal force to antenna distribution systems where the incoming signal is first amplified before it is dispatched to the various sets.

The necessity for knowing whether each component of an installation is doing its full share will be more pressing than ever and undoubtedly require additional testing equipment for the service technician. The technician will require more comprehensive methods for checking receivers in the home. If a set does not produce suitable color pictures, is the receiver at fault or does it stem from an inadequately applied signal? Some instrument, such as a color bar generator, which will definitely establish the condition of the receiver will almost be a necessity. The only other alternative would be to take the set back to the shop, a time consuming and certainly uneconomical procedure. The reliance of the service technician on accurate and reliable test equipment will be greater than ever.

There are, of course, additional reasons why a color television receiver is unable to produce color pictures. Consider, for example, the color subcarrier oscillator in the color sync section. The color signals which the *I* and *Q* (or *R-Y*, *B-Y*) demodulators receive from the bandpass amplifier are amplitude and phase modulated. To re-obtain the original information imparted to this signal, we need the presence of the missing subcarrier. This is supplied, with the proper phase, by the color sync section. Now, the heart of this section is the 3.58-mc. subcarrier oscillator and should something prevent this oscillator from generating the necessary voltage, no color demodulation will occur and with this, no color signals.

In the absence of color, then, a good place to check is at the 3.58-mc. oscillator. The tube might be tested first. If this is found to be good, an oscilloscope might be employed to check for the presence of a 3.58-mc. signal in the oscillator circuit. Measuring the control grid voltage of the oscillator is another good way to determine whether or not this stage is operating.

There are two methods in use for generating 3.58-mc. oscillations and a different service approach is required in each instance. For example, in the color sync system shown in Fig. 3, the 3.58-mc. oscillator is always in operation, color signal or no color signal. This means that if a color signal is reaching the color demodulators, the 3.58-mc. oscillator voltage should likewise be present unless the oscillator itself is inoperative. It makes little difference here whether the color burst reaches the color sync section or not. The oscillator, whether it is on frequency or not, will be developing a 3.58-mc. signal and some color should appear on the screen, even if this color has the wrong hue or is unstable.

On the other hand, consider the situation in a ringing-type color sync system, Fig. 4. Here, the 3.58-mc. generator is not in operation unless it is being pulsed by the incoming color bursts. Failure of the bursts to reach the ringing oscillator, perhaps because of a defective color burst amplifier, would result in a colorless picture. Hence, the logical place to check in this system is the color burst amplifier to see if the tube is good and if so, the rest of the color burst stage, including the voltages.

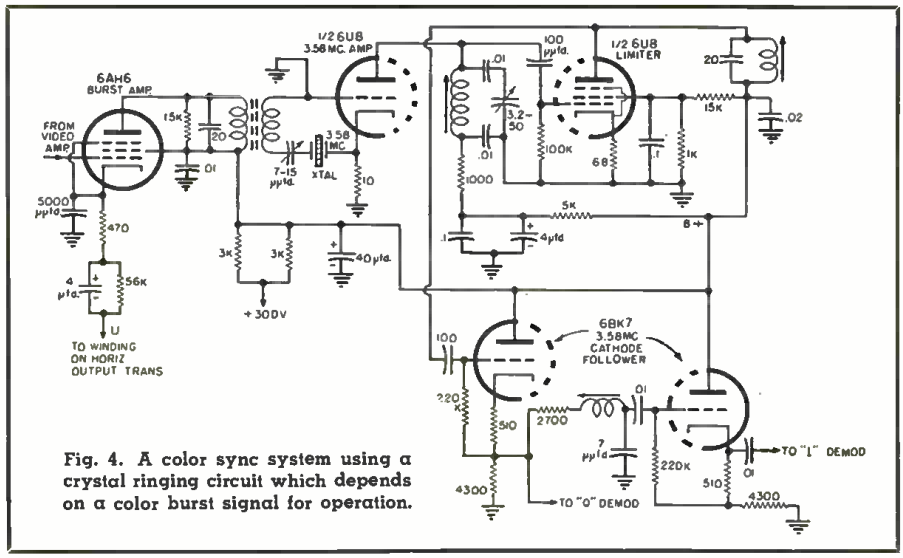


Fig. 4. A color sync system using a crystal ringing circuit which depends on a color burst signal for operation.

Note that in the color sync system of Fig. 3, trouble in the color burst stage, in the reactance tube, or in the phase detector would not keep the 3.58-mc. oscillator from operating. Color would appear on the screen even though, in all probability, the shading of the various objects would be wrong.

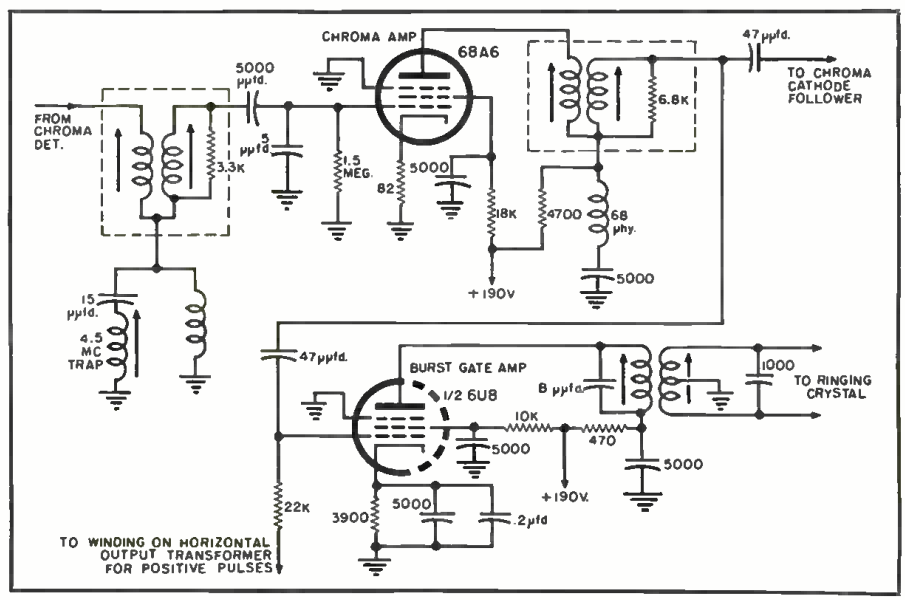
In the ringing system, for the generated 3.58-mc. voltage to reach the color demodulators, it is necessary that the stages between the oscillator and the demodulator be operating normally. This includes an amplifier, a limiter, and perhaps a cathode follower. See Fig. 4. Tests should be made, with an oscilloscope, at each of these points.

Another item which may be responsible for the absence of color is a defective bandpass amplifier. This stage stands at the head of the entire chrominance section of the receiver and any break in the signal path here would prevent the color sidebands from reaching the color demodulators.

Whether a defective bandpass amplifier will cause the complete absence of color on a screen, or simply lead to a condition where we have a black-and-white picture with a mottled (confetti-like) background depends upon the particular circuit in question. In the partial circuit of Fig. 5, the burst gate amplifier receives its pulses from the plate circuit of the bandpass (here called chroma) amplifier. Failure in the bandpass stage will not only prevent any of the color sidebands from reaching the color demodulators, but would likewise shut off the flow of color burst signals to the burst gate stage and the ringing oscillator that

(*Continued on page* 172)

Fig. 5. A defect in the chroma amplifier would completely inactivate the entire color section of the receiver using the chrominance circuits diagrammed here.



RADIO LICENSING AND THE FCC

By **JAY ROBIN GNESSIN**

A handy précis of current FCC rules and regulations for radio licenses, with hints on preparing for your exams.

THERE is no charge for any of the fifteen kinds of radio operator licenses issued by the Federal Communications Commission. It is not difficult to obtain a license. The certificate makes a handsome addition to your trophy collection, boosts your ego by proving you have passed the test, and counts heavily on any employment application form.

Are you far away from a metropolitan center so that you are unable to take an FCC exam in person? No matter! The "conditional class" amateur license exam will be given by mail if the applicant is more than 75 miles from the nearest examination point, yet it provides all regular amateur privileges. The same rule holds if the applicant is physically disabled or in the Armed Forces.

The "novice and "technician" class examinations are given by mail only. These provide for operation of your own amateur radio station with certain limitations. Each requires the applicant to pass a 5 wpm code test as certified by a volunteer examiner in your own neighborhood. Any ham will be glad to give you the code test. The written test you get by mail covers basic radio law or theory, depending upon the class.

What used to be the "Amateur Class C" is now covered by these new classes. The old "Class B" is now the "general class." This is relatively unchanged. It requires the applicant to present himself in person to an FCC Field Office at the designated time to take a 13 wpm code test with a written exam on basic amateur practice and general amateur regulations.

The old "Class A" was replaced for a while with "advanced class." This will continue to be renewed as long as the license holder continues to meet current requirements. No new examination for this class will be offered.

The "extra class" is the cream of the amateur licenses, the acme of advancement in these ranks. It is the highest grade of amateur license. It's reserved for old-timers. Licensed hams should write to the FCC if interested in this particular license.

When you apply for an amateur operator license you generally also apply for an *amateur station* license. In that case the application for station license must be notarized. It's worth it, though, since in that case you get a combination (really *two* licenses) deal. The operator's license permits you to operate any amateur radio station. The station license assigns you a set of call letters and you are authorized to operate a station of your very own.

There is some talk that a fee may be charged eventually for the station license only. At this writing the amateur station license is free for the application.

FCC Field Offices where radio licensing examinations are given regularly.

Alabama, Mobile 10
419 U.S. Courthouse and Customhouse

Alaska, Anchorage — P.O. Box 644
Room 53, U.S. Post Office and Courthouse Building

Alaska, Juneau — P.O. Box 1421
Room 7-8, Shattuck Building

California, Los Angeles 12
539 U.S. Post Office and Courthouse
Temple and Spring Streets

California, San Diego 1
15-C, U.S. Customhouse

California, San Francisco 26
323-A, Customhouse

Colorado, Denver 2
521 New Customhouse
19th between California and Stout St.

District of Columbia, Washington 25
Briggs Building
415 22nd St., N.W.

Florida, Miami 1 — P.O. Box 150
312 Federal Building

Florida, Tampa 2
409-410 Post Office Building

Georgia, Atlanta 3
411 Federal Annex

Georgia, Savanna — P.O. Box 77
214 Post Office Building

Hawaii, Honolulu 1, Oahu — P.O. Box 1142
Lanikai

Illinois, Chicago 4
826 U.S. Courthouse
219 South Clark Street

Louisiana, New Orleans 16
400 Audubon Building

Maryland, Baltimore 2
508 Old Town Bank Building
Gay Street and Fallsway

Massachusetts, Boston 9
1600 Customhouse

Michigan, Detroit 26
1029 New Federal Building

Minnesota, St. Paul 2
208 Uptown Post Office and Federal Courts Building
5th and Washington Streets

Missouri, Kansas City 6E
3200 Federal Office Building

New York, Buffalo 3
328 Post Office Building
Ellicott and Swan Streets

New York, New York 14
954 Federal Building
641 Washington Street

Oregon, Portland 5
307 Fitzpatrick Building
917 S.W. Oak Street

Pennsylvania, Philadelphia 6
1005 New U.S. Customhouse

Puerto Rico, San Juan 13
P.O. Box 2987
322-323 Federal Building

Texas, Beaumont — P.O. Box 1527
329 Post Office Building
300 Willow Street

Texas, Dallas 22 — P.O. Box 5238
500 U.S. Terminal Annex Bldg.
Houston and Jackson Streets

Texas, Houston 11
324 U.S. Appraisers Bldg.
7300 Wingate Street

Virginia, Norfolk 10
402 Federal Building

Washington, Seattle 4
802 Federal Office Building

Address: Engineer in Charge, Federal Communications Commission

Citizens Radio Service

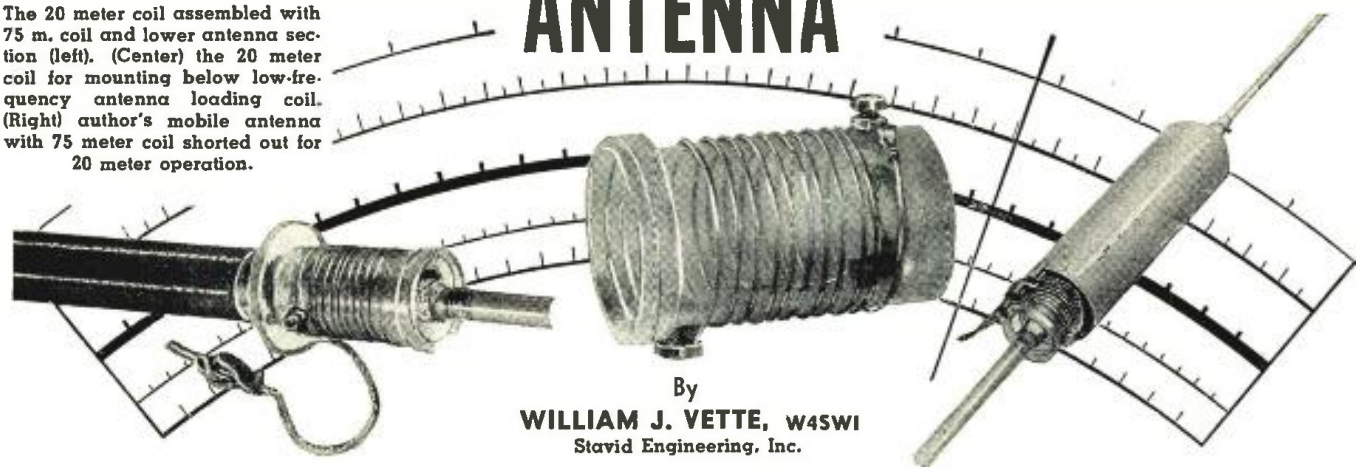
This is a new form of radio service for private or personal use for short distance radio communication, signalling and radio control of objects and devices such as model airplanes, garage doors, etc. Only citizens 18 years or older may obtain a station license in this service. It must not duplicate like facilities in any other radio service. Therefore it is not just another *amateur* radio service.

Where manually-operated telegraphy is used, or where adjustments during installation, testing, or servicing may cause the transmitter to change frequency or any other technical characteristic, an applicable operator's license is required. Where FCC-approved commercial Citizens Band transmitters are utilized without adjustments or telegraphy only a station license is required when purchasing the equipment. The store selling the transmitters generally keeps the required forms. In this case no operator's license is needed. The station licensee is responsible for the proper operation of his station at all times.

If simple antennas not exceeding 20 feet above terrain or structure are used no additional license is required in this service. For more elaborate structures, exceeding this minimum,

(*Continued on page* 149)

ONE MORE BAND WITH YOUR PRESENT ANTENNA



The 20 meter coil assembled with 75 m. coil and lower antenna section (left). (Center) the 20 meter coil for mounting below low-frequency antenna loading coil. (Right) author's mobile antenna with 75 meter coil shorted out for 20 meter operation.

By
WILLIAM J. VETTE, W4SWI
Stavid Engineering, Inc.

Increase the usefulness of your mobile antenna by adding this simple and easy-to-build accessory to your set-up.

FOR the amateur mobile operator who wants to operate on two or three favorite bands, but doesn't want to fool around with high-priced, low-efficiency, all-band loading coils, or who doesn't have the luggage space to carry a whole set of separate coils for each band, here is a low-cost scheme for getting the high efficiency of individual loading coils in no more space than his present low-frequency loading coil.

Basically, the idea is to add a coil for a higher frequency band, either 15, 20, or 40 meters, below and in series with the present low-frequency coil for 75 or 40. Arranged to allow the bottom section of the antenna to go through the new coil, the length of the coil is not added to the antenna, nor is the new coil form called upon to take the strain of the top section of the antenna or the upper loading coil. As originally done by the writer, a 20-meter coil was added below a 75-meter *Master-Mobile* coil, but the actual combination of bands is up to the individual constructor. In any case, 10-meter operation is had by shorting across the whole coil assembly with a heavy piece of copper braid or a heavy wire.

The coil is quite easy to make and adjust, and the coil form (which is usually the stopper when trying to home-brew antenna loading coils) is probably already lying around the shack, if not, it can be readily procured from any parts supply house.

The coil form is a standard 1¼" diameter form, 2¼" long, with the prongs removed. As shown in the photo, the coil was wound on a polystyrene form, such as the *Amphenol* 24-4P, and the use of such a form is recommended. The prongs can be easily removed if they are carefully heated with a soldering iron just enough to soften the base slightly.

After removing the prongs, drill three holes in the form: one, 7/16" in diameter, in the exact center of the bottom, and two ⅛" in diameter on either side of the form, as shown in Fig. 1. In each of these holes, insert a 6-32 screw, ⅜" long, from the inside, with a solder lug under the one at the open end of the form, and a similar lug on the outside of the form on the screw at the closed end of the form. When putting nuts on these screws, tighten very carefully, for the poly is easy to crack if put under much of a strain. Two nuts should be put on each screw.

A large solder lug with a 7/16" hole is placed inside the form, at the bottom, and should be connected to the solder lug at the opposite end of the form with short piece of stiff wire. If a lug of proper dimensions is not at hand, a brass washer might be used, soldering the connecting wire to it before inserting it into the form.

Connect one end of the wire you are using for the coil to the lug you placed on the outside of the form. The heat of soldering will soften the form slightly, and you should carefully retighten the nut as the connection cools to take up the slack caused by the screw sinking into the form. Do this carefully, or you will pull the screw right through the form wall. In winding the coil, add about 20% more turns than the table calls for, to allow for pruning the coil to frequency after installation. The number of turns as given in the table is correct for the writer's installation, but the correct number will vary, depending on the location and height of the antenna in any other installation.

To prepare the low frequency coil, it is necessary to insure that the bottom end of the coil is no longer connected to the metal insert into which the lower section of the antenna screws. In the case of the older *Master-Mobile* type coils, this is accomplished by removing the screw under which the bottom end of the coil fastens, replacing it with another screw which is not long enough to make contact with the metal insert—a 6-32 screw about ⅛" long does the job nicely. Also, the polystyrene disc which mounts below the low-frequency coil must have a 3/32" hole drilled through it, ¼" from the outer edge, to pass the wire connecting the two coils together.

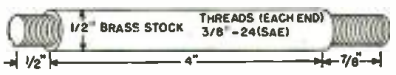
Assemble the two coils atop the lower section of the antenna, with the polystyrene disc between them, and with the bottom screw of the low-frequency coil lined up with the top screw of the new high-frequency coil. Connect these two screws together, using a short piece of No. 16 wire passed through the hole in the plastic disc. At this junction of the two

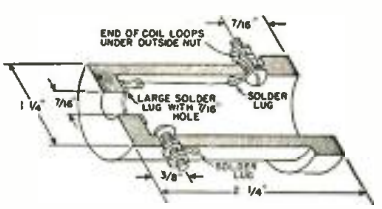
(*Continued on page* 128)

Fig. 1. Cut-away view of coil form showing placement and dimensions of holes, coil table, and details on base extender to be used to raise h.f. coil on base-loaded whips.

BAND	TURNS	WIRE
15	5½	#14 en.
20	10½	#14 en.
40	40½	#20 en.

Winding length 1-7/16" for all coils





A "UNIVERSAL" COUNTER

Fig. 1. Over-all view of the home-built counter with its associated accessories (from left to right): selenium photocell, mercury switch, the "Microswitch", and push-button switch.

By
LOUIS E. GARNER, JR.

Details on a versatile unit of many applications which features a compact, battery-powered transistor amplifier

THERE is probably not an industry or business in the nation that has not, at one time or another, been confronted with a "counting" problem of some sort. Manufacturing firms may wish to count the items passing a given point in a production line, department stores may wish to count the number of customers entering a certain door, a real estate firm may wish to count the persons visiting a model home, and almost every merchant has a good-sized counting job at inventory time.

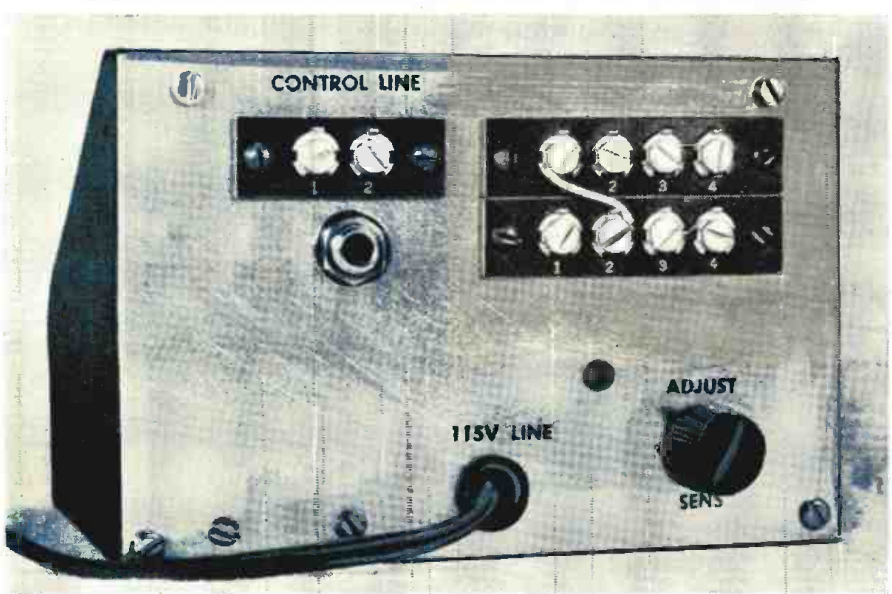
Although there are numerous commercial counters on the market, most units are designed to perform limited types of counting operations. In some instances, these limitations so restrict the applications of particular units that it is very often necessary to rely on "custom-built" counting devices.

However, the counter and accessories shown in Fig. 1 combine to provide so many different types of counting operations as to be considered an almost "universal" counter. Not only will the instrument handle routine counting operations, where the closure of a simple switch is involved, but it will also "count" where the actuating signal is a small current, as might be obtained from a photocell or thermopile.

This extreme versatility has been made possible by combining the characteristics of a direct-coupled transistor amplifier, a sensitive relay, and an electromagnetic counter in one compact assembly.

The basic design is straightforward and fairly simple, so the average technician should have little or no difficulty in assembling a similar unit in less than a day's time. Once assembled, the technician may keep the counter for his own use, or sell or rent it to firms requiring such an instrument.

Fig. 2. Rear view of the counter with the terminals and controls labeled.



Circuit Description

Reference to the schematic diagram given in Fig. 3 will show that the counter consists of three related but independent sections: a sensitive "electronic" relay featuring a transistor amplifier, a low voltage a.c. supply (T_1), and an electromagnetic counter. The connections from each section are brought out to separate terminals on screw-type terminal strips, permitting maximum flexibility in choosing a particular combination.

Let us discuss each section separately:

The "electronic" relay consists of a type CK722 *p-n-p* junction transistor connected as a direct-coupled grounded-emitter amplifier. A sensitive relay, RL_1, serves as the collector "load." Power is supplied by a 6 volt battery, B_1, controlled by power switch S_1.

Two modes of operation are possible, depending on whether the control signal is furnished through the closed circuit jack J_1 or "control line" terminals "A." Closed circuit jack J_1 is used where the control signal consists of a small current (from 150 to several hundred microamperes), such as might

be obtained from a photocell. The "A" terminals are used where the actuating signal is the simple closing (or opening) of a circuit.

Let us first consider the operation of the circuit where the "A" terminals are used, and where a simple push-button switch is used to close the circuit.

With power switch S_1 closed, a voltage is applied between the collector and emitter of the transistor. However, there is little or no current flow in this circuit since the base-emitter circuit is open (at the "A" terminals) and base current flow cannot take place. Thus, relay RL_1 remains open.

When the external push-button is depressed, shorting the "A" terminals together, base current can flow over the path consisting of the negative terminal of the battery, switch S_1, R_2, through the shorted "A" terminals, R_1, through jack J_1 (now closed), the base-emitter of the transistor, and back to the positive terminal of the battery. This base current flow permits a corresponding collector current flow, though of much greater amplitude due to the current amplification of the transistor stage. Relay RL_1 is thus closed and held in until the push-button is released, stopping base and collector current flow.

Resistor R_1 is used to limit the maximum base current flow, while R_2 is used to set the current flow to a fixed value within this maximum limit.

If the external switch is normally closed ("A" terminals shorted together), the action is just the reverse. Relay RL_1 is normally held closed, and "drops out" when the external circuit is opened.

Let us now consider the action of the circuit when a current generating device is plugged into the "control line" jack J_1. Since this is a closed-circuit jack, inserting a phone plug immediately disconnects R_1, "A" terminals, and the R_2 circuit.

Two conditions may exist. The external current generating device can supply a current only when the "counting" operation is to take place, or it can supply a current at all times, with the current dropping sharply or ceasing to flow when "counting" occurs.

In the first case, the relay will normally remain open, closing only when current is supplied to the base-emitter circuit of the transistor through J_1. In the second case, the relay will close and "hold in" until the current supplied through J_1 drops appreciably.

Since the base-emitter current of the transistor is supplied solely by the external circuit, this source should be capable of supplying at least 150 microamperes, and should not supply more than 5 ma. If there is a possibility of the current supplied by the external source exceeding 5 ma., an external current limiting resistor should be provided.

A typical "current generating device" that might be plugged into J_1 is an ordinary self-generating (barrier type) selenium photocell. Another such device could be a heat-operated thermopile (a series-parallel connection of several thermocouples to obtain greater current).

In any case, the connections of the external device to the phone plug should be such as to apply the negative terminal to the base of the transistor. See Fig. 5.

The low voltage a.c. supply is the next section of the "universal" counter to consider. This consists simply of a 6.3 volt transformer (T_1), a line cord, a power switch (part of S_1), and a pilot light.

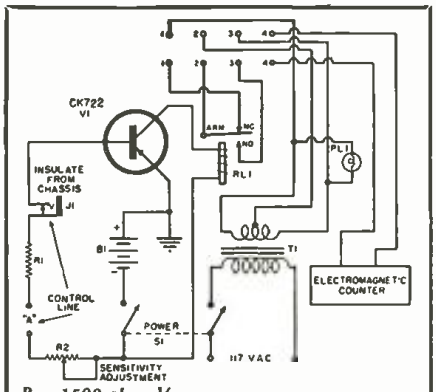
The electromagnetic counter is a commercial unit having "reset" provision and operating on 6 volts a.c.

An a.c.-operated supply was not provided for the transistor amplifier circuit for several reasons. First, there is no real need for such a supply since, with normal use, battery life is quite long (due to the small power requirements of the transistor). Secondly, a battery supply permits completely independent operation of the transistor amplifier and relay circuit. This allows the circuit to be used alone for control purposes without requiring line connections. Finally, providing an a.c. supply would needlessly overcrowd an already well-filled cabinet.

Construction Hints

The general layout used in the author's model is clear from the exterior, back, and interior views of the instrument, given in Figs. 1, 2, and 4, respectively. The entire counter circuit has been assembled within a standard *Bud* sloping panel utility box. The electromagnetic counter, the 6.3 volt transformer (T_1), the power switch (S_1) and the pilot lamp socket and jewel are all mounted in the "cabinet." All other parts, including the relay, transistor, phone jack (J_1) and battery are mounted on the back panel. The *Mallory* battery is held in place by a large cable clamp.

Layout and wiring are not critical, however, and another builder may easily vary the layout to suit his own requirements.



R1—1500 ohm, ½ w. res.
R2—100,000 ohm pot ("Sensitivity" adjustment)
J1—Closed-circuit jack
RL1—5500 ohm, d.c. coil, relay (Advance Type 1200)
B1—6 volt battery (Mallory 302424 or RCA VS068)
S1—D.p.s.t. toggle switch ("Power")
PL1—6.3 volt pilot light
T1—Fil. trans., 6.3 v. @ 1 amp. (Stancor P-6134)
V1—p-n-p junction transistor (Raytheon CK722)
1—Electromagnetic counter (Mercury MDB-S4-6A)
1—Cabinet (Bud C-1604)
1—Self-generating (barrier type) selenium photocell*
1—Microswitch*
1—Mercury switch*
1—S.p.s.t. push-button switch*
**These items are optional accessories for use with the counter*

Fig. 3. Complete schematic diagram of the counter. It uses a Raytheon transistor.

Commercially available "decals" were used for labeling both the front panel (white decals) and the back (black decals). After application, the decals were protected with several coats of clear plastic, applied from a "spray can."

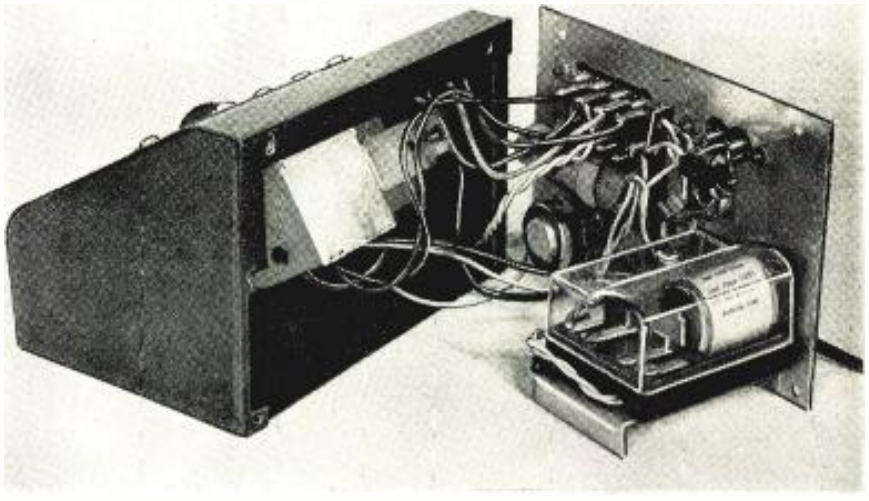
Two methods may be followed when installing the transistor. A socket may be provided or the transistor may be permanently wired into the circuit.

If the builder prefers to use a socket, a standard 5-pin subminiature tube socket is satisfactory. Only three of the pins are used.

On the other hand, if the builder

(*Continued on page* 173)

Fig. 4. Interior view of the instrument showing components mounted on panel.



POWER SUPPLY REGULATION

By **GERARD J. WENDELKEN**

Color TV as well as many other electronic devices use the circuits described and explained in this article.

SINCE the introduction of color television, the service technician has heard more and more about power supply regulation. As a matter of fact, electronic devices of all types use more regulating circuits than ever before. This article will review some of the more important aspects of regulated power supplies.

In large cities, line voltage variations of ten per-cent are not uncommon; in rural areas, the voltage available may vary as much as twenty per-cent. Consider the result of such a change on the output of a typical power transformer with a voltage ratio of 1 to 2.56, primary to secondary. A twenty per-cent change in line voltage would mean that the primary voltage would vary between 105.3 and 128.7 volts (assuming that 117 volts were normal). The secondary output under such conditions would change from 270 to 330 volts, a total variation of 60 volts.

The power transformer itself is another important factor in a well regulated supply. If the transformer does not contain a sufficient amount of core material and wire of adequate size, the secondary voltages will change with even small variations in the load current drawn. When an adequately rated transformer is used, the secondary voltages will remain relatively stable regardless of the changes in load current. Similarly, the rectifier tube used in the supply circuit must also be adequately rated if voltage changes are to be minimized.

Another significant item which affects the supply regulation is the filter network used. This is illustrated in Fig. 1 which shows some of the operational characteristics of a 5V4G rectifier when used with various filter arrangements. Notice that when a 4 μfd. capacitor is used in a capacitor input filter the output voltage variation is approximately 395 minus 330 or 65 volts for a load current change of between 25 and 100 milliamperes. If an 8 μfd. capacitor is substituted, the output variation is approximately 395 minus 345 or only a 50 volt drop for the same load current change. When even smaller variations in output voltage are desired a choke input filter is generally used. Referring again to Fig. 1, note that for the same change in load current the output voltage variation is 260 minus 250 or only 10 volts. The value of the choke in this instance is at least 4 henrys.

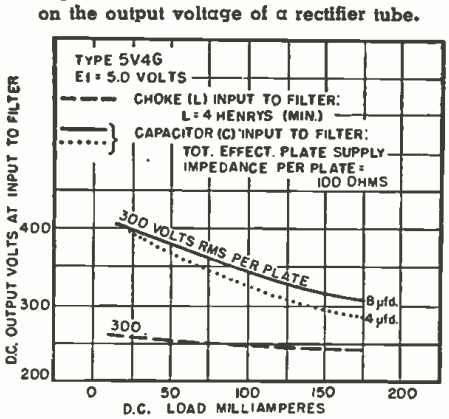
Bleeder or load resistors when used also affect the degree of regulation achieved in a well designed power supply. They provide a fixed minimum d.c. load into which the supply operates, and thus tend to minimize changes in supply voltage. This is illustrated in Fig. 2. Note that the circuit load in Fig. 2A varies from 2000 to 4000 ohms, or a maximum change of 2000 ohms. Assuming that a 4000 ohm bleeder resistor were inserted at the supply output as in Fig. 2B, note that the load variation would now be as follows: At minimum circuit load the power supply would be operating into 4000 ohms in parallel with 4000 ohms or 2000 ohms. At maximum circuit load the supply would operate into 2000 ohms in parallel with 4000 ohms or 1333 ohms. The maximum variation would then be 2000—1333 or 667 ohms, only one third of the original load variation. With a more stable load, the supply output voltage would then be more stable.

Another method of obtaining better regulation is through the use of a ballast tube. This tube contains a special wire element enclosed in a gas filled envelope. Variations in current passing through the element cause its resistance to change. When the current increases the element resistance increases. When the current decreases the resistance of the element becomes less. The tube thus tends to minimize changes in current. In many circuits it is used for that very purpose. In other circuits it is inserted to compensate for variations in the voltage applied to the circuit. This type of regulator is very frequently found in series with a tube heater string. It must be remembered that this type of regulator is used to compensate for changes in input voltage and not variations in circuit load. Actually, if the load varied in a circuit using this tube the voltage change would be even greater than without the ballast. This can be visualized by assuming that the load on the power source increased. This would cause more current to flow through the ballast. The element resistance would increase causing an even greater voltage drop across it. For the above reason it is generally found only in circuits where the load is relatively constant.

While the preceding methods of improving regulation are important, they are usually considered passive methods. Although they are not often recognized as contributing to good regulation they are utilized in one form or another in almost every well designed power supply. There are, however, other voltage stabilizing means which are not often found in ordinary electronic equipment. These other stabilizing means are generally used when the regulation requirements are more critical, as in color TV receivers.

The VR or voltage regulator tube is one such device to limit variations in supply voltages. This tube contains a certain amount of argon or neon gas. Within the normal operating voltage range of the tube the gas ionizes with a visible glow, and because of this, it is often referred to as a glow tube regulator. VR tubes maintain a constant voltage drop across their output despite large variations in current. This is due to the fact that the degree of ionization of the gas within the tube changes depending upon the voltage across it. When the ionization is high, the internal resistance of the tube is low and the current through it is large. Conversely, when the tube's internal impedance is high the current is

Fig. 1. The effect of different filters on the output voltage of a rectifier tube.



low. The *IR* drop across the tube tends to stay constant, and thus, the voltage across the tube remains consant. When properly utilized in conjunction with a suitable series resistor, these tubes will maintain relatively stable voltages despite considerable changes in circuit loads.

Two typical circuits using VR tubes are illustrated in Fig. 3. The basic function of the series resistor is to limit the current through the regulator tube to within its proper operating range. To illustrate clearly how the circuit of Fig. 3A operates, assume that the power supply voltage drops. The voltage across the VR tube is thus lowered, partially de-ionizing the gas and increasing the tube's internal resistance. Due to this, the current through the tube and series resistor decreases, and the *IR* drop across the resistor also decreases, keeping the output voltage stable.

In order to ionize the gas in a VR tube it is necessary for the supply voltage to be 20 to 30 per-cent greater than the normal operating voltage of the tube. Once the gas ionizes, the applied voltage drops to the normal rated value of the tube. Care must also be taken to insure that the circuit load variations do not exceed the normal rating of the tube. VR tubes can be connected in series as in Fig. 3B if higher voltages are involved. When they are connected in series, taps may be made in between the tubes to provide additional regulated voltages.

In some circuits vacuum tubes are used to maintain the proper degree of regulation. A simple circuit utilizing a vacuum tube is illustrated in Fig. 4. The amplifying properties of the tube give a more sensitive response to small variations in voltage. The tube is generally a triode with a low internal impedance, and in this application is used as a variable resistor and called a "pass tube." In the circuit of Fig. 4 it functions as the upper leg of a voltage divider, the bottom part of which is the load.

The internal resistance of the tube is determined by the bias applied to it by the circuit. With the grid connected to the VR tube, as shown, the output voltage will remain relatively constant. To illustrate the operation of the circuit, visualize that the voltage across the load has decreased. The cathode of the triode, which is positive with respect to the grid, would now be at a lower voltage. The voltage on the grid of the tube, however, has remained constant due to the action of the VR tube. As a result, the bias on the pass tube is less, and its internal resistance is lower. This causes a reduction in the voltage drop across the pass tube sufficient to correct for the original change in voltage. Where the rating of a single tube is not sufficient to compensate for large current variations, pass tubes are paralleled.

More sensitive regulation is possible by utilizing a vacuum tube amplifier to control the variable resistance or pass tube. A voltage regulator of this

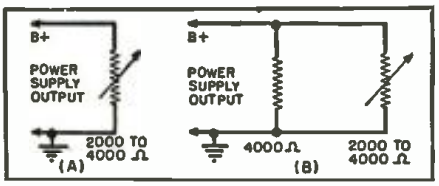


Fig. 2. Bleeder resistors across the output from a power supply are effective as regulators. The bleeder resistor shown in (B) increases the regulation of (A).

type is shown in Fig. 5. The amplifier tube used is usually a pentode because of the great amount of amplification possible. In the circuit of Fig. 5 the cathode of the amplifier is held at a constant voltage level by the VR tube. The grid voltage for the amplifier is obtained from the voltage divider network connected across the output of the supply. Plate and screen voltages for the tube are taken from the unregulated "B+" voltage. The screen resistor is actually part of the series resistance necessary for the proper operation of the VR tube.

The action of the regulator circuit is as follows: When the output voltage of the supply changes, the grid voltage on the amplifier tube changes. Since the cathode of the tube is held at a constant voltage, the effective bias on the amplifier tube also changes, increasing or decreasing the tube current. This change in current causes a variation in the voltage drop across the amplifier tube plate load resistor. As connected, this tube is used to provide bias voltage for the pass tube. Thus, the change in voltage on the plate of the amplifier causes a change in bias on the pass tube, and as previously discussed varies its internal resistance and the voltage drop across it. This change in the voltage drop across the pass tube compensates for the original variation in the output of the supply.

The methods used to regulate high voltage power supplies are not very different from those used to regulate low voltage supplies. Special high voltage regulator tubes are available and function in the same manner as the VR tubes shown in Fig. 3. Another type of tube used for this purpose is a special high voltage, low current triode. This tube is usually connected as in Fig. 6. To understand how it functions, visualize that the load current has increased with a resultant drop in high voltage output. The cathode is maintained at a relatively constant voltage by the low voltage power supply. The grid voltage however, which is obtained from a tap on the high voltage bleeder network is now lower causing an increase in the negative bias on the regulator tube. This change in bias increases the internal resistance of the tube and reduces the regulator tube current by an amount roughly equal to the increase in current drawn by the load. The total current drawn thus stays constant.

Another means of regulating high voltage is to vary the screen voltage on the oscillator or output tube

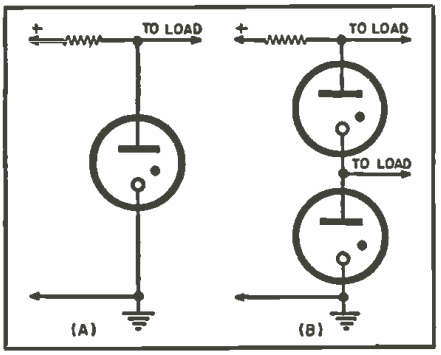


Fig. 3. The use of voltage regulator tubes (A) for a single output voltage, and (B) for two different output voltages.

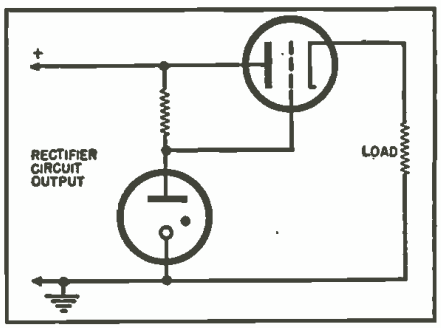


Fig. 4. The use of a triode vacuum tube for more sensitive voltage regulation.

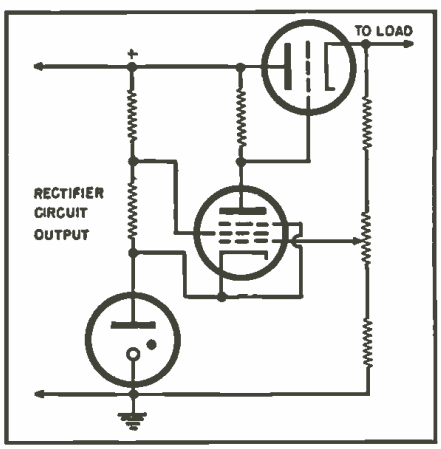
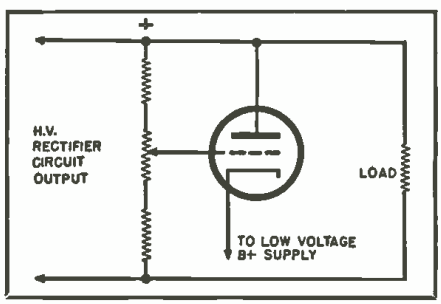


Fig. 5. Shown here is the use of a pentode amplifier tube to amplify small variations in output voltage for regulation.

driving the high voltage transformer. This is done in such a manner as to compensate for changes in the output voltage. The methods used to control the screen voltage are similar to those used in the low voltage supplies previously discussed. —30—

Fig. 6. One type of power supply regulation circuit for TV high voltage.



TV SIGNAL TRACER

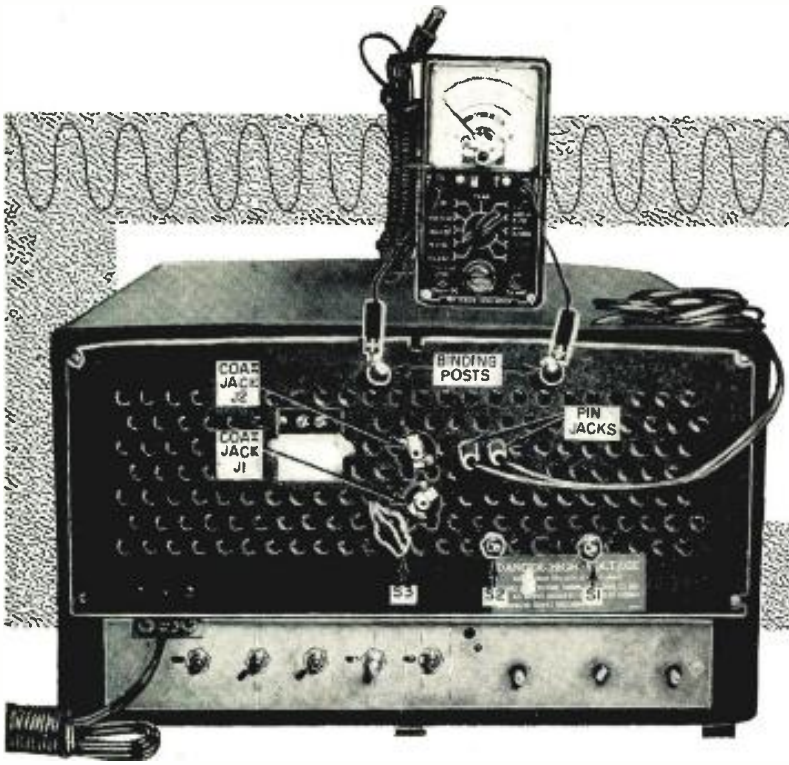


Fig. 1. Rear view of an old Admiral 19A1 TV receiver converted to a TV multi-tester as explained in the text.

By **HARRY E. NEWTON**

Convert a traded-in or unused small screen TV set into an oscilloscope or signal tracer for servicing.

DUE to the relatively high cost of 7-inch electrostatic deflection picture tubes as well as the demand for larger screens, many set owners traded in their small sets or put them aside when the picture tube became weak. Such sets can now be bought at relatively low cost and easily converted into one of the most versatile test instruments around the shop or home laboratory.

The addition of two jacks to the set converts it to a signal tracer as well as a source of signal for injection purposes. A pair of binding posts brings out the video output which can be used to facilitate antenna alignment and for making signal strength measurements on all channels. And lastly, by connecting the set to a suitable push-pull video amplifier, it becomes a 7-inch oscilloscope.

With all of these changes, the set remains a TV receiver both internally as well as externally. Other than wiring in the jacks and switches, no changes are made in the circuit of the set. The amplifier used for the oscilloscope can be built on a separate chassis and mounted on the test bench if desired.

A good picture tube is desirable but a weak tube will function satisfactorily as an oscilloscope if the picture is bright enough to be observed indoors. A shield for the tube face will improve visibility out of doors.

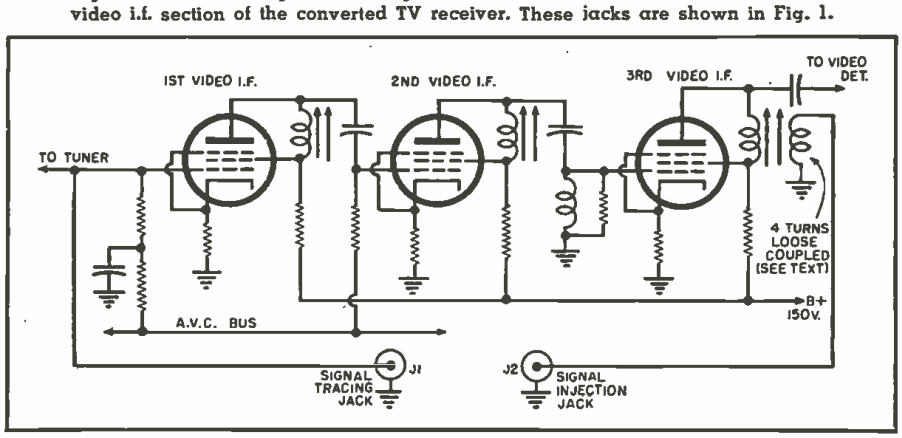
Fig. 2 shows where the two jacks are added to the circuit. Jack 1 is connected to the 1st video i.f. grid and jack 2 is connected to the 3rd video i.f. output by link coupling to the i.f. transformer. These two jacks may be seen in Fig. 1 mounted one above the other on the back cover. If desired, they may be mounted on the chassis but this requires drilling the chassis; it is much simpler to use the back cover. Shielded leads should be used.

Connection of jack 2 to the 3rd i.f. is made by wrapping about 4 turns of insulated wire around the 3rd i.f. transformer. One end of the wire is grounded and the other terminates in jack 2.

The next step consists of extending the output of the video amplifier to a pair of binding posts in the rear of the set as shown in Fig. 1. The signal is taken from the video loading coil and used for antenna orientation and signal strength measurements. Since the plate load on the video amplifier is only on the order of 10,000 ohms or so, an ordinary 1000 ohms-per-volt meter may be used rather than a v.t.v.m. Sufficient voltage is obtained to permit the deflection to be seen from quite a distance, an important feature when moving an antenna about a roof.

The oscilloscope function of the tester takes advantage of the fact that most of the wave shapes to be observed in TV work require either a 60 cycle or a 15,750 cycle sweep and these sweeps are already built into the set being converted. All that is necessary is a push-pull video amplifier which is flat up to about 300 kilocycles and which can deliver about 250 volts of signal to the deflection plates. Provision is made for switching the amplifier signal from the vertical to the horizontal plates and at the same time making the unused sweep inoperative. This is done by the use of two double-pole, double-throw switches and one single-pole,

Fig. 2. Schematic diagram showing how the coaxial jacks are connected to the video i.f. section of the converted TV receiver. These jacks are shown in Fig. 1.



single-throw switch. The single-pole, single-throw switch grounds the grid of the vertical output tube when the signal is applied to the vertical plates.

Fig. 5 is a simplified schematic of the switch connections using one pair of pin jacks, three switches, and two binding posts. The scope amplifier is connected to the same binding post that brings out the video from the video amplifier for signal strength readings on a meter.

Using the Instrument

For signal tracing, plug a signal tracing probe into coaxial jack 1. Connect an antenna to the set under observation and turn on the set and the tester. Switch the tester to an unused channel and allow both sets to warm up. Bring the probe into the vicinity of a tube carrying i.f. or r.f., and the picture and sound will be seen and heard in the tester. As the probe is moved from the tuner of the set under observation toward its video amplifier, the picture and sound will become progressively clearer in the tester.

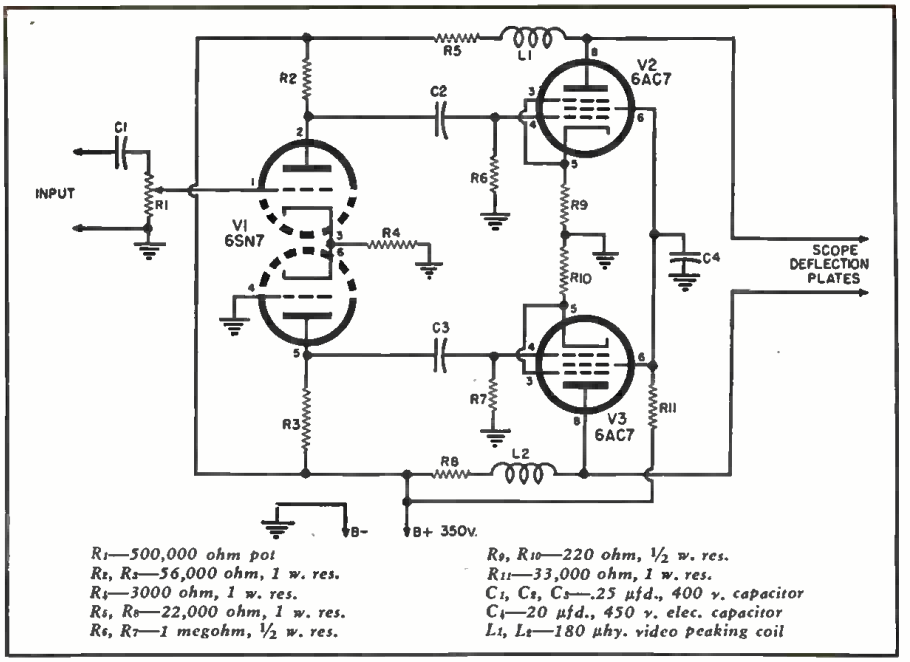
It is not necessary to remove the set being tested from the cabinet since these tests may be made on the top side of the chassis, with a resulting big saving in time for the technician. In checking tubes which are shielded, the probe should be touched to the shield which should be lifted, so that it does not make contact with the chassis.

To inject a signal into the set under test, connect an antenna to the tester and tune the tester to a channel in use. Connect a probe to jack 2 and, starting at the video detector tube in the set being worked on, move the probe from tube to tube toward the front end. As before, the set can be tested in the cabinet.

To make signal strength tests, the tester may be taken either to the roof or left below where a second technician telephones information on signal strength and ghosts to the man on the roof. The installation can be made by observing the meter readings and the actual picture.

The tester is turned on and tuned to the station which is expected to give the poorest reception in the locality where the installation is being made. The switches are set for normal TV reception (switches S_2 and S_3 open, S_1 down, see Fig. 5), and a v.o.m. is connected to the video output binding posts. Connect the antenna to the tester through twinlead of approximately the length of the downlead to be used in the installation and orient the antenna for a maximum reading on the v.o.m.

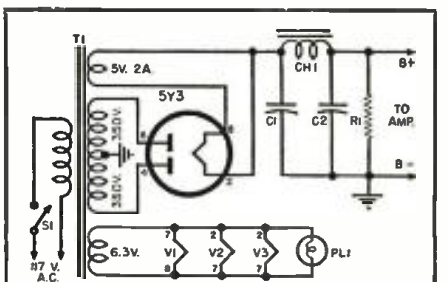
When the location of the antenna has been decided upon and the proper orientation found, it is a good idea to check the actual picture and sound before tying the antenna down. The reason for this is that a maximum reading may be obtained from ghosts and a compromise orientation must be found in some locations. Bear in mind that the coiled up twinlead which connects the tester to the antenna is far more subject to extraneous noise and interference than it will be when run down the side of the building on standoffs and twisted properly. Pull the twinlead out as straight as possible doubling it back upon itself and conditions will very nearly approximate the final installation.



R_1—500,000 ohm pot
R_2, R_3—56,000 ohm, 1 w. res.
R_4—3000 ohm, 1 w. res.
R_5, R_6—22,000 ohm, 1 w. res.
R_7, R_7—1 megohm, ½ w. res.
R_9, R_{10}—220 ohm, ½ w. res.
R_{11}—33,000 ohm, 1 w. res.
C_1, C_2, C_3—.25 µfd., 400 v. capacitor
C_4—20 µfd., 450 v. elec. capacitor
L_1, L_2—180 µhy. video peaking coil

Fig. 3. Circuit diagram and parts list for a wide-band amplifier to be used with the converted TV set when it is used as an oscilloscope in servicing.

The performance of the tester as an oscilloscope is limited by several factors. In the first place, it has, as presented here, only two sweep frequencies which may be varied a few cycles from their normal 60 or 15,750 cycles per second. However these two frequencies represent about 90 percent of the time-base frequencies required for TV service work. Secondly, the frequency response of the scope will be limited by the amplifier bandwidth and the fact that there will be high frequency losses in the cabling between the amplifier and the tester. By keeping these leads as short as possible these losses become negligible because the highest frequency to be passed is only 300 kc. The amplifier required is one that is relatively flat from 20 to 300,000 cps. It should be able to deliver about 250 volts of signal to the deflection plates. Fig. 3 is a schematic for an easily constructed amplifier which meets these requirements. Fig. 4 is a diagram of a power supply that will furnish the necessary power for the amplifier.



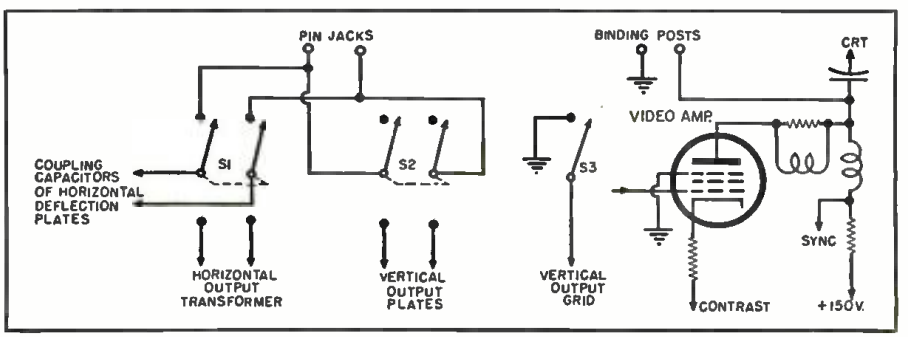
R_1—25,000 ohm, 25 w. wirewound res.
C_1, C_2—10 µfd., 450 v. elec. capacitor
CH_1—10 hy., 110 ma. choke (Stancor C1001 or equiv.)
S_1—S.p.s.t. switch
T_1—Power trans, 350-0-350 v. @ 90 ma.; 6.3 v. @ 3 amps.; 5 v. @ 2 amps. (Stancor PM-8409 or equiv.)

Fig. 4. Schematic diagram of a suitable power supply for the amplifier in Fig. 3. The tube numbers in the heater circuit of T_1 refer to the tubes in the amplifier.

To observe video and blanking pulses, connect a probe to the ampli-

(*Continued on page 153*)

Fig. 5. Switch and binding post arrangement for the converted TV receiver.



AN EFFECTIVE, LOW-DISTORTION LIMITING AMPLIFIER

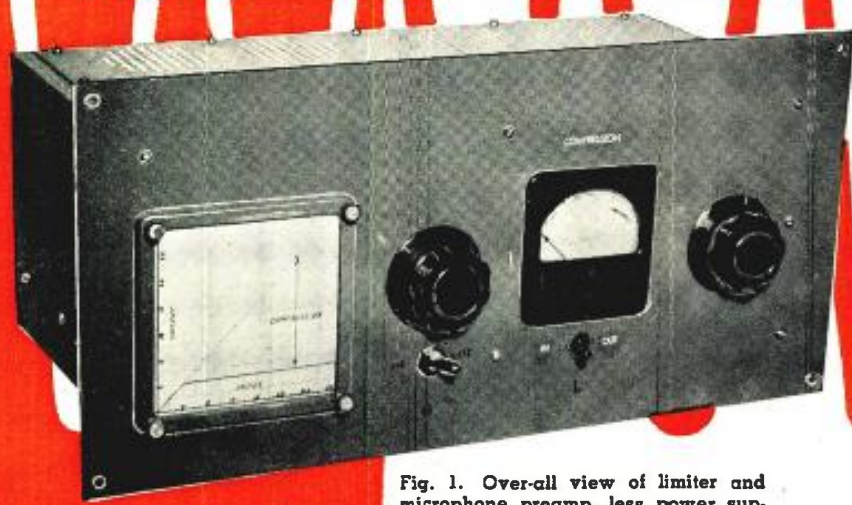


Fig. 1. Over-all view of limiter and microphone preamp, less power supply. Knob on left is interstage gain control in the preamp which adjusts the amount of limiting. The switches are to cut in high- or low-frequency compensation to emphasize speech frequencies, if desired. The chart is used to record the optimum settings.

By
W. HERBERT HARTMAN W6UAF

Construction details on a unit which offers negligible distortion and has a high degree of control leverage.

IT IS well recognized that an effective phone signal is one that is maintained at a high degree of modulation at all times. A completely modulated 250-watt signal is approximately as effective as a kilowatt signal that is only 50% modulated, and considering that a.v.c. action of the receiver adjusts the receiver volume in proportion to *received carrier*, the 250-watt signal would actually put out *more* volume from the speaker than would the kilowatt station.

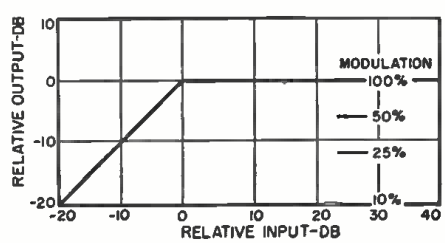
It is the desire of every station operator to find an effective means of keeping the modulation level as high as possible, but at the same time preventing it from exceeding the legal maximum. Many schemes have been advanced, such as clipping-filtering combinations and various types of limiting or compression amplifiers.

It is the intent of this article to describe one such device that has proven to be very effective, yet includes few of the usual disadvantages. The limiter to be described is the outcome of several years' experimentation and closely parallels several of the commercially built units designed for broadcast work.

It might be well to begin by reviewing the requirements to be met by the limiting amplifier. (1) The amplifier must be capable of large amounts of compression with negligible distortion in the important speech frequency ranges. (2) It must have a high degree of control leverage, *i.e.*, above the threshold point, the gain should virtually cease to increase for any further increase of input signal. The ideal curve of input plotted against output would be one that suddenly flattened out to a perfectly straight line having no slope. See Fig. 2. (3) The limiter must have a fast attack time. Irrespective of amplitude, the limiter must catch the first impulse and prevent it from exceeding the pre-determined maximum. (4) It should also have a reasonable recovery time; fast enough to allow the gain to rise between syllables to keep every word at maximum modulation, yet slow enough so that clipping of individual cycles does not take place in the important speech range of frequencies. (5) There must be no type of instability nor should any control surges get through to cause popping or thumping in the output of the device. The unit to be described qualifies on all these points and its effectiveness is acknowledged by those who have heard it operate.

It may be of interest to the reader to know why the author felt that clipping-filtering does not meet the requirements. A detailed discussion about transient response of filters, networks, and waveform distortion would be necessary to explain the deficiencies of the system. In a nutshell, the author believes it is much better to use a system that does not severely distort the waveform. Even after filtering, the clipper type of system exhibits an amazing amount of intermodulation products that cannot be eliminated, all of which seem to mask the intelligence of the signal and otherwise offset much of the increase in loudness. Also, due to the overshoot of a sharp cut-off type of filter when subjected to a square-wave type of impulse, an average loss of approximately 30% of possible modulation level must be maintained to prevent overmodulation. These factors made it desirable, in this instance, to concentrate on a compression type of circuit.

Fig. 2. Ideal curve of input versus output.



A compression, or limiting amplifier does not change the character of the waveform, unlike a clipper, but merely reduces the total size of the waveform to conform with certain pre-determined peak amplitudes. It does this instantaneously without detracting from the intelligence or articulation of the speech being transmitted. The manner in which this is accomplished can be seen from Fig. 3. If curve A of Fig. 3A is designated as the characteristic plate curve of tube V_1 (or V_2), Fig. 4, with no reduction in gain, an input volt-

age E impressed on the tube will result in a given output voltage E'. If a control circuit is arranged to change the gain of V_1 by shifting the operating characteristics and hence the *slope* of the plate curve in such a way that when the impressed input voltage is raised, the slope will change in the same proportion, then the output waveform will remain substantially the same size, irrespective of the amount of input voltage, as in Figs. 3B or 3C. In other words, it is the slope of the curve that is changed, and not the shape of the waveform, which remains a perfect replica of the input waveform, except for size. The dynamic curve of the gain reduction amplifier stage is essentially a straight line under all degrees of compression. This, then, is the key to the operation of the limiter. It is a dynamic device that provides a set of operating conditions suited to each part of the signal it encounters in order to maintain a certain maximum peak level at all times.

The complete diagram of the W6UAF limiter is shown in Fig. 4. To make the device most effective for amateur work, several measures have been incorporated that would not prove desirable in broadcast work. A higher degree of control ratio has been achieved, at the expense of distortion at extremely low frequencies. We are not concerned with small amounts of distortion at frequencies below 100 cycles, whereas such a compromise cannot be made in broadcast work. The recovery time of the control circuit has been made very short so it will effect its recovery between syllables instead of after several words have been spoken. This keeps the modulation high for each word or syllable, even when speaking at a rapid rate. This has also been done at the expense of low frequency distortion. Extremely fast attack time has been achieved through the use of a low impedance cathode follower circuit that will charge the time

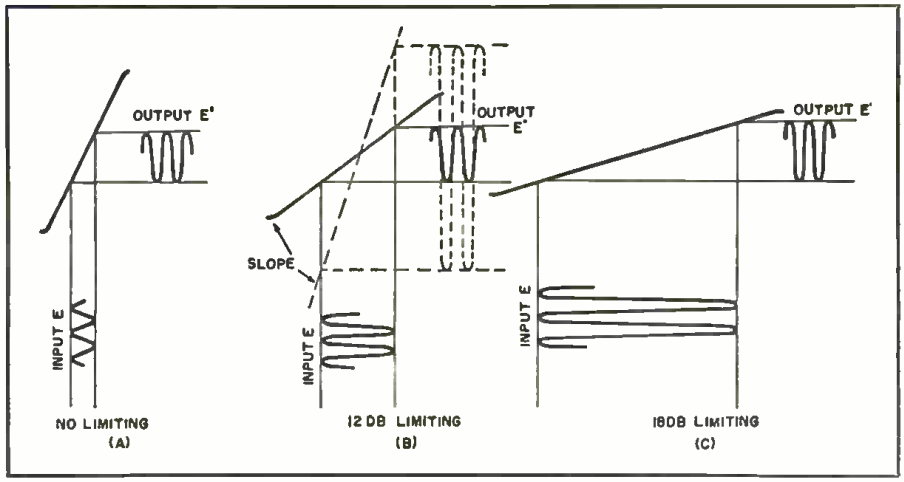
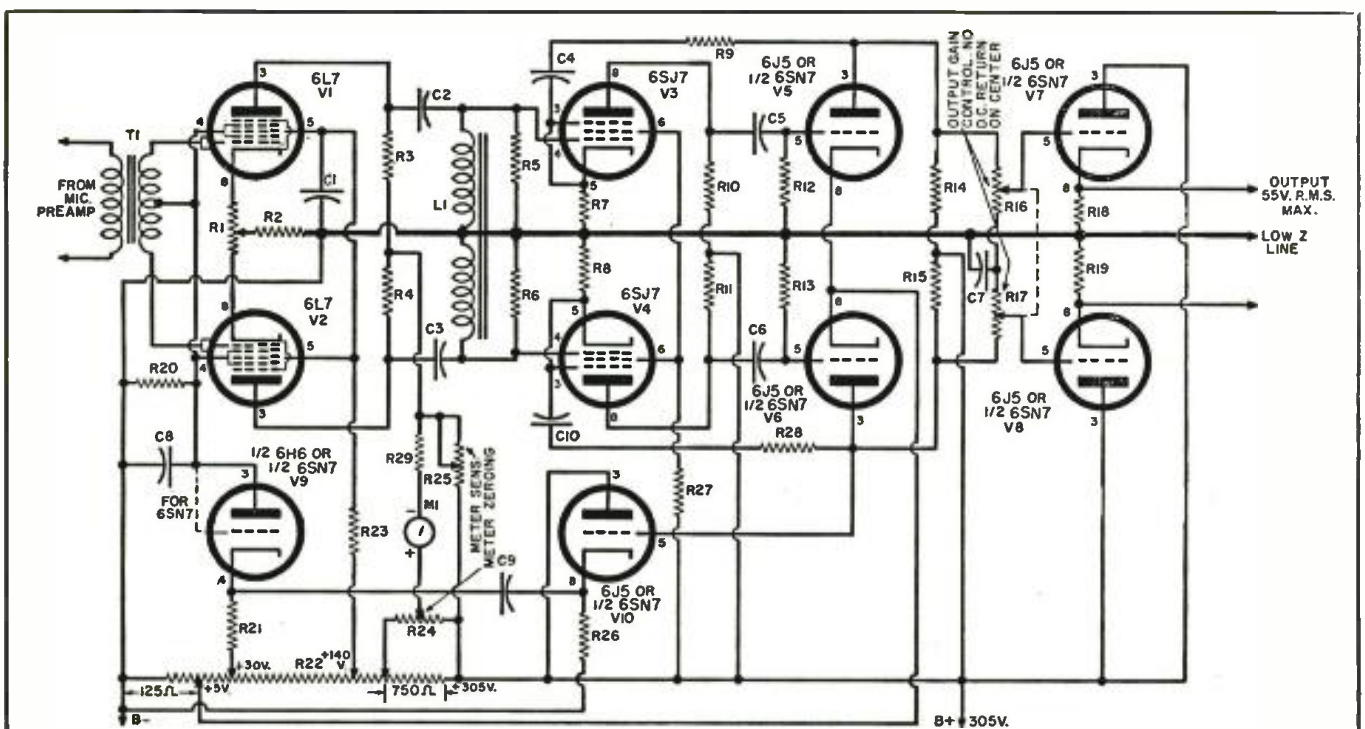


Fig. 3. Idealized characteristic curves of V_1 and V_2. Fig. 4. See text.

Fig. 4. Complete schematic diagram of limiting amplifier. For an auxiliary power supply to be used with this unit, see Fig. 6.



R1—100 ohm wirewound pot
R2—250 ohm, 1 w. res.
R3, R4—25,000 ohm, 1 w. res. (matched ± 1%)
R5, R6—500,000 ohm, ½ w. res.
R7, R8—1500 ohm, 1 w. res. (matched ± 1%)
R9, R20—30,000 ohm, ½ w. res. (matched ± 1%)
R10, R11—250,000 ohm, ½ w. res. (matched ± 1%)
R12, R13—500,000 ohm, ½ w. res. (matched ± 1%)
R14, R15—75,000 ohm, 1 w. res. (matched ± 1%)
R16, R17—500,000 ohm dual audio taper pot
R18, R19—25,000 ohm, 10 w. wirewound res.
R20—15 megohm, ½ w. res. (Measure after soldering in place to insure value hasn't dropped after heating)
R21—100,000 ohm, ½ w. res.
R22—10,000 ohm, 50 w. bleeder res. (with 4 adj. taps)
R23—30,000 ohm, 1 w. res.
R24, R25—5000 ohm wirewound pot
R26—20,000 ohm, 10 w. wirewound res.
R27—500,000 ohm, 1 w. res.
R28—10,000 ohm, ½ w. res.
C1—.5 μfd., 600 v. capacitor
C2, C3, C5, C6, C7—.1 μfd., 600 v. capacitor
C4, C10—1 μfd., 600 v. bathtub capacitor
C8—.01 μfd., 400 v. capacitor
C9—1 μfd., 400 v. bathtub capacitor
L1—Sec. winding UTC Type 0-6 "Ouncer" trans. Pri. left open and unused (Do not substitute)
M1—0-1 ma. d.c. milliammeter
T1—Interstage trans. (Any high quality unit having sec. with accurately matched halves, such as UTC LS series or Stancor WF series, can be used. Sec. grid winding imped., nominal 50,000 ohms)
V1, V2—6L7 tube V3, V4—6SJ7 tube
V5, V6—Single 6SN7 tube or two 6J5 tubes
V7, V8—Single 6SN7 tube or two 6J5 tubes
V9—6H6 tube or ½ diode-connected 6SN7 if other half is used for V10
V10—6J5 or ½ 6SN7 tube

Note: Except in the case of R7, R8, R9, R20, the nearest available RETMA standard value resistor may be substituted should the values specified be unobtainable, however each resistor must be matched in value with its corresponding mate on the opposite half of the push-pull circuits.

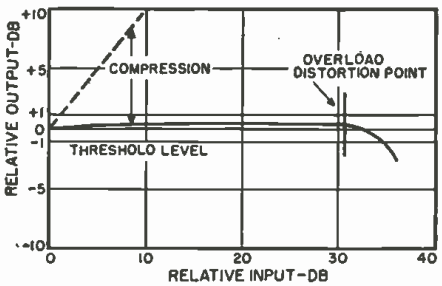


Fig. 5. Compression characteristics. Single tone distortion less than 2% up to 30 db compression for any frequency above 100 cps and less than 5% down to 50 cps (a steady-state tone). See discussion in text.

constant capacitor at a very rapid rate. Push-pull circuits are used throughout to prevent undesirable thumps, and other phenomena attributable to control circuit surges, from appearing in the output of the speech system.

Upon examination of Fig. 4, it will be noticed that the control voltage is sampled off only one side of the waveform in a half-wave rectifier circuit. In broadcast work this would be undesirable since it would allow certain voices to sound much louder than other voices or music depending upon the polarity of the speech waveforms. This is no problem to the amateur, whose object is to sound as loud as possible from only one sound source, so the point can be taken to advantage. This is discussed later on in this article.

The circuit consists of three principal parts: the gain reduction stage, the stabilized amplifier, and the control circuit. Also included as a somewhat optional feature is the output coupling stage.

The variable gain stage consists of a pair of 6L7 tubes operated in push-pull, with the signal applied to one set of control grids and the control voltage to both sets of control grids. This gives the control voltage additional amplification or leverage over that of the signal voltage alone. The 6L7 tube is admirably suited to this purpose since it has a variable mu characteristic coupled with very low distortion over the entire operating range until the input signal is increased sufficently to cause the signal grids to draw grid current. This latter factor becomes evident at input levels in excess of approximately 31 db of compression at which point the output becomes severely distorted and the output level drops abruptly. It is interesting that once the limiter becomes overloaded, the output *drops* instead of continuing to increase so that even under these circumstances overmodulation of the transmitter will not occur.

The gain reduction stage is followed by a two stage amplifier having certain critical requirements. The gain-frequency characteristics have been carefully selected to make the amplifier stable under all conditions of compression. Stability has been made high by means of inverse feedback and other features make it relatively insensitive to control thumps. The design of this portion of the limiter is extremely important, since it is essentially a part of a very high gain feedback loop. The mechanical analogy is the governor-controlled engine. Any mechanical instability causing erratic or sluggish operation of the governor will result in "hunting," which is a form of oscillation.

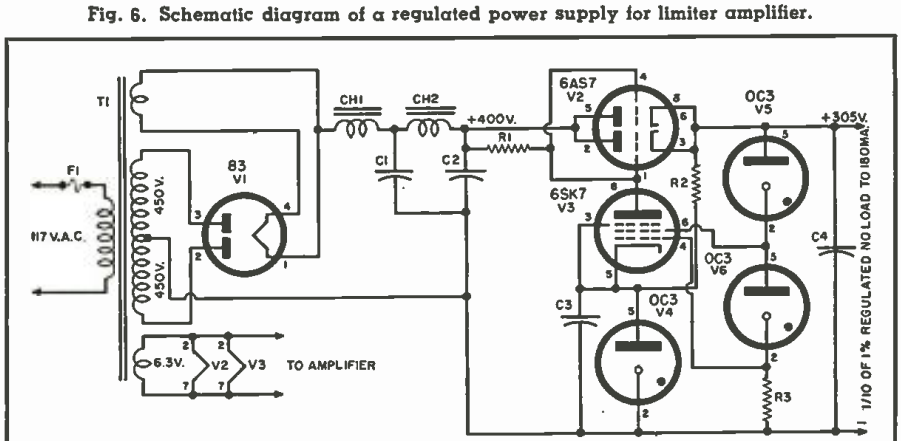
Any type of feedback path formed by a control circuit that samples the output of the device being controlled is capable of oscillation unless the frequency response of the loop is carefully controlled over many octaves, especially when the control leverage is very high (large feedback factor). The low frequency design is of great importance because perhaps it is the most difficult to control. It is in order to meet this design requirement that the inductance, L_1, is used between the gain reduction stage and the remainder of the amplifier. Because of its effect on the control circuit loop, the requirements for the secondary ratings of the interstage transformer from the preceding microphone stages are quite critical. This transformer must have a well balanced secondary winding with low residual parameters.

Another similar oscillation is possible in the limiting amplifier if any control surge gets through the signal portion, becomes amplified, and is again sampled by the control rectifier. The frequency of oscillation is determined by the discharge time of the time constant circuit, C_8 and R_{20}, the circuit that normally determines the recovery rate of gain limiting. This oscillation is not likely to take place with matched tubes and components in a push-pull type of circuit. Means for balancing the circuit for dynamic operating conditions are provided by adjustment of R_1.

The high frequency response of the control loop determines the behavior to impulses or transients. This defines how quickly gain stability is obtained after a sudden increase in gain has taken place. Poor high frequency response of the loop will cause the control to overshoot. The output will then decrease below that desired, then above, etc., in a damped type of oscillation before equilibrium is established for the new steady-state value of input signal. Careful design of the response and amount of damping insure that overshoot will be negligible.

The control rectifier is biased so that limiting action is delayed until the output signal voltage exceeds the bias voltage. With the bias voltage set at 30 volts, the output signal on the side of the circuit that is sampled by the control circuit cathode follower cannot greatly exceed 30 volts since the amount beyond which it actually exceeds 30 volts is impressed directly as a negative bias on the grids of the 6L7 tubes. There is no such limitation to the level encountered on the opposite side of the push-pull amplifier. This means that if the side of the signal appearing in the controlled side of the amplifier is chosen to modulate in the *downward* direction, the absolute limit of modulation will be the desired amount on *negative* peaks, but any unsymmetrical speech wave having high peaks in the upward direction is not limited, except in its normal proportion to the height of the negative peak. Thus if the transmitter is capable of a very high degree of modulation in the positive direction, compared to the negative direction (as most transmitters are that are not skimpy on design) advantage can be made of it. This will amount to some 6 db or better. There will be no difference in the height of the positive and negative peaks on sine-wave tone. Unfortunately speech does not consist of pure sine-wave tone and the energy content is much lower for the same peak amplitude, however the most can be made of the normal asymmetry existing in male speech by allowing the highest peaks to go only in the direction that can most easily be accom-

Fig. 6. Schematic diagram of a regulated power supply for limiter amplifier.



R_1—470,000 ohm, 1 w. res.
R_2—20,000 ohm, 10 w. wirewound res.
R_3—5000 ohm, 10 w. wirewound res.
C_1-C_2—10/10 μfd., 500 v. elec. capacitor
C_3—.1 μfd., 600 v. capacitor
C_4—10 μfd., 450 v. elec. capacitor
CH_1, CH_2—10 hy., 200 ma. filter choke
F_1—3 amp. fuse
T_1—Power trans. 450-0-450 @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. @ 5.8 amps.
V_1—83 tube
V_2—6AS7 tube
V_3—6SK7GT or GT tube
V_4, V_5, V_6—0C3/VR-105 tube

modated without distortion. Failure to regard the importance of this factor will result in seemingly weak modulation should the wrong speech wave polarity be observed, even though the scope shows consistent 100% modulation is being achieved on negative peaks.

The particular values chosen for the recovery-time-constant circuit were selected to allow the fastest possible attack time. The recovery rate is determined by the speed with which C_8 discharges through R_{20}, according to the formula $T = CR$. T is the time measured in seconds, C is in microfarads and R is in megohms. This formula gives the time required for the voltage to decay to 63% of its steady-state value after the applied control voltage has been removed. The value of 15 megohms and 0.01 μfd. gives a recovery rate of .15 second. The actual value is probably closer to .2 second if the stray capacity of the transformer winding of T_1 is included as part of C_8.

The attack time is determined by the series impedance of the source used to charge C_8. The resistance of the diode is probably in the vicinity of 300 ohms and the source impedance of the cathode follower is approximately $1/G_m$. Using published values of operating characteristics that most nearly match the actual operating conditions of the cathode follower, we obtain a source impedance of 385 ohms. This, added in series with the 300 ohm diode resistance gives a total charging resistance of 685 ohms. The charging time would be (neglecting the 15 megohms across the capacitor) .01 x .000685 second. If we round off the .000685 to .0007 and assume some stray capacity in the transformer, we arrive at a time of approximately 7 microseconds. This is fast enough so that for all practical purposes the attack time can be assumed to be infinite for any impulse we propose to transmit having a frequency limitation of from 3000 to perhaps 10,000 cycles. It can be shown that if any appreciable overshoot does exist on the modulated carrier, it is probably due to poor transient response of the modulator rather than actual overshoot of the compression amplifier.

Thus, in order to utilize the full effectiveness of the limiter, the audio stages following the unit should be very carefully designed for minimum phase shift and flat response. A poor response curve following the stages of compression will result in persistent overmodulation at certain frequencies, or if this is corrected by lowering the gain, will necessitate the reduction of the average level of modulation. Restricted frequency range of the modulator will result in poor transient response and will cause hangover on steep wavefronts and result in shot type overmodulation. Phase shift of the relative frequency components will cause severe shifting of energy content-*vs*-peak power of the wave after the initial complex wave has already been limited by compression. This will cause wide variation in gain after it has supposedly been set to a definite maximum in the compressor. This would limit the effectiveness of the gain limiter as a device to prevent overmodulation.

Design the remainder of the modulator for the best frequency response possible even if the desired range is only that of the speech frequencies. Any frequency shaping or limitation *must* take place somewhere in the microphone preamplifier stages *preceding* the limiter.

The output circuit consists of a direct coupled, cathode follower circuit. This is an optional feature that performs the impedance transformation without the use of a costly transformer and allows the use of a simple dual volume control for the output gain control of the amplifier. It is to be noticed that d.c. appears on these leads and should be isolated with capacitors at the far end of the output leads before entering the input of a modulator, or if fed into a line-to-grid transformer means must be taken to keep the primary winding at d.c. potential above ground and to provide a large (25 μfd.) capacitor from the center of the winding to ground as a bypass.

There is a certain maximum output voltage which can be obtained directly from the limiter. This limit is approximately 55 volts r.m.s. which allows considerable margin for speech waves having low energy content. The limitation is caused by certain requirements of the feedback loop in the two stage amplifier. This feedback is always

(*Continued on page* 129)

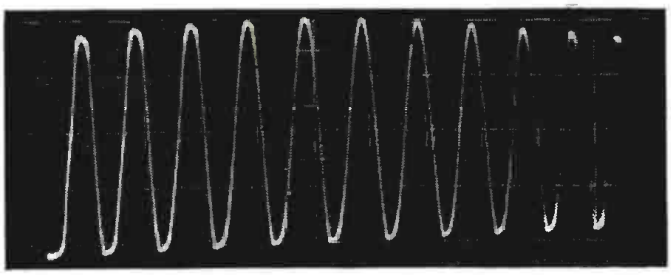


Fig. 7. Actual photo of output waveform when a 1000 cycle note is keyed. Triggered scope sweep started just as signal was keyed on. The oscillogram shows the first ten cycles after a signal was applied. This, and the other scope patterns, were taken with a Speed Graphic from the face of a Tektronix Model 514-D scope. The control rectifier sampled the side of the waveform that appears on the bottom of the pattern shown.

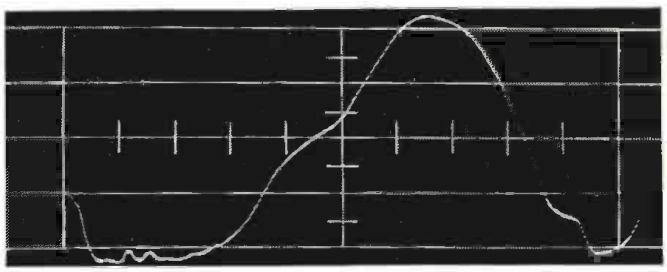


Fig. 8. Photo of first cycle undergoing compression in a wavetrain at 1000 cycles as in Fig. 7. Note the control circuit acts to make the first wave square-topped since the control cannot act until the actual signal exceeds the control bias voltage. The slight irregularities are due to the constants of the various feedback loops, as discussed in text. Circuit components were chosen to minimize these irregularities. Note that size of wave would be ten times as large had compression not taken place, barring overload of tube characteristics.

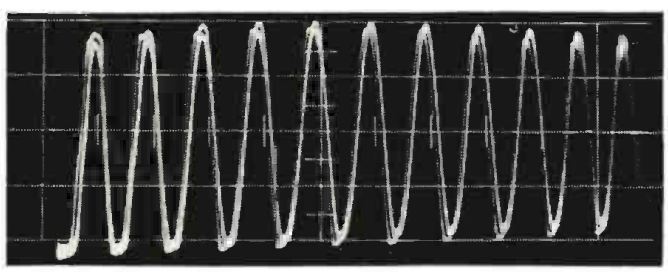


Fig. 9. Camera left open to record three separate, successive keyed 1000 cycle wavetrains at 20 db of compression. They do not precisely overlap because triggered sweep is more accurately activated with a pulse-type waveform than with sine wave.

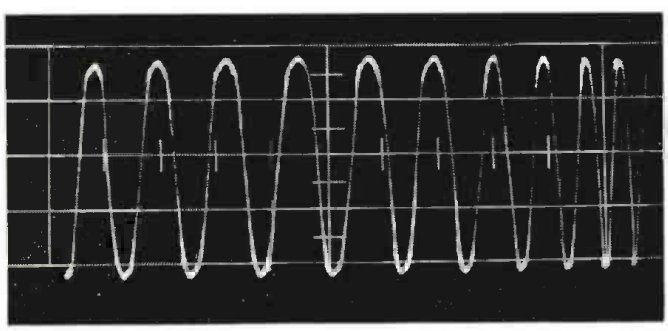
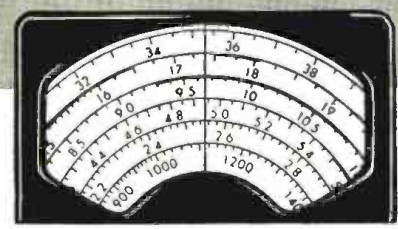


Fig. 10. Photo of first ten cycles of keyed 20 kc. note. This high frequency was immediately arrested on the first cycle, showing the effectiveness of the fast attack time. Waveform clipping exhibited in this and in all the preceding waveforms is more severe than would normally be encountered in speech material because the unit was keyed into very deep compression from a "no-limiting" condition. Unlike the keyed signal, the human voice usually requires several cycles to build up to maximum value, and the limiter has an opportunity to operate on a number of cycles of the wavetrain before the highest maximum occurs. The keyed tone is an especially severe test. Very little waveform clipping, except on the first cycle, will occur on normal speech wave under standard operating practice.

International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

WE HAVE a fairly good "bag" of choice contacts to report this month as details pour in from all parts of the globe.

Around the World

Alaska—KLE, 3.35A, noted 0112 with *test* for tuning and circuit adjustment purposes. (Chamberlayne, Va.)

Albania—ZAA, 7.848 (*measured*), Tirana, noted 1530-1600 with *English* now. (Ferguson, N. C.; Cox, Dela.)

Andorra—*Radio Andorra,* 5.972AV, is scheduled now 0700-1900. (URDXC)

Angola—CR6RC, 11.862, Luanda, is again audible some days with interval signal of steady native drum beats, clock striking sequence, and "A Portuguesa," preceding actual sign-on 1330. (Niblack, Ind.) CR6RA, 4.870A, Luanda, noted 1505 with piano music, man announcer in Portuguese. (Cox, Dela.) Heard over 9.030 in Sweden 1650-1730 sign-off. (*Nattugglan*) *Radio Diamang,* Dundo, CR6RG, is heard in Sweden on 9.240 from 1410 to closedown 1430. (Etersvep)

Argentina—*Radio del Estado,* 9.690, Buenos Aires, noted at excellent level 1912-2000 with symphonic music. (Kippel, Colo.) LRY, 9.760, Buenos Aires, *Radio Belgrano,* is good level from around 1800 to 2258 closedown when has powerful signal. (Adam, B. C.)

Australia—When this was compiled, *Radio Australia* was testing VLB9 on 9.540 as a possible replacement for 9.615 in the 0700-0845 daily beam to Eastern North America. And VLA11, 11.810, had replaced VLA15, 15.200, to Western North America 2155-2315. VLA15, 15.200, noted by Woods, Utah, 0030-0100 with request musical program. Parsons, Pa., reports the 11.900 channel closing 1230 in the Asiatic beam.

VLI6, 6.090, Sydney, N.S.W., is good strength in Colo. 0500. (Kippel) VLX9, 9.610, Perth, noted 0300-0415, excellent level in B. C. (Adam)

Austria—*Osterreichische Rundfunk,* Innsbruck, is now back on 6.000, heard in Sweden around 1300. (Radio Sweden) *Radio Osterreich,* 7.245, Vienna, noted with call 0200, then news in German. (Pearce, England)

Belgian Congo—*Radio Congo Belge,* 9.380, Leopoldville, noted at good level 0000-0130 with music, news in French, Flemish 0100; now re-opens 1030 instead of 1130. (Morgan, Calif.)

Belgium—ORU4 noted on 6.085, poor to fair, 2000-2200 in *English* to North America. (Stanley, Conn., others) Heard opening in *English* 0500 over 17.860, good level in N. Z. (Hardwick)

Bolivia—CP38, *measured* 9.436, noted 1930 with news in Spanish followed by musical program; built up to good signal by 2000. (Ferguson, N. C.) CP5, *Radio Illimani,* 5.970, La Paz, heard in Sweden 2100-2200. (*Nattugglan*)

Brazil—ZYK3, 11.825, Recife, noted around 1900. (Anderson, Texas) ZYK3, 9.565, good level in *English* 2005-2025A, with "Brazil Calling" session. (Stanley, Conn.) PRL, 9.720, Rio de Janeiro, has news in Portuguese 2300, moderately strong level with some CWQRM from TGZ, Guatemala. (Kippel, Colo.) A Brazilian on 11.965A, giving location as Sao Paulo, observed closing 2300 on a *Sun.* (Niblack, Ind.) *Radio Record,* 9.505, Sao Paulo, noted at good level 1930-2000 with Portuguese music. (Mathieu, Mass.) PRL5, 11.950, heard 1825 with sports commentary in Portuguese; identifying on 9.770 at 1900 closedown (NNRC)

British Honduras — Radio Belize, 3.300A, noted 2040-2132. (Bannon, Fla., others)

British New Guinea—VLT6, 6.130, Port Moresby, heard with children's program on *Sat.* 0300. (Mike Christie, Calif.)

British Somaliland — VQ6MI, 7.125, Hargeisa, noted at poor level 0830, fair to good 0915-0930 closedown. (Morgan, Calif.)

Bulgaria—*Radio Sofia,* 6.070, noted with news to North America 1930. (Lipinski, Mich., others) Schedule for *English* to North America now is 1930-2030, 2300-2330. (Ferguson, N. C., others)

Burma—Sutton, Ohio, reports *Radio Rangoon,* 6.034, heard in *English* 0115-0145, news 0130, announcing "The Voice of Burma."

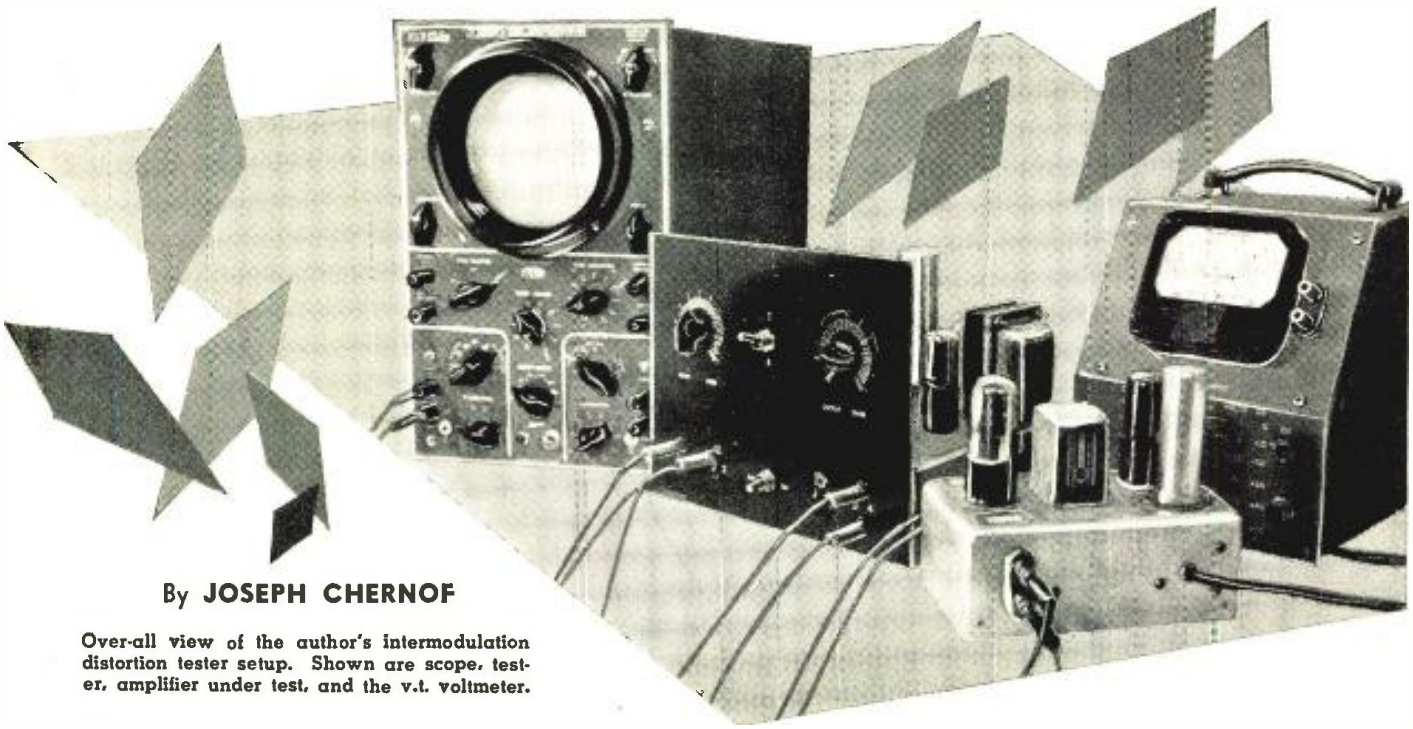
Canada—CHNX, 6.130, Halifax, N. S., is good level daily around 0600-0700 and later. (Snyder , Mass.) CFRX, 6.070, Toronto, Ont., good level 1330. (McGerald, Conn.) VE9AI, 9.540, Edmonton, Alta., strong with QRM in

(*Continued on page* 141)

(Note: Unless otherwise indicated, all time is expressed in American EST: add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

This is the transmitter hall of the Belgian National Broadcasting Service, located at Wavre-Overijse, near Brussels, Belgium. In the foreground are the three short-wave transmitters and in the background are the two medium-wave transmitters (used for the Home Service). Currently, ORU has English for North America daily 2000-2200 EST over 6.085, relayed by OTC, 9.655, in Leopoldville, Belgian Congo. Look for it.

INTERMODULATION DISTORTION TESTER



By **JOSEPH CHERNOF**

Over-all view of the author's intermodulation distortion tester setup. Shown are scope, tester, amplifier under test, and the v.t. voltmeter.

Details on an inexpensive unit for the audiophile which can be used with a standard oscilloscope or vacuum-tube voltmeter.

AN INSTRUMENT which measures audio frequency intermodulation distortion can be an extremely useful addition to the test equipment shelf. Of all the distortion tests available for evaluation of audio amplifier performance, none seems to agree so completely with listener judgment as the measurement of intermodulation distortion. While harmonic distortion should definitely be minimized in amplifier design, its presence in moderation merely adds some color, in the form of harmonics, to the reproduced sound which was not present in the original. This does not constitute faithful reproduction and is therefore to be avoided; however, the over-all effect is generally not unpleasing to the human ear. In contrast, intermodulation distortion produces combination tones which usually bear no harmonic relationship to the original. The result is harsh, unpleasant, and, if present in any apprcciable amount, conducive to listener fatigue.

An instrument for the detection and measurement of intermodulation distortion consists, basically, of a tone generator producing two separate output frequencies which are linearly combined and supplied to the amplifier under test. The output of this amplifier is then analyzed and the intermodulation distortion products present measured on a vacuum-tube voltmeter which is an integral part of the analyzer. This makes for a rather complicated and expensive piece of equipment which may explain why few audio experimenters are able to make these measurements on home equipment.

The writer has attempted to work out the design of an inexpensive intermodulation distortion tester which would perform the same functions as its more expensive commercial counterpart. This has been done, in part, by avoiding the use of special or costly components and partly by eliminating the built-in vacuum-tube voltmeter which is a part of commercial circuits. This was done in the belief that practically every experimeter has access to either a v.t.v.m. or an oscilloscope so that there would be little purpose in duplicating the function of these instruments in the design of an intermodulation distortion tester.

Fig. 1. Block diagram of the test setup.

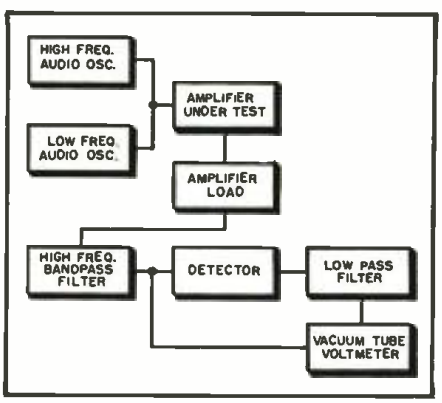
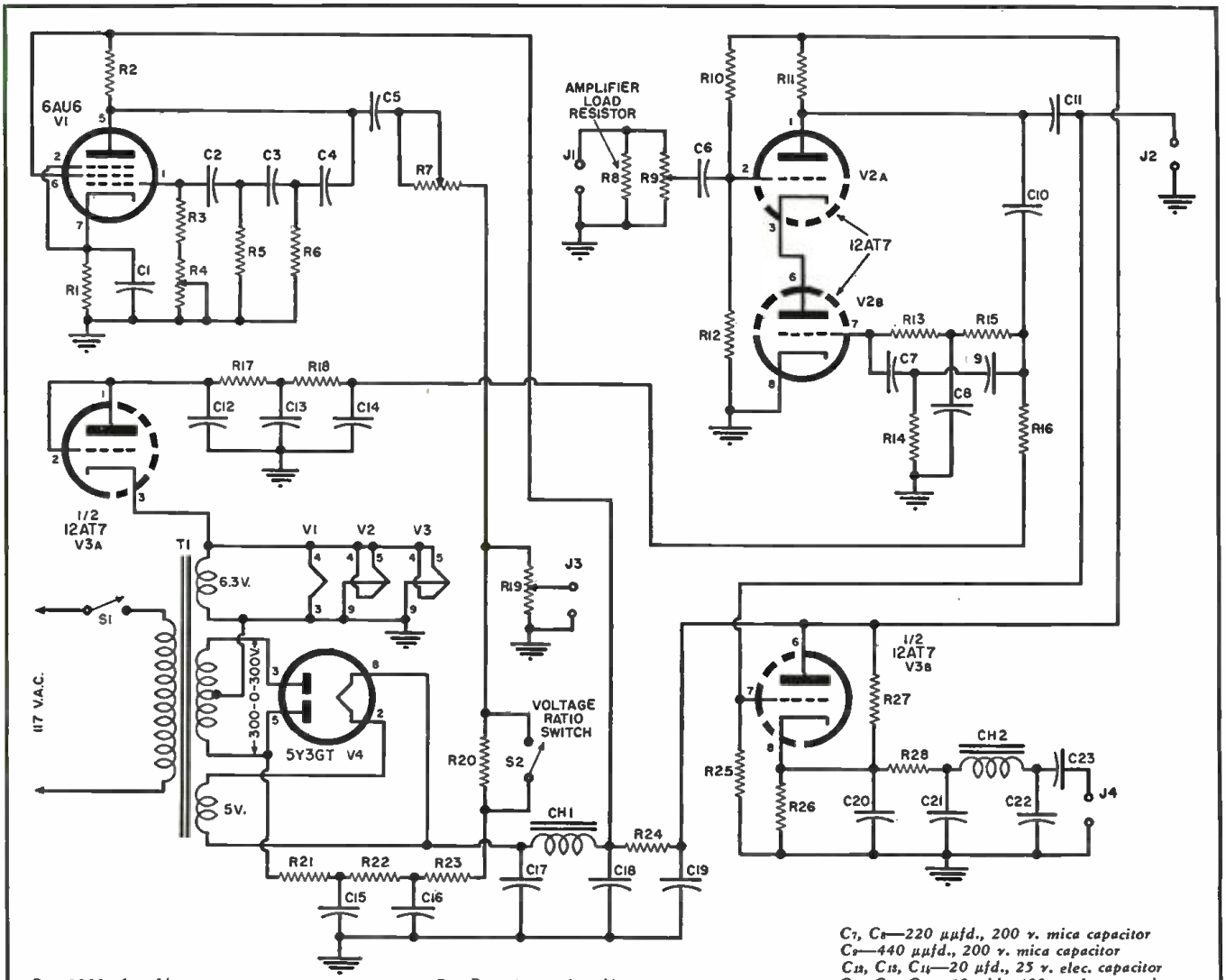


Fig. 1 shows a block diagram of a typical tester. The outputs of two audio oscillators, one a low and the other a relatively high frequency, are combined in a linear mixer circuit and the combination tone supplied to the input of the amplifier under test. This amplifier is then terminated in its rated load impedance and the output fed to the input of the analyzer circuitry. Here the combination tone is observed to determine the amount that the high-frequency tone has its amplitude modulated by the low-frequency tone. The low-frequency component is removed by means of a bandpass filter which accepts only the high-frequency component. The high-frequency tone accompanied by its associated modulation products is then detected and the carrier frequency filtered out. The low-frequency modulation products remaining are then measured and compared to the amplitude of the high-frequency carrier to determine the percentage of intermodulation distortion present.

At any given power output level, most amplifiers show indications of intermodulation distortion first at the lower audio frequencies. For this reason, an amplitude ratio of 4:1 between the low modulation frequency and the high modulation frequency is generally supplied to the amplifier under test so that low frequency distortion will be more apparent. If it is suspected that the amplifier under test has more distortion at the higher audio frequencies, an amplitude ratio of 1:1 will indicate a greater intermodulation distortion than the 4:1 ratio.



R1—2000 ohm, ½ w. res.
R2—39,000 ohm, ½ w. res.
R3, R5, R12—100,000 ohm, ½ w. res.
R4—25,000 ohm linear taper pot (screwdriver adj.)
R6, R17, R18—47,000 ohm, ½ w. res.
R7—50,000 ohm linear taper pot (screwdriver adj.)
R8—Load resistor to match ratings of amplifier under test
R9—500,000 ohm linear taper pot
R10—2 megohm, ½ w. res.
R11—820,000 ohm, ½ w. res.
R13, R15—150,000 ohm, ½ w. res.
R14—75,000 ohm, ½ w. res.
R16, R25—1 megohm, ½ w. res.
R19—5000 ohm linear taper pot
R20—220,000 ohm, ½ w. res.
R21, R23—24,000 ohm, ½ w. res.
R22—27,000 ohm, ½ w. res.
R24—18,000 ohm, ½ w. res.
R26—22,000 ohm, 1 w. res.
R27—82,000 ohm, ½ w. res.
R28—1.5 megohm, ½ w. res.
C1—.25 µfd., 100 v. capacitor
C2—100 µµfd., 200 v. mica capacitor
C3—150 µµfd., 200 v. mica capacitor
C4—200 µµfd., 200 v. mica capacitor
C5, C11, C15, C16, C23—.05 µfd., 400 v. capacitor
C6, C10—.1 µfd., 400 v. capacitor
C7, C8—220 µµfd., 200 v. mica capacitor
C9—440 µµfd., 200 v. mica capacitor
C12, C13, C14—20 µfd., 25 v. elec. capacitor
C17, C18, C19—10 µfd., 400 v. elec. capacitor
C20, C22—.01 µfd., 400 v. capacitor
C21—.015 µfd., 400 v. capacitor
CH1—10 hy., 50 ma. filter choke (Triad C3X or equiv.)
CH2—15 hy., 20 ma. filter choke (Triad C1X or equiv.)
T1—Power trans. 300-0-300 v. @ 50 ma.; 5 v. @ 2 amps; 6.3 v.c.t. @ 2 amps (Triad R7A or equiv.)
S1, S2—S.p.s.t. toggle switch
J1, J2, J3, J4—Banana jack (Paired)
V1—6AU6 tube
V2, V3—12AT7 tube
V4—5Y3GT tube

Fig. 2. Complete schematic diagram of the IM distortion analyzer. Quality parts should be used for best performance.

The schematic diagram of the complete intermodulation distortion tester is shown in Fig. 2. The high audio test frequency is generated by a phase-shift *RC* oscillator using a 6AU6 tube, V_1. The output frequency is determined by the values chosen for C_2, C_3, C_4, R_3, R_4, R_5, and R_6. This circuit has less distortion than the conventional phase-shift oscillator where all the "*R*'s" and "*C*'s" are made equal. A frequency of approximately 5000 cycles is produced by this oscillator. R_4 allows adjustment of the oscillator frequency over a small range. R_7 sets the output voltage of the high-frequency oscillator.

The low frequency audio signal is very simply obtained. 60-cycle voltage is picked off from one side of the power transformer high-voltage winding and passed through an *RC* filter to remove higher harmonics and reduce the amplitude of the 60-cycle test signal to approximately 5 volts r.m.s. through the voltage dividing network consisting of R_{19}, R_{20}, R_{21}, R_{22}, and R_{23}, with the voltage ratio switch, S_2, in the 1:1 position. With S_2 in the 4:1 position, R_{20} is shorted out to give the higher test voltage. The 60-cycle low-frequency test signal and the 5000-cycle high-frequency test signal are combined across audio output level control R_{19}. The variable output level is fed to output jack J_3 on the front panel where it is available for connection to the amplifier under test. The output attenuator is used to set the power level at which an amplifier is to be tested.

The amplifier under test is terminated in its rated load impedance by a resistor capable of dissipating the full power output capabilities of the amplifier. This is shown as R_8 in the schematic diagram although it is not physically located in the tester chassis. The actual amplifier power output may be established by measuring the output voltage across this load resistor. Since a complex waveform is involved, a correction factor must be applied to the voltage measurement before the equivalent power output can be calculated. The correction factor for the 4:1 test voltage ratio is

approximately 1.3 and that for the 1:1 ratio is approximately 1.6. The output voltage is multiplied by this form factor to obtain the equivalent a.c. voltage corresponding to the voltage peaks of the complex output waveform.

The test amplifier output voltage is supplied from front panel jack J_1 to the analyzer section of the intermodulation distortion tester, attenuated in analyzer input level control R_9, and then applied to the bandpass filter circuit consisting of both sections of V_2, a 12AT7 twin-triode, connected in cascode with a twin-T *RC* feedback network. This network has a null frequency of approximately 5000 cycles and provides negative feedback at all frequencies but its null frequency to produce the bandpass filter effect at the null frequency. The 60-cycle low-frequency component is effectively removed by this filter leaving the 5000-cycle high-frequency component plus the sidebands which were generated by the interaction and distortion of the two test frequencies in the amplifier under test. The filter output is connected to the front panel jack J_2 so that the high-frequency carrier amplitude may be measured externally.

The 5000-cycle carrier is then demodulated by half a 12AT7, V_{3B}, in an infinite impedance detector circuit which builds up a voltage across its load resistor, R_{29}, practically equal to the envelope amplitude. A small positive bias is supplied to the cathode of V_{3B} to allow it to operate close to cut-off with no input signal. The demodulated output is applied to a low-pass filter consisting of R_{28}, CH_2, C_{20}, C_{21}, and C_{22} and the carrier frequency is effectively removed. The low-frequency modulation products which now remain are a direct measure of the intermodulation distortion in the amplifier under test; these are connected to front panel jack J_1. The exact percentage of distortion is determined as follows. The 5000 cycle carrier-frequency amplitude is measured by connecting, an oscilloscope or v.t.v.m. to J_2. This level is noted and then the measuring instrument is connected to J_1 and the amplitude of the modulation products is noted. The ratio of these two voltages is the percentage of intermodulation distortion.

A conventional power supply is employed using a 5Y3GT rectifier. The other power supply components are not critical and any comparable values that the experimenter may have in his parts box would be acceptable. The 6.3-volt a.c. filament voltage is rectified by bias rectifier V_{3A}, the remaining half of the 12AT7 connected as a diode, to provide the class A operating bias for the bandpass filter tube. Normal wiring procedures should suffice except that some care should be taken to isolate the 5000-cycle oscillator from the bandpass filter circuitry. Since 60 cycles is used as one of the test frequencies, every attempt should be made to eliminate stray 60-cycle fields during layout and wiring.

Initial set-up of the instrument is short and sweet. R_{20}, R_{21}, R_{22}, and R_{23} have been chosen to work with a power transformer with a high-voltage winding supplying 300 volts a.c. each side of the center tap. For any other voltage rating, it will be necessary to change the values of R_{20} and R_{23}, keeping in mind that 5 volts r.m.s. of 60-cycle signal is to be developed across output level control R_{10} with S_2 in the 1:1 position. Likewise, the high frequency oscillator output attenuator, R_7, is adjusted until 5 volts of 5000-cycle signal is developed across R_{10}. This can be checked with a voltmeter or oscilloscope at J_3. The high-frequency oscillator is adjusted to the center frequency of the analyzer bandpass filter by jumping J_3 to J_1 and observing the bandpass filter output at J_2 with an oscilloscope or v.t.v.m. The oscillator frequency is adjusted by means of R_4 for maximum output from the bandpass filter circuit. Analyzer input level attenuator R_9 is set just high enough to give sufficient output voltage at both J_2 and J_4 to be conveniently observed and measured. If R_9 is set too high, V_2 will be overdriven and the resulting distortion will cause erroneous results.

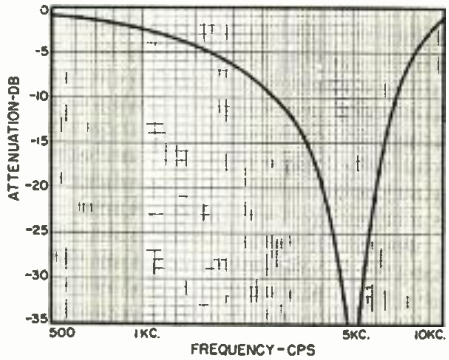


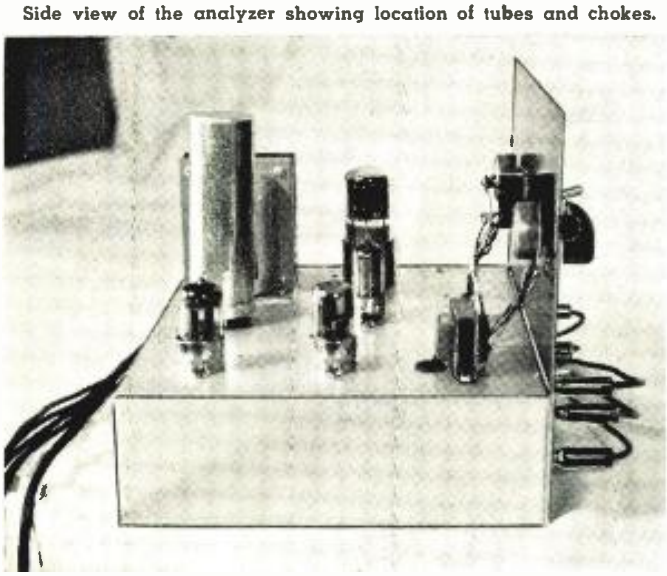
Fig. 3. Transfer characteristics of the twin-T feedback network as used in the IM distortion analyzer's bandpass filter circuit.

It is difficult to quote a figure for maximum allowable intermodulation distortion for a given amplifier, though it is generally accepted that a really top-notch amplifier should not exceed a figure of about 6% over its entire usable frequency range. Common causes of high amounts of distortion are operating circuit components such as tubes and output transformers beyond their normal ratings into regions of nonlinearity. Particularly in the case of output transformers, the highest quality components should be used whenever possible. When, in the interests of economy, compromises must be made, it is often possible to make up for component deficiencies by means of negative feedback loops around one or more amplifier stages.

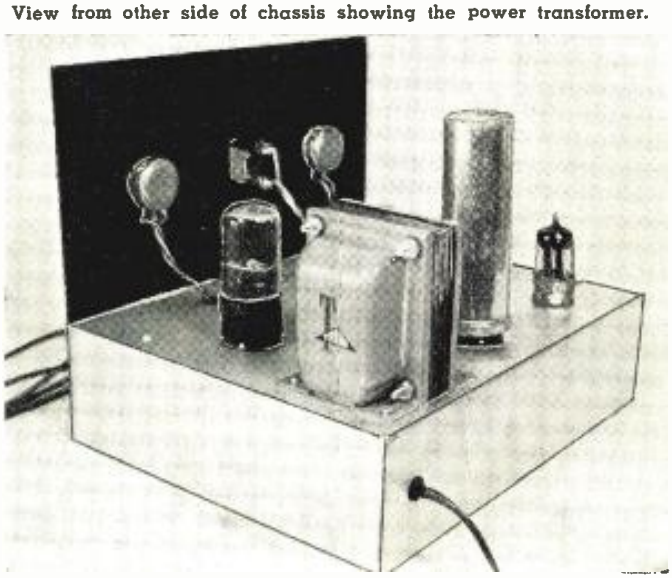
Should the builder already have an audio oscillator in his possession, the construction of the IM distortion analyzer could be simplified. High-frequency test oscillator, V_1, and its associated circuitry would then be deleted. The external audio oscillator voltage would be inserted into the circuit at the top of R_{10}. This could best be done, physically, by the addition of another pair of banana jacks on the front panel of the unit.

-30-

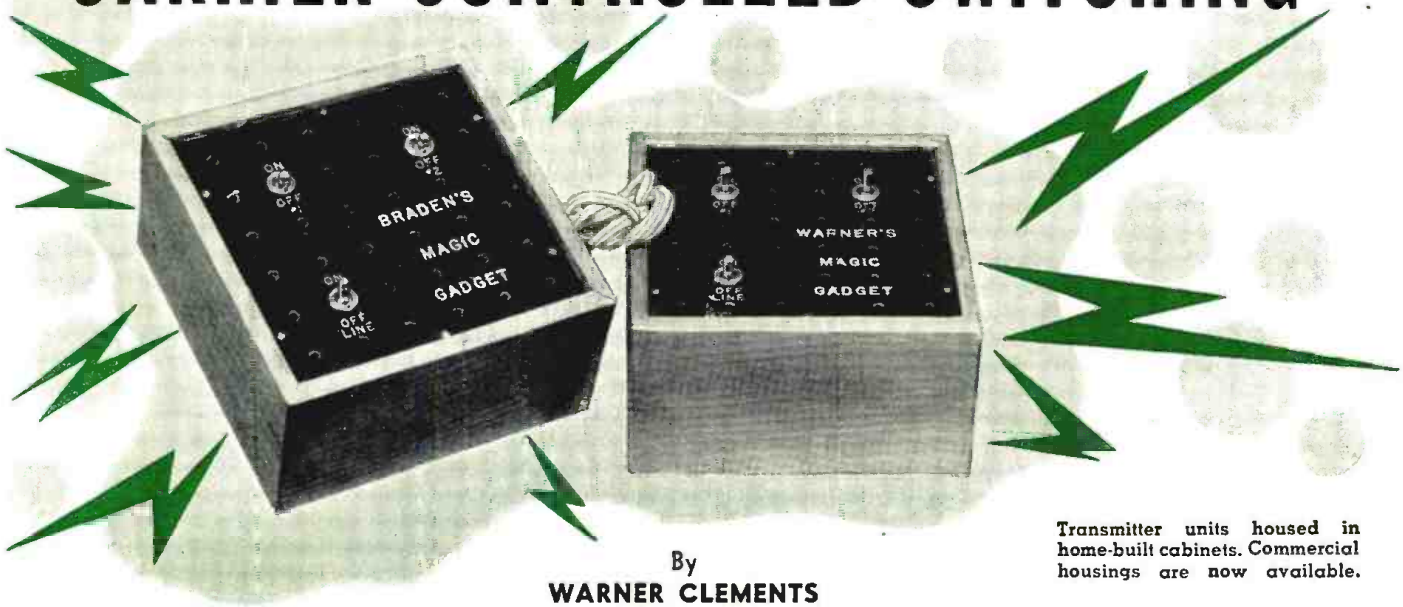
Side view of the analyzer showing location of tubes and chokes.



View from other side of chassis showing the power transformer.



CARRIER-CONTROLLED SWITCHING



Transmitter units housed in home-built cabinets. Commercial housings are now available.

By
WARNER CLEMENTS

Construction details on a simple transmitter-receiver to operate remote equipment via the household power lines.

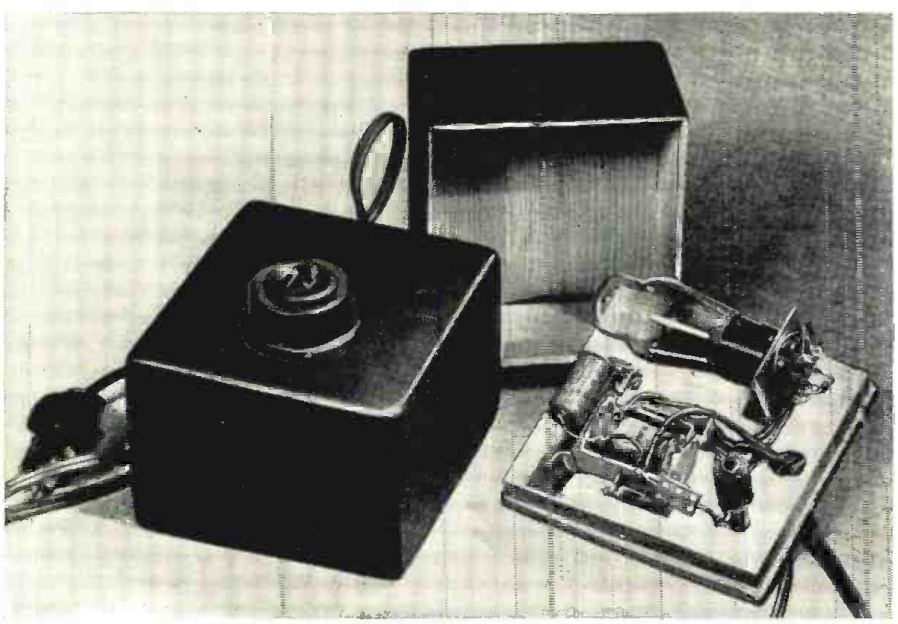
THE time to install wiring in a home, store, or office is when the building is under construction. If you have to do it at any other time it can be either very messy or very expensive.

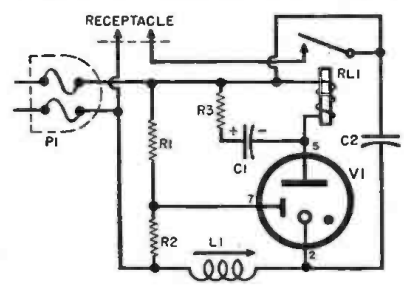
Now suppose that you need new wiring for the purpose of turning some electrical device on and off from a distance, and that it looks like a formidable task to conceal the wiring you are going to have to run. Why not make use of the already-existing a.c. power wiring? You can send radio-frequency signals over the power lines to control a relay which does the required switching at the remote location. You can, that is, if you can build equipment for the purpose that is simple and economical enough to be worth the trouble.

The simplest remote-unit (receiver) circuit for the purpose is that of Fig. 1. No detection is needed; the r.f. currents fire the cold-cathode gas discharge tube directly. This identical circuit (except that C_1 and R_3 have been added here) has been appearing in tube manuals for sixteen years. During that time it has probably broken the hearts of more people who tried to put it to work than any other circuit that would appeal to experimenters. It's easy to make it work *after a fashion,* but hard to make it work reliably and consistently. I say "hard"; of course it will work reliably under any circumstances if you use a powerful enough transmitter. But it gets a little ridiculous to use, say, 100 watts input on the transmitter for the humble purpose of controlling a 60 watt light bulb in the garage.

A number of factors tend to bring about poor results with this circuit. These involve the control unit (transmitter) as well. One factor has to do with the unavailability of suitable high "*Q*" inductors. The sensitivity of the receiver is almost directly proportional to the "*Q*" of its tuned circuit; the transmitter needs a high "*Q*" tank for the sake of efficiency. While any good radioman can wind a coil suitable for

Fig. 1. Photograph and schematic diagram of remote receiver unit. Many such units can be built and operated from the transmitter.





R_1—15,000 ohm, 1 w. res. ± 5%
R_2—10,000 ohm, ½ w. res. ± 5%
R_3—1000 ohm, 1 w. res.
C_1—8 μfd., 150 v. elec. capacitor
C_2—800 μμfd. silver mica capacitor (for channel 1), 1500 μμfd. silver mica capacitor (for channel 2)
RL_1—See text
P_1—Fused line plug. Fuse size chosen to protect relay points (El-Menco)
L_1—16 mhy. width control (RCA 212R1)
Receptacle—Amphenol 61F, 23-1S
V_1—0A4G tube (Sylvania)

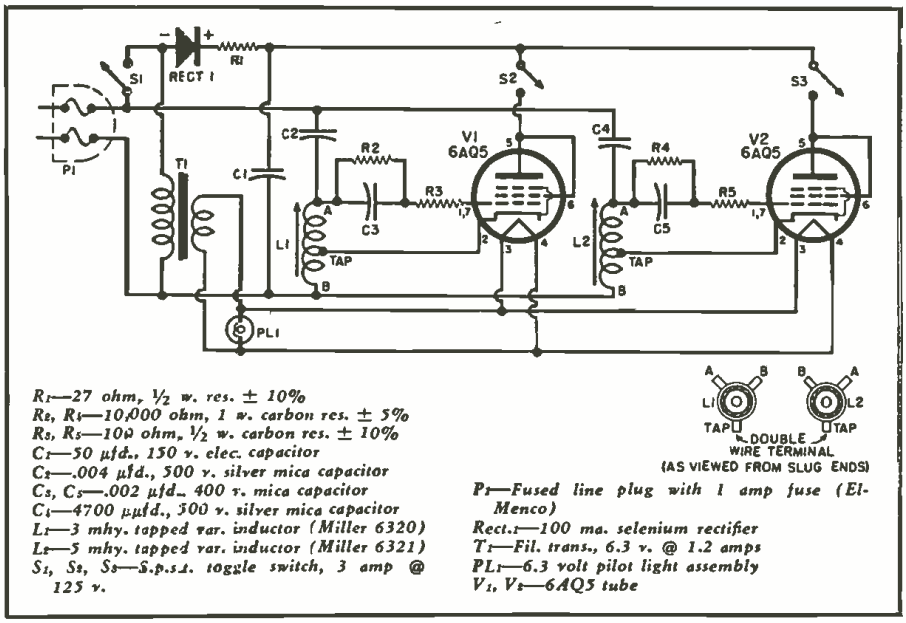
use at high frequencies, it's not so simple at the low frequencies necessary for so-called "carrier" transmission. In the latter case a coil-winding machine is a "must." It has been recommended elsewhere that 175 kc. i.f. transformers be used for this application. These just simply won't do the job. For one thing, 175 kc. is too high a frequency. Dozens of devices in modern homes have line filters built in; oil burners, vacuum cleaners, food mixers, electric razors, radios, etc. These all add up to pretty heavy and variable capacitive loading at 175 kc. You want a switching system that will work all of the time and not quit on you when a neighbor turns on his television set. And if you work i.f. coils at lower frequencies than they were designed for, they cease, in effect, to be high-"Q." Another drawback to i.f. transformers is that any but a microbe-powered transmitter will burn them up, nor will iron-cored inductors designed for filter applications fill the bill. The latter will tolerate little or no d.c. current and anyway they cost too much.

The whole problem has been solved in the equipment described here through the use of inexpensive television components; namely width-linearity controls. The adjustable cores on these controls provide a convenient means of tuning.

The next problem is a little different. It concerns the coupling of the transmitter tank to the line. The impedance of the line is pretty low; seldom over a few ohms and as low as a fraction of an ohm. So why not use a transformer output to roughly match impedances? Well, there are two reasons why not. One is that the secondary of a transformer would short the power line without the use of a blocking capacitor. But the capacitance of that blocking capacitor would ideally be high enough so that it would also carry a very heavy 60-cycle current. The other objection to transformer coupling, as well as to any other form of coupling that would provide a good match over a broad band, is that you might want to use more than one channel. Then every time you turned on another transmitter (in the extreme theoretical case) you would cut the line impedance in half. Each transmitter would load down the others.

What is called for is a resonant impedance match and that is just what is provided in the transmitter circuit of Fig. 2. Here C_2 and C_4 are actually the tank capacitors. You can see that the power line is simply included in series with the respective tank circuits of the two oscillators. The high resonant currents flow through the line, while the tube still "sees" a shunt resonant circuit. There is a theoretical L/C ratio that will give the optimum match between any two impedances in this arrangement. The inductance selected for L_1 and for L_2 is somewhat higher than the optimum, for the sake of stronger oscillation. Anyway, *some* mismatch is desirable.

Speaking of line loading; as you can well imagine, every time somebody in the neighborhood turns anything off or on it detunes the transmitter to some extent (provided the latter is in operation). Many radiomen will be horrified at the idea of taking the r.f. power output directly from the oscillator. But before you start building an oscillator-buffer setup, you might consider what happens at the same time to *receiver* tuning. The receiver, too, has the line as part of its tuned circuit. The beauty of the transmitter coupling method described here is that in combination with line and receiver it adds up to a perfectly symmetrical arrangement, as shown in the equivalent circuit of Fig. 3. You might say that a given change in line loading detunes both transmitter and receiver in the same direction. (Not by the same *amount* in the present case, as L/C ratios are not the same.)



R_1—27 ohm, ½ w. res. ± 10%
R_2, R_4—10,000 ohm, 1 w. carbon res. ± 5%
R_3, R_5—10Ω ohm, ½ w. carbon res. ± 10%
C_1—50 μfd., 150 v. elec. capacitor
C_2—.004 μfd., 500 v. silver mica capacitor
C_3, C_5—.002 μfd., 400 v. mica capacitor
C_4—4700 μμfd., 500 v. silver mica capacitor
L_1—3 mhy. tapped var. inductor (Miller 6320)
L_2—5 mhy. tapped var. inductor (Miller 6321)
S_1, S_2, S_3—S.p.s.t. toggle switch, 3 amp @ 125 v.
P_1—Fused line plug with 1 amp fuse (El-Menco)
Rect.1—100 ma. selenium rectifier
T_1—Fil. trans., 6.3 v. @ 1.2 amps
PL_1—6.3 volt pilot light assembly
V_1, V_2—6AQ5 tube

Fig. 2. Schematic diagram and parts list covering the control unit transmitter.

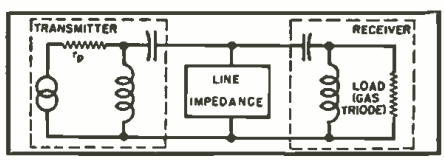
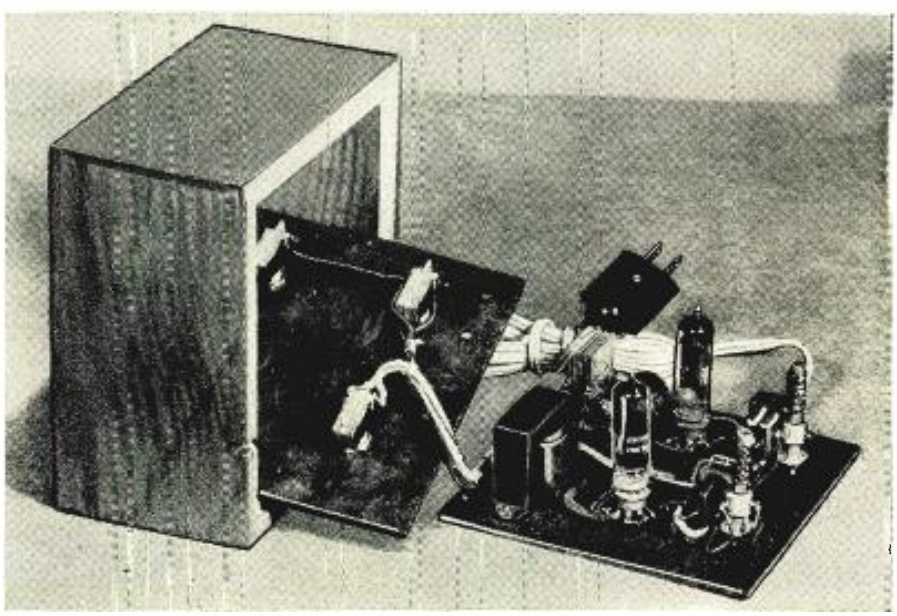


Fig. 3. Simplified equivalent circuit for r.f. portion of carrier switching system. Line constants are assumed to be lumped.

Anyway, the thing works up into an extremely simple and compact setup. You will note that the transmitter circuit requires neither chokes nor coupling capacitor. The well-built little *Miller* coils specified withstand high r.f. voltages and run for hours on end just warm to the touch. While a two-channel outfit is shown in the diagram and illustrations, there is nothing to prevent one from adding channels. The component values given here have

(*Continued on page* 147)

Fig. 4. Dual-channel control unit with cabinet disassembled. Note the roomy construction and the provision for ventilation via the perforated hardboard cover.



IMPROVING AUDIO QUALITY IN A.C.-D.C. RECEIVERS

By
JOHN P. BILLON

With some minor modifications, service technicians can improve their customers' radio sets for extra income.

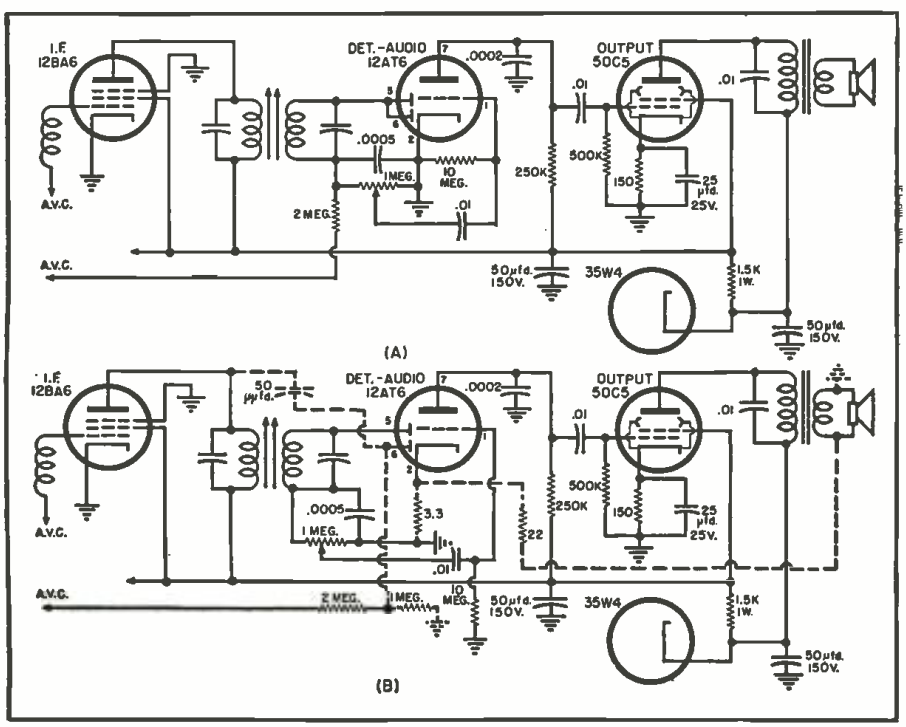
AFTER being spoiled by the quietness of modern high-fidelity audio systems, it is very irritating to be forced to listen to the hum prevalent in most bedside table-model radios. Instead of lulling one to sleep, they may, instead, produce the opposite effect. Service technicians looking for auxiliary sources of income would do well to sound out their customers on whether they would like to have their small radios improved so that they sound as good or better than many of the small commercial sets sold today as "hi-fi." The modifications necessary are really minor.

Obviously, hum can be reduced by better filtering, but most sets use half-wave rectification and complete filtering is not economical. Instead, it is better to attempt hum reduction with feedback.

The receiver whose modification is described in this article is typical of many table-model a.c.-d.c. sets, and will yield some helpful hints for such jobs. Any simple single-ended audio circuit is easily adaptable to this revision, including most small a.c.-d.c. table-model phonographs and single-tube output circuits in TV sets.

Some consideration was given to using anode feedback and series feedback, but because too much power is consumed by the former and no correction is given the driver tube by the latter, while neither takes into consideration the output transformer, it was decided to attempt a feedback loop which would include all these components at once.

Fig. 1. Partial schematic diagrams of the original circuit of a typical a.c.-d.c. radio (A) and the circuit after modification to improve its audio quality (B). The dotted lines and components in (B) are the additions to the original radio circuit.



The circuit of the modified set appears in Fig. 1B. The tube numbers may vary in other sets, but the basic types used for the first audio and output tubes will remain a high-mu duo-diode, triode, and power pentode respectively. It should be kept in mind that the addition of a feedback circuit around the output transformer is not a cure-all, and high-fidelity, as it is known in the industry today, will not result even if a better transformer is used. All that may be hoped for is improved audio.

It is advisable to begin the changes at the detector. A diode detector is quite satisfactory even for high-fidelity requirements, as long as the a.c. loading is kept low. The harmonic distortion can be quite distressing if it is not. Therefore, remove the a.v.c. load from the detector circuit, thereby reducing a.c. loading and eliminating differential distortion. It is possible to use one diode for detection and one for a.v.c. voltage. This is accomplished by disconnecting either pin 5 or 6 at the 12AT6 socket, whichever is physically easier to reach, and connecting this pin *via* a 50-$\mu\mu$fd. capacitor to the plate of the preceding i.f. tube. (See Fig. 1B.) Install a one-megohm resistor from this diode to a ground; the two-megohm a.v.c. series resistor is moved from the volume-control arm and connected to the available diode. This completes the changes in the detector circuit.

In order to install a feedback loop between the output transformer secondary and the first audio tube cathode, it is necessary to use a voltage divider, one leg of which is added to the cathode circuit of the 12AT6. This takes the form of a 3.3-ohm resistor. A smaller value could be used, with the reduction of the series feedback resistor, but the value would necessarily have to be selected more carefully than with this arrangement to prevent too much feedback and, if made too small, would absorb part of the power normally intended for the speaker.

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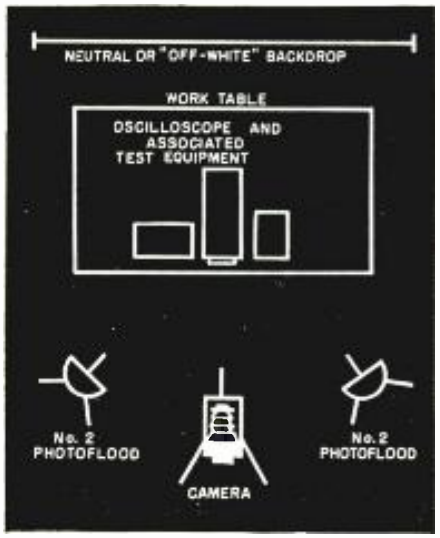

Fig. 1. The author's set-up for making oscilloscope waveform photographs. No special equipment is required with this method.

OSCILLOSCOPE PHOTOGRAPHY

By **E. G. LOUIS**

Details on a simple technique for recording waveforms using standard cameras, photofloods, and simple "props."

TECHNICIANS and engineers who are investigating new circuits frequently find it desirable to record oscilloscope waveform patterns. In many cases, the recording may consist of a simple sketch or tracing. Where extreme accuracy is required, however, a photographic record of the scope pattern will be made.

Oscilloscope pattern photography is not especially difficult in itself. Larger laboratories needing a good many waveform records employ specially-designed commercial *oscilloscope cameras*. These cameras are generally built to mount directly on the oscilloscope. They are available in a wide variety of designs to meet almost every laboratory requirement.

Smaller laboratories and individuals, on the other hand, usually rely on a standard camera. In some cases, the camera may be equipped with a reasonably light-tight cone shaped hood.

Although simple waveform photographs will satisfy the average laboratory demand, the need frequently arises for photographs in which not only the waveform pattern, but the settings of the oscilloscope controls and possibly a complete test equipment set-up are shown. A typical example, in which both oscilloscope control settings and the pattern obtained are shown, is given in Fig. 2 (right).

In some cases, it may even be desirable to show human hands adjusting the test equipment controls. Photographs of this type are useful for illustrating technical reports, instruction books, and professional papers.

Under ideal conditions, it is sometimes possible to make such photographs by using average room lighting. The *"Intensity"* control of the scope is turned considerably past its normal setting, and a fairly long time exposure is made, using a relatively fast lens setting. Unfortunately, even when these precautions are taken, if a good "equipment" photo is obtained, the waveform pattern may lack contrast and may not be suitable for reproduction. Or, if a good waveform picture is obtained, portions of the test equipment may be fuzzy and out of focus due to a shallow depth of focus.

In any case, it is virtually impossible to stop down the lens opening to obtain good depth of focus, and to use floodlights and short exposure intervals without "washing out" the scope image.

The author, requiring a number of illustrations showing both oscilloscope waveform patterns and the equipment control settings, worked out a special technique for making such photographs. The photo shown in Fig. 2 (right) was obtained using this method.

Equipment Required: The only "special" equipment used to obtain such photos is a dull black circular mask cut to fit over the cathode-ray tube screen. Such a mask may be obtained by cementing black "construction paper" to card stock. If construction paper is not available, the black inner envelope supplied with photographic enlarging paper may be used.

Of course, a camera, tripod, and a pair of standard floodlights (with stands) are needed. A neutral color or "off-white" backdrop is useful, but not essential. A satisfactory equipment arrangement is shown in Fig. 1.

Basic Technique: With the test equipment connected and adjusted to give the oscilloscope pattern desired, the camera is sharply focused on the cathode-ray tube screen. The lens opening is then stopped down until all the electronic test equipment is in sharp focus. The black mask previously prepared is placed on the face of the scope. If a human model is to be used, he is placed in position.

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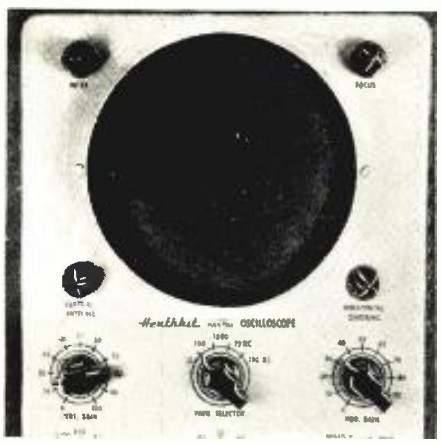
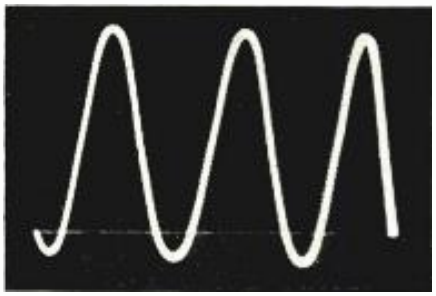
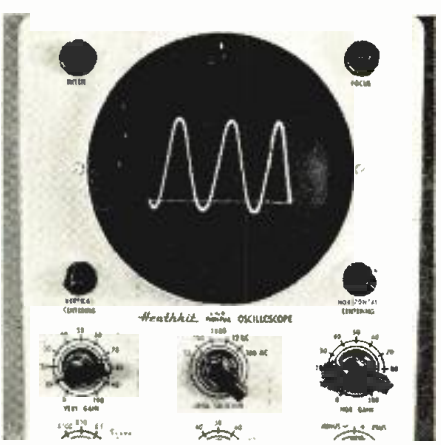


Fig. 2. (Left) Initial step in photographing waveform. Tube face is masked out as described in text. (Center) Second step in which pattern is photographed on same film. (Right) The composite photograph obtained.





THE MOTOROLA 19" COLOR TV RECEIVER

By
M. S. KAY

Part 2. Sweep and convergence circuits of this first commercial large screen color TV set; also CRT circuits.

IN LAST MONTH'S article we covered the signal circuits of the *Motorola* color television receiver, from the antenna to the cathode and three control grids of the picture tube. In this article we will concentrate principally on the deflection and convergence circuits and on the color picture tube itself.

Deflection Systems

The deflection systems of a tri-gun color television receiver possess a marked similarity to the deflection systems of monochrome receivers. The same type of deflection waveforms are required at the deflection yoke and these are produced in more or less the same manner. Circuit variations that do exist stem primarily from the altered requirements of the high-voltage supply or because of the added precautions needed to maintain the three beams in close convergence over the entire area of the screen. Just what these differences are will become evident as we analyze, step-by-step, the deflection system of the *Motorola* color television receiver.

In the vertical section there is an integrating network, a blocking oscillator, and an output amplifier. The incoming sync pulses, both horizontal and vertical, are applied to the integrator network but, because of the time constant involved, only the vertical sync pulses develop a sizable voltage at the grid of the blocking oscillator. The latter, in turn, uses these periodic pulses to synchronize its frequency to that of the received broadcast. A vertical hold control helps bring the oscillator frequency to a point where effective lock-in can be achieved.

The amplitude of the deflection wave developed by the oscillator is governed by the vertical size (*i.e.*, height) control. The saw-tooth shape of this wave is established by a time-constant network in the output circuit of the vertical oscillator. This signal is then applied to the grid of the vertical output amplifier and, beyond this, to the vertical deflection coils of the yoke.

The only significant departure from monochrome practice is the fact that the bottom end of the vertical output transformer connects to a vertical convergence circuit. More on this presently.

In the horizontal sweep system there is an a.f.c. network, a stabilized horizontal multivibrator, and a power output amplifier. These are then followed by the horizontal output transformer, the high-voltage system, and the boost "B+" circuit, wherein additional "B+" voltage is developed by utilizing the excess deflection energy. (The latter portion of the circuit is shown in Fig. 1.)

The final stage in the horizontal deflection system is a 6CD6 power output amplifier. The power requirements of the final stage in a color receiver are greater than for a comparable monochrome receiver because, first, three beams must be deflected instead of one and, second, a 25 kv. accelerating voltage is required by the tri-gun picture tube.

The horizontal output transformer contains two principal windings and a number of auxiliary windings. The two principal windings provide connections for the plate of the 6CD6, the high-voltage rectifiers, the deflection yoke, and the 6AU4 damper tube. The auxiliary windings provide positive and negative triggering pulses for the various a.g.c. and chrominance circuits, and filament power for the high-voltage rectifiers. In the circuit of Fig. 1, three high-voltage rectifiers are employed to develop the 25 kv. accelerating potential required by the tri-gun picture tube.

The accelerating potential required by the focus electrode is much less than the 25,000 volts of the *Aquadag* coating. Hence, it is possible to obtain the focus voltage from a prior point in the high-voltage rectifier system. A variable resistor is inserted between the first 3A2 and the diode coupler that follows it, and from this resistor the needed focus voltage is obtained.

Within the same high-voltage supply is a special gaseous regulator. The unit, labeled CR6, is a long, narrow cylinder which is filled with hydrogen gas. The purpose of this device is to maintain a constant load on the high voltage power supply so that changes in picture contrast will not cause the high voltage to change, with corresponding variations in brightness, focus, and deflection (*i.e.*, picture size). What the regulator tube does, in essence, is vary its internal resistance in a manner opposite to the current drawn by the picture tube. For exam-

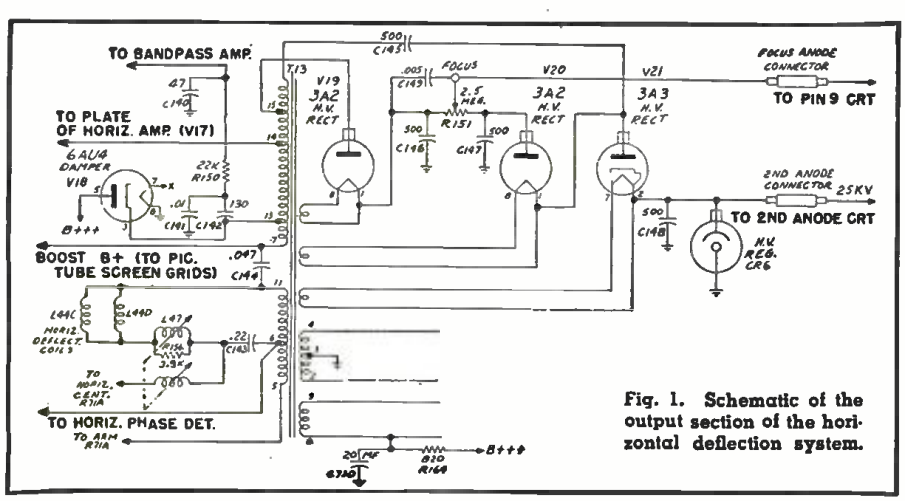


Fig. 1. Schematic of the output section of the horizontal deflection system.

ple, when a bright element is being traced out on the screen, picture tube current is high and the drain on the high-voltage power supply is increased. During this interval the drain of the regulator tube is reduced by a proportionate amount.

Conversely, when a darker portion of the picture is being traced out, the current requirements of the picture tube are reduced. This reduction would tend to cause the high voltage to rise were it not for the fact that now the regulator tube increases its current drain, thereby maintaining a constant over-all load on the power supply.

The damper tube in the output circuit absorbs whatever excess energy is developed during the horizontal retrace interval and converts this into an equivalent amount of voltage which is then combined with the receiver "B+" to provide a boosted "B+" voltage. In the circuit of Fig. 1 this boosted "B+" is employed only by the plate of the 6CD6 horizontal output amplifier and by the screen grids of the picture tube.

Electrical centering is usually employed with the tri-gun color picture tube. For this purpose there are vertical and horizontal centering potentiometers, each with enough d.c. potential difference across it to achieve the picture centering variation.

Convergence Circuits

The one remaining section of a color television receiver still to be examined is the convergence circuit. Convergence, it will be recalled, is the action which causes the three electron beams to pass through the same hole in the aperture or shadow mask at the same time. When the beams do this, they emerge from the mask at the correct angle to strike the dots of the proper color.

At the center of the screen, beam convergence is accomplished by physically tilting the electron guns inward as well as by external, individually adjustable, beam-bending magnets. The adjustment of beam convergence at the center of the screen is known as static convergence.

There is, in addition, dynamic convergence and this is concerned with maintaining the beams in proper convergence at points away from the center. The need for this arises from the fact that the shadow-mask surface is not completely spherical and therefore does not follow the curve necessary to keep the beams converged at all points. To correct this condition, we must introduce an additional voltage which will change the convergence point of the beams as they sweep over the face of the screen, both from side to side and up and down. At the center of the screen no additional convergence voltage is needed. The shape or form of the voltage best suited to achieve this variation is a parabolic wave.

The dynamic convergence system consists of three separate coils mounted on the neck of the picture tube. Each coil is positioned over a pair

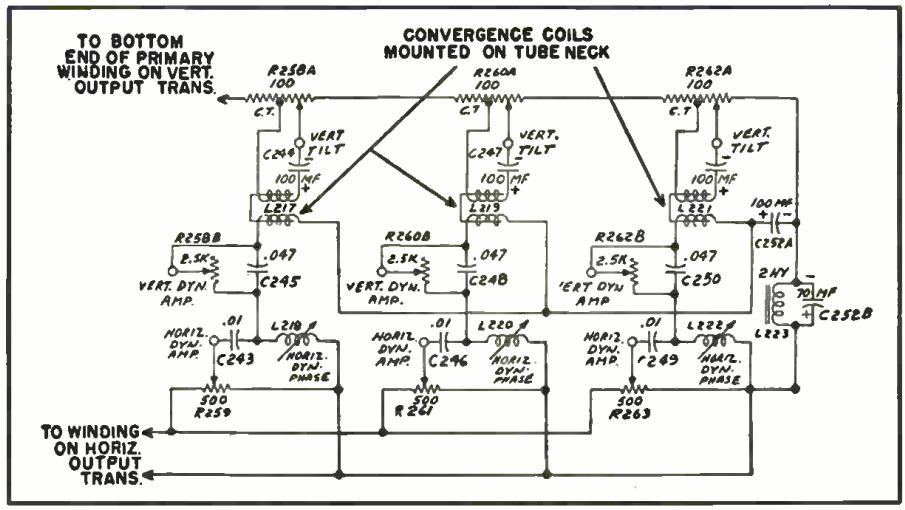


Fig. 2. Schematic diagram of the dynamic convergence circuit used by Motorola.

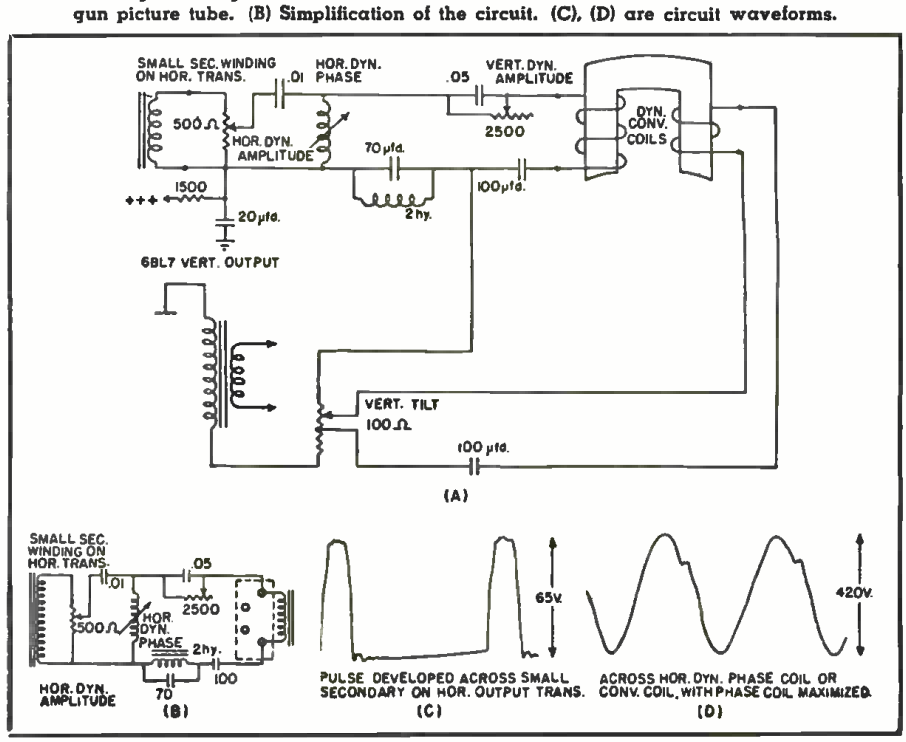
of pole pieces which is part of the structure of each electron gun. The internal pole pieces shape and confine the fields so as to affect only the particular electron beam to which the individual pole pieces correspond. Each beam will be moved at right angles to the magnetic field produced by the coils. Furthermore, since the guns are spaced at intervals of 120 degrees from each other, the red and green beams will be shifted at an angle while the blue beam will move straight up and down.

Each of the foregoing coils is supplied with vertical and horizontal parabolic currents and it is the amplitude and phase of these currents which govern the convergence of the three beams at every point on the screen. In the paragraphs to follow the dynamic convergence circuit of the *Motorola* will be examined. See Fig. 2.

Driving voltages for this circuit are obtained from two points—the plate circuit of the vertical output amplifier and from a separate winding on the horizontal output transformer. Let us start with the horizontal section of this circuit first.

A simplified diagram of the convergence network is shown in Fig. 3A and if we consider the operation solely in terms of the horizontal line frequency, then the diagram can be further simplified to the form shown in Fig. 3B. A pulse having an over-all amplitude of 65 volts is made available at the horizontal output transformer winding. The portion of the pulse which the rest of the network receives is governed by the arm setting of the horizontal dynamic amplitude control. Whatever value of pulse the control picks off is then used to shock-excite a series resonant circuit formed by the .01 μfd.

Fig. 3. (A) The horizontal and vertical dynamic convergence circuit for a single convergence magnet. There are three of these mounted on the neck of the three-gun picture tube. (B) Simplification of the circuit. (C), (D) are circuit waveforms.



capacitor and the horizontal dynamic phase coil. The circuit is tuned to 15,750 cycles per second and the strong circulating currents develop fairly large sine-wave voltages across each of the resonant components. See Fig 3D. This voltage, in turn, is forwarded to the dynamic convergence coils on the picture tube neck and through the resulting magnetic field, influences the electron beams which the guns develop. So far as the 15,750 cps voltages are concerned, the .05 μfd. capacitor, the 70 μfd. capacitor, and the 100 μfd. capacitor all present low impedances between the horizontal phase coil and the convergence coil.

The horizontal dynamic amplitude control determines how much voltage reaches the convergence coil and, in consequence, how powerful a magnetic field is developed. The phase of the 15,750 cps sine wave depends upon the adjustment of the phase coil. Changing the frequency of the circuit by adjusting the phase coil slug will vary the phase of the voltage applied to the convergence coil. This, in turn, will change the deflection angle of the electron beam and thereby alter its point of convergence with the other two beams as they move from left to right across the screen. Thus, it is possible to change the beam convergence at the sides of the screen permitting us to counteract the normal misconvergence of the beams. Each beam has a similar convergence circuit and responds in a similar way.

One further point concerning this circuit. The series resonant network develops a sine wave instead of a parabolic wave. However, only the bottom portion of the wave is used in the converging action and this is close enough to a parabola in shape to do an effective job.

Let us consider now the vertical portion of the dynamic convergence network. Referring back to Fig. 3A, we note that the bottom end of the vertical output transformer reaches "B+" through the vertical tilt potentiometer (100 ohms), a 2 henry choke (with a parallel 70 μfd. capacitor), and finally a 1500 ohm resistor. The flow of plate current (from the vertical amplifier) develops a voltage across the 2 henry choke and the subsequent flow of current between the choke and its parallel capacitor produces a parabolic voltage across the combination. What happens here is that the saw-tooth plate current is converted *via* the capacitor (principally) into a parabolic wave and this voltage is applied across the convergence coil. The path from the choke and the 70 μfd. capacitor to the convergence coil consists of a 100 μfd. capacitor, the horizontal dynamic phase coil, and the parallel combination of a .05 μfd. capacitor and a 2500-ohm potentiometer. At the vertical sweep frequency of 60 cycles, the horizontal dynamic phase coil and the 100 μfd. capacitor offer negligible opposition. The vertical current, however, finds that the opposition of the .05 μfd. capacitor is high and, so, the current is driven through the 2500-ohm potentiometer. The latter, then, rightfully becomes the vertical dynamic amplitude control.

Still required is some method of varying the phase of the vertical dynamic convergence voltage and this is achieved through the presence of another winding on each convergence coil. This is the so-called tilt coil, the word tilt referring to the effect which its voltage has on the vertical parabolic wave.

The method of developing the required tilt (or phase) voltage is quite simple. The saw-tooth plate current of the vertical output amplifier flows through a 100-ohm potentiometer. The control contains a center tap and the movable arm may be moved above or below this tap. When the arm position is above the tap, the saw-tooth voltage fed to the tilt coil possesses one polarity; when the arm is below the tap, the polarity is reversed. Finally, no saw-tooth voltage is fed to the tilt coil when the arm and center tap coincide. In other words, a saw-tooth of variable amplitude and with positive or negative polarity may be added to the electron beam. The net effect of this is to add the saw-tooth to the vertical dynamic parabola voltages to shape them as required for best convergence in the vertical plane.

External Picture Tube Components

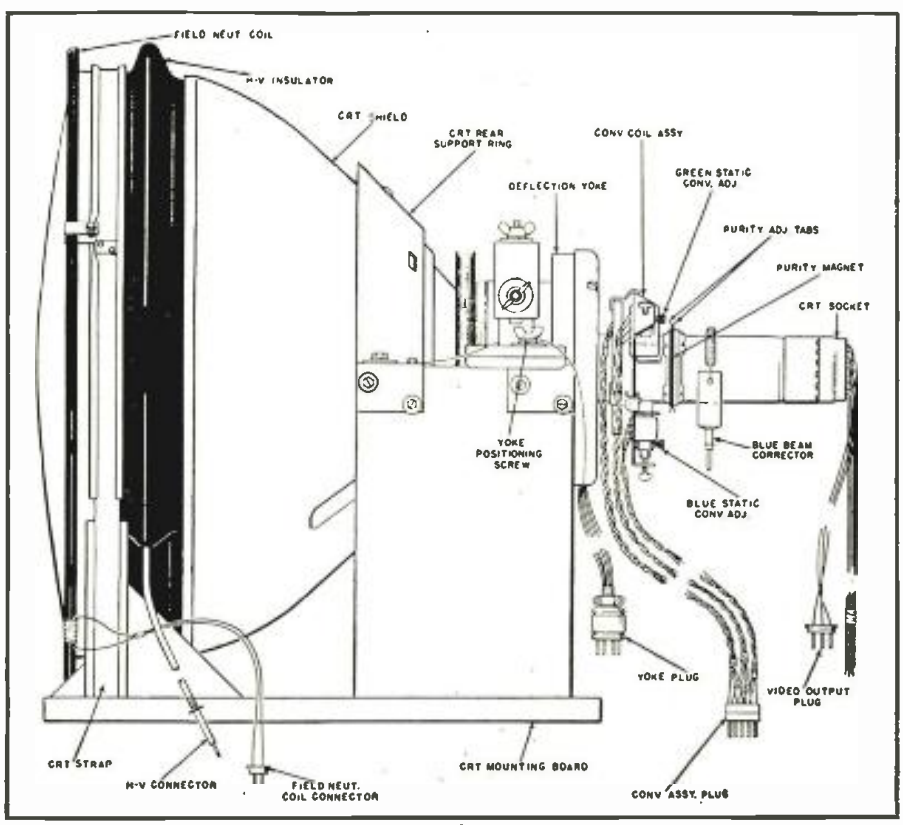
We come now to the components which are mounted on the neck of the 19-inch tri-color picture tube. See Fig. 4. The first item that we recognize is the deflection yoke. This is, to a considerable extent, similar to the deflection yokes used with black-and-white tubes. However, its design is more complex because three beams must be deflected instead of one and it is of the utmost importance that a symmetrical and uniform magnetic field be maintained throughout the deflection area. Also, the deflection power required is about twice that of present black-and-white TV sets (for the same size screen) and special insulation must be employed in the yoke structure to prevent arcing.

A second component found on the neck of the color picture tube is the purity coil or magnet. This device adjusts the axis of each electron beam so that it approaches each hole in the shadow mask at the right angle to strike the appropriate color phosphor dot. In other words, the purity magnet provides for the proper alignment of the three beams with respect to the phosphor-dot plate and the shadow mask. When this component is properly set, a uniform color field will be obtained for each gun. For example, with only the red gun in operation a uniform red raster should be observed. Any departure from pure red at any point on the screen indicates that the beam is striking phosphor dots other than red. Similarly, when only the green gun is in operation, a uniform green raster should be obtained, and when only the blue gun is active, a blue field should be visible.

The color tubes with which we are most concerned utilize magnetic convergence and toward that end employ three sets of convergence coils, each positioned directly over the pole pieces

(*Continued on page* 91)

Fig. 4. Three-gun color TV picture tube with the various external components.



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MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

BARNEY TAKES ON COLOR

"HEY! What gives?" Barney asked as he stopped short in the doorway of the service department that Monday morning.

"You mean you notice something different?" Mac, his boss, blandly inquired.

"I hope to kiss a pig I do," Barney retorted. "When did you do all this—and why?"

"The wife went to visit her sister over the weekend," Mac explained, "and whenever she is gone that darned house of ours seems as empty as a high vacuum rectifier. To get away from it, I came down here to sort of look around when there were no distractions—especially of the chattering, red-headed, Irish variety," he added with a teasing grin.

"I'm overlooking that crack—for the time being," Barney retorted.

"It's kind of funny how a familiar place seen under different circumstances spotlights things not normally noticed. I immediately saw several changes that cried out to be made; so I spent the whole of Sunday making them.

"First, I put up that little shelf right at the end of the service bench. This will now hold the few publications and sheets to which we refer constantly in our work. I call it the 'First Aid Shelf' because the articles on it are calculated to be the ones we shall normally consult before we turn to our service library. For example, there are the four dial-stringing manuals. Nine times out of ten these tell us all we need to know to replace a dial cord, and we do not have to go into our service data files at all. Also there is an up-to-date tube manual giving complete operating potentials, characteristic curves, and base diagrams of all tubes. You know how often we reach for that. Naturally, the latest index to our service information on radios, TV sets, tape recorders, and record changers is here. A glance at this tells us at once if we have information on a particular piece of equipment and exactly where to find it, together with any factory-suggested changes to be made in that particular model.

"Our record changer manuals will go here, too. As you know, many manufacturers are pretty careless about listing the make and model number of a changer used in their combination sets—especially when they do not make the changer themselves. In such a case you can often spot a given changer quicker by leafing through the record changer manuals and looking at the pictures than you can by trying to work through service data cross-listings. Since about every changer that comes in can stand a minor adjustment of the needle set-down points, the tripping mechanism, etc., I think having the manuals right at hand will speed up this work. In addition, there is a sheet showing interchangeable portable batteries of different makes and another giving interchangeable phono cartridges. These allow us to carry a single line of each of these items and still be able to service most record players and portable receivers that come into the shop—and to do it quickly and accurately.

"Finally, there is a good wholesale radio and TV parts catalogue. The illustrations and descriptions contained in this can be a great help to a technician in selecting a needed repair part or tool, even though he does not order from the firm putting out the catalogue. He can see side by side the offerings of competitive manufacturers with concise and accurate descriptions of each product. What's more, the catalogue gives him a good idea of what a fair price for the item should be. An intimate acquaintance with a good wholesale catalogue permits a technician to buy much more intelligently than is possible otherwise."

"As I get it," Barney said, "this 'First Aid Shelf' is to contain only the articles we use a lot. It is to be a sort of *Reader's Digest* of our service library."

"That's it exactly," Mac applauded; "and now let's turn our attention to this adjustable lamp clamped to the edge of the bench exactly between our two working positions."

"Is that what that is!" Barney marvelled. "I thought it was an overgrown modernistic sculpture of a praying mantis."

"There is a resemblance," Mac grinned as he looked at the folded, spring-loaded arms holding the deep shade of the lamp. "I firmly believe a service technician can never have too much light—either intellectual or actual—while doing his work. I'm doubly sure of this whenever I cut loose a wrong lead because I can't see clearly. Our overhead bench lights give all the light we need when the chassis is turned upside down, and of course we have various flashlights for looking into dark corners; but most TV chassis must be worked on while they are lying on their sides, and record changer action frequently must be watched while the changer is right side up. This new lamp gives a flood of light exactly where we need it and leaves both hands free at all times.

"Just look how it can reach out to any part of the bench and throw the light in any desired direction. That's because those folding arms extend out to forty-five inches and the lamp itself is mounted on a swivel. Notice, too, that while the lamp can be moved into any position with a touch of the finger, it stays exactly where you put it. When you want to watch a record changer going through its cycle, the lamp will get right down on its knees and peer up into the mechanism with you. If you drop something, the lamp will bend over so the bulb is nearly touching the floor to help you look for the dropped object. When you are taking a set out of a cabinet, the lamp will reach away out from the bench and throw a strong light over your shoulder or up into the speaker compartment to aid you in locating screw slots, and so on."

"Man, that thing has got more movements than a can-can dancer," was Barney's man-of-the-world comment.

Mac passed over this and went on to point out little plastic dishes mounted along the back of the service bench beneath various instruments.

"You know what a fan I am for all sorts of special probes to use with our instruments. I think we've got about

(*Continued on page* 80)

SAVE UP TO 50% during GIGANTIC CLEARANCE SALE of USED TEST and COMMUNICATION EQUIPMENT

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FLEXIBLE TV PROGRAM CENTER

CBS' Hollywood facility is a fantastic "electronics lab."

COLUMBIA'S "Television City" in Hollywood is a self-contained television center which has been designed expressly for the efficient production of TV programs.

This mammoth plant consists of four fully-equipped theaters of operation under one roof, with an extensive decentralization of the video facilities in keeping with well-established audio practice.

The audio and video installations in all existing "Television City" studios are essentially identical, except for an added control booth in Studio 43 and technical facilities utilizing four complete color camera chains for color programs.

Equipment and techniques used in the production of programs are a combination of those developed especially for television plus those borrowed and adapted from the motion picture industry. Most productions utilize a four-camera setup for maximum coverage and selection of scene and to minimize stage floor traffic. Two microphone booms, normally used, are supplemented by strategically placed hidden microphones, depending on the production.

A standby in movie production and now converted, with refinements, for television use is the *Houston-Fearless* camera crane. Operated by a three-man crew, the crane is d.c. power driven and represents a miracle of teamwork to present wide latitude of camera shots, ranging from a simulated balcony-type high, wide-angle shot to a ground-level closeup. One operator steers the crane in its movement on the studio floor and ramp; the "arm man" directs the vertical movement of the crane arm in positioning the camera; and the cameraman governs lens selection, focus, and the panoramic movement of the camera proper. All three members are on an interphone system with each other and with the control room, and the camera monitor informs them of the scene covered by the crane camera. The crane, as used by *CBS,* is readily adaptable for the tri-tube color camera.

In addition to such modern studio facilities, "Television City" boasts unique patching bays, electronic lighting control boards, and sound studios for piping the musical backgrounds from remote areas to eliminate any possibility of cast mike pickups.

These are but a few of the modern electronic miracles that make *CBS's* "Television City" one of the most advanced "programming plants" in existence today. —30—

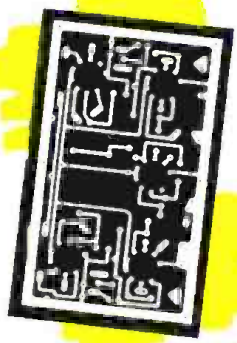
NEW 1955

Heathkit

Engineering Features

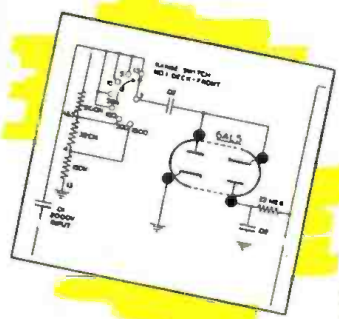
New PRINTED CIRCUITS

One of the many tremendous improvements in the new 1955 Heathkits is the use of an etched metal process printed circuit board. Printed circuits will be used in Heatakits whenever they will affect construction simplification, performance stabilization, and lend themselves to instrument design. Now for the *first* time a kit instrument company offers the advantages of modern printed circuit instrument construction technique. For the *first* time consideration has been given toward reducing kit assembly time. Also this is the *first* time that printed circuit boards have been hand soldered on a volume basis. Offered only by Heathkit, the pioneer and leader in kit instrument design.



New PEAK-TO-PEAK VTVM CIRCUIT

New 6AL5 full wave rectifier in AC input circuit permits full scale peak-to-peak measurements. Seven ranges — upper limits 4000 volts peak-to-peak. Just the thing you TV servicemen have needed in making TV circuit voltage checks. Precision resistor voltage divider limits AC RMS level to 150 volts. Prevents overloading the rectifier—extends upper limit AC RMS ranges to 1500 volts—further protects meter and circuitry against AC flash-over or arcing. Another definite example of continuing Heathkit design leadership in the kit instrument field.



New HIGH READABILITY PANELS

New 1955 Heathkits feature complete panel redesign. Sharp white lettering applied to the beautiful charcoal gray panels, provide a new high in readability. Lettering is easy-to-read open style and panel calibrations are vividly clear against the pleasing soft gray background. New knobs of exclusive Heathkit design.

New 3" UTILITY SCOPE

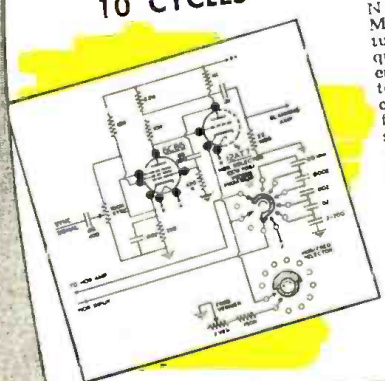
The new 3" Scope is a "natural" for the well rounded line of Heathkit instruments. Small in size, 11¾" deep, 6½" wide, 9½" high, yet big in performance. Just think of the value, an Oscilloscope for $29.50. Brilliant intensity, sharp focusing, wide positioning range. An ideal portable Scope for the TV serviceman—a second shop scope—modulation monitor for you hams (deflection plate terminals in rear of cabinet). Performance to spare for all general scope applications. See specifications on following page.

New STYLING New COLOR

New styling and coloring is responsible for tremendous improvement in Heatkit appearance. The new instrument panel color combination is high definition white lettering in a soft charcoal gray panel. Cabinet color is a lighter leather gray. The satin gold baked enamel cabinet for the WA-P2 Preamplifier is further indicative of the modern pacesetting trend in Heathkit styling.

New SCOPE SWEEP CIRCUIT 10 CYCLES — 500 KC

New 1955 Heathkit Model O-10 Scope features a new wide frequency range sweep generator covering 10 cycles to 500,000 cycles. This coverage is available in five virtually decading sweep ranges and is five times greater than the sweep frequency range usually available. Excellent retrace time characteristics, actually less than 20% at 500 KC. Use of the free running Heath circuit provides a larger margin of stability and a new high in Heathkit Scope performance.



Continuing PROGRESS FUTURE LINE EXPANSION

The outstanding improvements featured in the 1955 Heathkit line are representative of the progress characterized by Heath Company operation. Long range planning will provide a continuing succession of new kit releases to further expand the Heathkit line which already represents the world's greatest selection of electronic kits. The innovations in the 1955 line, are representative of additional new models scheduled for release for the coming years.

SEE THE INSTRUMENTS ON THE FOLLOWING PAGES

HEATH COMPANY • • Benton Harbor 15, Mich.

Mac's Radio Service Shop

(*Continued from page* 76)

every kind of probe you can mention, but we've not had a handy way of storing them. They've all been kept in a drawer where they have a nasty way of getting their leads tangled up. In fact, there have been times when you were trying to sort out a probe from this mess where I couldn't be sure if you were doing service work or trying to weave a fishnet. What's more, it was not always easy to remember which probe was designed for use with what instrument.

"That's a thing of the past now. Beneath each instrument you see a deep little plastic dish I bought at the dime store. Probes for each instrument are stored in its individual dish. For example, below the vacuum tube voltmeters we have a crystal probe for reading r.f. voltages, a high voltage probe for going up to 30,000 volts, and a peak-to-peak probe. The new v.t.v.m. reads peak-to-peak voltages directly, but this probe lets the older meter do the same thing. Under the signal tracer we have the r.f. crystal probe and the straight-through audio probe. Beneath the scope we have the demodulator or signal tracer probe, the 100/1 voltage divider probe, and the low-capacity probe, together with the single shielded lead that fits all three probe heads. The dish under the sweep generator doesn't hold probes but in it are stored the various special leads that go with this instrument. It is my fond hope that having these probes ready to hand will encourage you-know-who to use them more often. What's more, I want you-know-who to fold the probe leads up neatly and snap rubber bands around them to keep them in place when he is through using them."

"Roger from you-know-who. Wilco. Over and out," Barney chanted.

There was a brief silence finally broken by Barney:

"Say, Mac, I'm having a rough time trying to bone up on color TV. I've been reading everything I can get my hands on, but I just can't seem to nail it down the way I'd like. There seems to be so much repetition, conflicting analogies, etc., in the articles I've been reading that I'm downright confused. It's not that I'm not trying, either. I think about color TV so much that when I go to bed I even dream in technicolor."

Mac chuckled at this as he went over to a cabinet and took out a large bulging manila envelope. "I've been waiting impatiently for you to display interest in color television," he remarked, "but I didn't want you to feel I was pushing you into it. In this envelope is a complete nine-lesson home study course just for you!"

"When I finish the course, I'll know all I need to know about color TV, huh?"

"Not by a long shot. I intend for

NEW *Heathkit*
5" PUSH-PULL
OSCILLOSCOPE KIT
FOR COLOR TV

First color television service Oscilloscope with necessary high sensitivity and full 5 megacycle bandwidth.

New 5UP1 CR tube

New printed circuit construction, all components mounted on high insulation surface resulting in uniformly low circuit capacities.

New type wide frequency range Heath sweep generator 10 cycles to 500,000 cycles.

New cabinet styling and color harmony—charcoal gray panel with high readability white lettering.

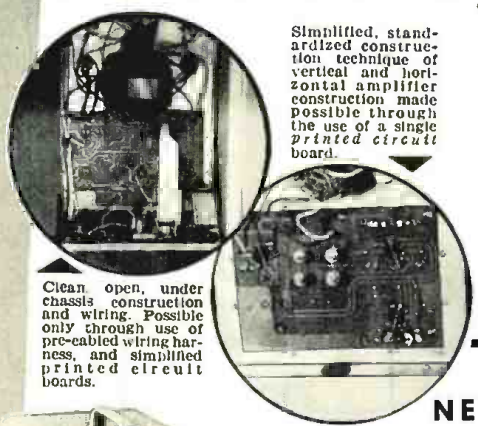
New electronic positioning controls for instantaneous, definite positioning without bounce or overshoot.

BRAND NEW DESIGN: The new Heathkit Model O-10 Oscilloscope would be something special at any price, but is almost unbelievable at $69.50. Completely re-designed scope has broadband amplifiers for color TV work and offers brilliant overall performance. Vertical frequency response within 5 db from 5 cps to 5 mc. Even more astounding, the response is down less than 1½ db at 3.58 mc. the color TV sync burst frequency. It is essential that scopes for color work have these broadband characteristics.

PRINTED CIRCUITS: Two printed circuit boards used in this fine instrument to insure stable, consistent performance. Problems solved by pre-engineering of boards, and their use guarantees completed unit that will have same characteristics as lab development model. Printed circuits simplify construction and save labor.

NEW SWEEP CIRCUIT: Sweep circuit operates with exceptionally good linearity from 20 cps to over 500,000 cps. 5 times the usual range for scopes in this price range. An entirely new circuit introduced for the first time in any Heathkit.

MODEL O-10
$69.50
Shpg. Wt. 27 lbs.

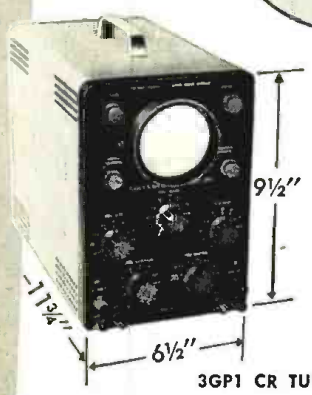


Simplified, standardized construction technique of vertical and horizontal amplifier construction made possible through the use of a single *printed circuit* board.

Clean, open, under chassis construction and wiring. Possible only through use of pre-cabled wiring harness, and simplified printed circuit boards.

FEATURES: Other outstanding characteristics of this professional oscilloscope are: Built-in 1V peak-to-peak reference for calibration of plastic CRT face-plate; 5" 5UP1 CRT; push-pull hor. and vert. deflection amplifiers; hor. trace width expandable to 3 times diameter of CR tube to allow inspection of any small portion of the signal; deflection sensitivity, .025 volts per inch; wiring harness pre-formed and cabled to save construction time and insure professional appearance and operation. Incorporates efficient retrace blanking. Frequency compensated step attenuator at the vertical input. Entire tube face useable. No foldover on vertical over-load. Performance obtainable only in much more expensive laboratory models.

Uses 5UP1, 6AB4, 6BO7, 12BH7, 6CB6, 12AT7, 2-12AU7, 6X4, 1V2, and 6C4. Quality components used throughout so that outstanding performance characteristics may be maintained for years to come. Plastic molded condensers are used in all coupling and by-pass applications. The "new-look" in Heathkit styling produces professional appearance in keeping with the professional performance of this instrument.



3GP1 CR TUBE

NEW
Heathkit
3" PRINTED CIRCUIT
OSCILLOSCOPE KIT
MODEL OL-1
$29.50 Shpg. Wt. 15 lbs.

New compact utility Scope—lightweight—portable for service work.

Deflection plate terminals—ideal for ham transmitter modulation monitoring.

New easy-to-build printed circuit board with high insulation factor.

New Heathkit instrument styling—charcoal gray panel with high readability white lettering.

New Heath twin triode sweep generator 15–100,000 cycle sweep.

EXCEPTIONAL VALUE: The brand new Model OL-1 Utility Oscilloscope is designed especially for portable applications so that outside servicemen or persons performing field tests can have the advantages of a scope available. Then too, it is ideal for home workshop, the ham-shack, or as an "extra" scope for the service shop. It is compact, light in weight, and surprisingly versatile in operation. An outstanding instrument for the price.

Front panel controls are "bench-tested" for ease of operation and convenience. Printed circuit board used for constant circuit performance. Assembly time cut in half!

SPECIFICATIONS: Vertical amplifiers feature frequency response within 1 db from 10 cps to 100 kc, and within 5 db from 5 cps to 500 kc. Vertical sensitivity .2 volts per inch at 1 kc, with input impedance of 12 mmfd shunting 10 megohms.

Horizontal response within 1 db from 10 cps to 200 kc, and within 5 db from 5 cps to 500 kc. Hor. sensitivity .25 volts per inch at 1 kc, input impedance of 15 mmfd shunting 10 megohms. Sweep generator covers 10 cps to 100,000 cps with stable positive lock-in circuit. Cathode follower input in both vert. and hor. amplifiers; push-pull vertical and horizontal deflection amplifiers; 3" CRT; electronic positioning controls for wide range of vertical and horizontal spot deflection; provision for internal and external sync; 60 cycle line sweep. New modern color styling and unusual performance make this instrument an outstanding value.

5BP1 CR TUBE

NEW
Heathkit
5" PRINTED CIRCUIT
OSCILLOSCOPE KIT
MODEL OM-1
$39.50 Shpg. Wt. 24 lbs.

VERSATILE INSTRUMENT: The new Model OM-1 general purpose Oscilloscope represents an outstanding dollar value in reliable test equipment. Full 5 inch CRT. Printed circuit boards for ease of assembly, constant circuit characteristics, and rugged component mounting. Includes all the design features necessary for servicemen, students, experimenters, radio amateurs, etc. Frequency response of amplifiers flat within 1 db from 10 cps to 100 kc, and down only 7 db from 10 cps to 500 kc. Sweep generator range from 20 cps to 100,000 cps. Also features new Heathkit color styling with charcoal gray panel and high definition white lettering for readability even under subdued lighting conditions.

DESIGN FEATURES: A full-size, versatile oscilloscope at a price you can afford. Other features are: adjustable spot shape control; RF connections to deflection plates; direct coupled centering controls; external and internal sweep and sync; 60 cycle line sync; built in 1 volt peak-to-peak panel terminal reference voltage; professional appearance of cabinet, panel, and knob styling.

HEATH company
BENTON HARBOR 15,
MICHIGAN

you to use this course as a kind of basic framework on which you will hang all the other things you will be continually learning about this fast-moving, far-from-simple subject. I know it will help you to approach color television in the carefully-planned, step-by-step procedure presented by this course; but there are bound to be many points that will not be crystal clear even after the course is finished. That's where your supplemental reading of magazine articles should help. Each writer sees things a little differently and writes about them from a different point of view. By reading what two or three of them have to say on the same subject, you often see quite clearly something that was a big mystery the first time you read about it.

"Speaking of magazine articles, I don't think you will find any much more helpful than those written by Milton Kiver in RADIO & TELEVISION NEWS, starting with the March, 1954, issue. I think he calls the series 'Fundamentals of Color TV.' One thing I like about the articles is that Kiver takes time at the end of several of them to prove mathematically puzzling general statements made in the body of the articles. I think you'll be surprised at how much more useful and informative a series of articles like this seems when you have several of them on hand and can refer back and forth through them and through your course, instead of just reading them one at a time, with a whole month elapsing between readings."

"You would help a guy out with his homework if he got stuck, wouldn't you?" Barney suggested slyly.

"Yes, if I could. But you've got to remember that when it comes to color TV I'm just a student same as you are; but we'll sure do our darndest to puzzle it out together." —30—

2 SETS OFF ONE ANTENNA

By ELMER C. FISCHER

HERE'S a little antenna tip that has proved quite successful.

Since the local TV stations have upped their power, the problem has become one of preventing overload and avoiding transmission-line pickup. This can be solved by inserting a 10 db pad at the receiver and running coax instead of twin-lead.

This excess signal can be put to better use by using it to drive two sets from one antenna. The author's installation consists of a "Q-Tee" antenna and two 75-ohm transmission lines from antenna to living room and basement sets. Each feed line connects from one antenna terminal to a common ground on the mast. Apparently, little transformer action takes place in the antenna since, with a 21-inch TV set monitoring one feed line, 200 feet of coax connected to the other was opened, shorted, and terminated with no noticeable effect on the picture.

With receivers using a center-tapped input coil, a good match can be obtained at the set by using only one-half the coil. —30—

NEW Heathkit VACUUM TUBE VOLTMETER KIT

PRINTED CIRCUIT DESIGN

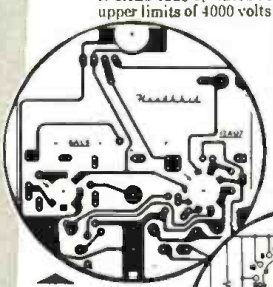
New charcoal gray baked enamel panel with high readability, white lettering. New soft feather gray cabinet; subdued pilot light indicator.

New printed circuit board for faster, easier construction—exact duplication of Lab development model.

Another outstanding example of continuing Heath Company pioneering and leadership in the kit instrument field. A new **printed circuit** VTVM. New peak-to-peak circuit—new styling and new panel design. A prewired, prefabricated printed circuit board eliminates chassis wiring, cuts assembly time in half, assures duplication of Engineering pilot model specifications, and virtually eliminates possibility of construction error.

CIRCUIT:

A 6AL5 tube operated as a full wave AC input rectifier permits seven peak-to-peak voltage ranges with upper limits of 4000 volts P—P. Just the ticket for you TV servicemen. Voltage divider in the 6AL5 input circuit limits applied AC input to a safe level. This circuitry and the isolation of the meter in the cathode of the 12AU7 bridge circuit affords a high degree of protection to the sensitive 200 microampere meter.



Full wave rectifier in AC input circuit. Read peak-to-peak and RMS volts with upper limit of 4000 P—P and 1500 volts RMS. Voltage divider input circuit.

RANGES:

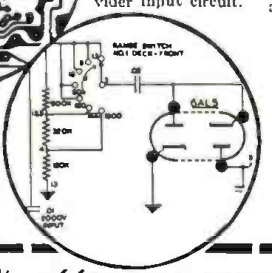
Seven voltage ranges. 1.5, 5, 15, 50, 150, 500 and 1,500 volts DC and AC RMS. Peak-to-peak ranges 4, 14, 40, 140, 400, 1400, 4000. Ohmmeter ranges X1, X10, X100, X1000, X10K, X100K, X1 meg. Additional features are a db scale, a center scale zero position, and a polarity reversal switch.

New easy-to-read open panel layout. Off-on switch now incorporated in the selector switch.

MODEL V-7

$24.50

Shpg. Wt. 7 lbs.



The first kit instrument to offer a labor-saving, error-free *printed circuit* board. Your instrument an exact wiring replica of Engineering development model.

IMPORTANT FEATURES:

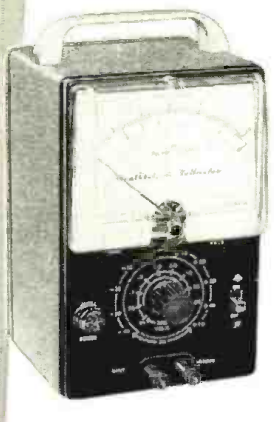
High impedance 11 megohm input—transformer operated—1% precision resistors, 6AL5 and 12AU7 tube—selenium power rectifier— individual AC and DC calibrations—smoother improved zero adjust control action—new panel styling and color—new placement of pilot light—new positive contact battery mounting —new knobs—test leads included.

The new V-7 also sets the pace as a kit instrument style leader. Smart, good-looking charcoal gray panel and soft feather gray cabinet. High readability panel with sharply contrasting white calibrations. The pleasing, eye catching, modern styling is in harmonious balance with the outstanding circuit design improvements. Easily the best buy in kit instruments.

New peak-to-peak meter scale—new color harmony—new knobs.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2



$29.50 Shpg. Wt. 5 lbs.

Extreme sensitivity has been emphasized in the design of the Heathkit AC VTVM. Ten full scale RMS ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts. Frequency response is substantially flat from 10 cycles per second to 50 KC with input impedance of 1 megohm at 1 KC. Will accurately measure as low as 1 millivolt at high impedance. Total db range is —52 db to +52 db. An excellent kit for measuring the output of phono cartridges and the gain of amplifier stages. Use it also to check power supply ripple, as a sensitive null detector, and for compiling frequency response data. Features one knob operation, 200 microampere Simpson meter and precision resistors.

Heathkit 30,000 VOLTS DC PROBE KIT

Measure up to 30,000 volts DC with the Heathkit VTVM and the 336 high voltage Probe. Precision resistor provides multiplication factor of 100. Can be used with any 11 megohm input VTVM. Housed in a Polystyrene two color sleek plastic probe body for safety of operation.

No. 336

$4.50

Shpg. Wt. 1 lb.

Heathkit PEAK-TO-PEAK PROBE KIT

No. 338-C

$5.50

Shpg. Wt. 2 lbs.

Peak-to-peak values not exceeding 80 volts at a DC level of not more than 600 volts, can now be read directly by using 338-C Probe with previous model Heathkit VTVM's or any VTVM with 11 megohm input resistance. Probe construction features a modern printed circuit board for easy assembly. Frequency range 5 KC to 5 MC.

Heathkit RF PROBE KIT

The Heathkit RF Probe will permit the measurement of RF voltages up to 250 MC with an accuracy of ±10%. The limits are 30 volts AC and a DC level of 500 volts. Designed for any 11 megohm input VTVM. Modern styling, Polystyrene aluminum housing, Polystyrene insulation, and printed circuit board for easy assembly.

No. 309-C

$3.50 Shpg. Wt. 1 lb.

Heathkit AUDIO WATTMETER KIT

Read audio power output directly without using external load resistors with the new Heathkit Audio Wattmeter. Built-in non-inductive load resistors provide impedances of 4, 8, 16, and 600 ohms. Flat response from 10 CPS to 250 KC. Full scale power ranges are 0–5 MW, 0–50 MW, 0–500 MW, 0–5 W and 0–50 W. Model AW-1 will operate continuously at 25 watts and has a duty cycle of 3 minutes at 50 watts. Total db range in five positions is —50 db to +48 db, using the standard 1 milliwatt 600 ohms.

MODEL AW-1

$29.50

Shpg. Wt. 6 lbs.

HEATH company

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Technical BOOKS

"AUDIO AMPLIFIERS AND ASSOCIATED EQUIPMENT" by Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. $3.95. Paper bound. Vol. 5 (AA-5).

This newest volume in the *Sams'* "Amplifier" series covers 1953 and 1954 model audio amplifiers, preamps, and AM-FM custom tuners.

Each unit is pictured, controls are identified, tubes are listed and the power supply and rating given in tabular form. Under chassis and top chassis views are also provided along with complete parts lists and circuit diagrams.

Where pickup arms are part of the unit, complete details on the correct cartridges and needles to be used are also given.

This volume also contains a cumulative index covering all of the volumes in the series thus far for the speedy location of the desired schematic and service data. This listing is divided into amplifiers and tuners for further ease in spotting the correct diagram.

* * *

"MOST-OFTEN-NEEDED 1955 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by *Supreme Publications*, Chicago. 192 pages. Price $3.00. Paper bound. Vol. TV-9.

This is the newest volume in the popular *Supreme* series of TV servicing data and covers practically all of the early 1955 video sets produced by some 26 manufacturers.

As with the earlier volumes, each receiver model is given a careful survey as to service faults and potential trouble spots, alignment procedures are outlined, waveform data is given, and the complete schematic of the set is provided.

Service technicians who rely on these compact manuals to speed their trouble-shooting and repair work will welcome the appearance of this up-to-date volume. Those not yet acquainted with these books can get a good introduction with this most recent work.

* * *

"SINGLE SIDEBAND TECHNIQUES" by Jack N. Brown, W3SHY. Published by *Cowan Publishing Corp.*, New York. 112 pages. Price $1.50. Paper bound.

This is a specialized text written by an enthusiastic champion of SSB operation and he is a persuasive advocate. The author has managed to transmit some of his enthusiasm to the reader both by hard hitting technical reasons for adopting the technique and by the infectious quality of his advocacy.

The text is divided into ten chapters covering a discussion of SSB, the filter method, phasing method, linear amplification theory, high-power linear final, balanced modulators, phase-shift networks, construction details on a 35-watt

NEW *Heathkit* TV ALIGNMENT GENERATOR KIT

Controllable inductor sweep oscillator with output entirely on fundamentals.

Triple marker system 4.5 MC crystal controlled—3 sets of low loss, low capacity shielded cables included.

Electronically operated, smooth continuously variable, sweep circuit. No vibration, hum or noise.

Here is the most radically improved Sweep Generator in the history of the TV service industry. The basic design follows latest high frequency techniques which result in a combination of performance features not found in any other sweep generator.

SWEEP:

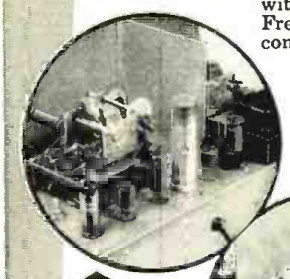
Sweep action is obtained electronically through the use of a newly developed controllable inductor, thereby eliminating all moving parts with their resultant hum, vibration, fatigue, etc. Frequency coverage entirely on fundamentals, is continuous from 4 MC to 220 MC at an output level well over a measurable .1 volt.

Frequency coverage 4 MC—220 MC continuous including FM spectrum. RF output well over .1 volt.

MODEL TS-3

$44.50

Shpg. Wt. 18 lbs.



Triple marker system, 4.5 MC crystal controlled marker—continuously variable marker—provisions for external marker.

Automatic amplitude control circuit—constant output voltage regulated power supply.

MARKER:

The same instrument incorporates a triple marker system with a crystal controlled reference. A variable marker provides accurate coverage from 19 to 60 MC on fundamentals, and 57 to 180 MC on calibrated harmonics. A separate fixed crystal controlled 4.5 MC marker can be used for checking IF, bandpass, calibration, reference, etc. Provisions are also made for external marker use. A 4.5 MC crystal is supplied with the kit.

POWER SUPPLY:

The transformer operated Power Supply features voltage regulation for stable oscillator operation. Three sets of shielded cables are furnished with the kit. Sweep range is completely and smoothly controllable from zero up to a maximum of 50 MC, depending upon base frequency.

Here is a TV Sweep Generator that truly no serviceman can afford to be without for rapid, accurate, TV alignment work.

NEW *Heathkit* SIGNAL GENERATOR KIT

MODEL SG-8

$19.50 Shpg. Wt. 8 lbs.

The new Heathkit service type Signal Generator, Model SG-8 incorporates many design features not usually found in this instrument price range. Frequency coverage is from 160 KC to 110 MC in five ranges, all on fundamentals, with useful calibrated harmonics up to 220 MC. The RF output level is well in excess of 100,000 microvolts throughout the frequency range. The oscillator circuit consists of a twin triode tube, one-half used as a Colpitts oscillator, and the other half as a cathode follower output which acts as a buffer between the oscillator and external load, thereby eliminating oscillator frequency shift usually caused by external loading.

All coils are factory wound and adjusted, thereby completely eliminating the need for individual calibration and the use of additional calibrating equipment. The stable, low impedance output, features step and variable attenuation for complete control of RF level. A separate 6C4 triode acts as a 400 cycle sine wave oscillator, and a panel mounted switching system permits choice of either external or internal modulation.

Heathkit LABORATORY GENERATOR KIT

MODEL LG-1

$39.50

Shpg. Wt. 16 lbs.

The new Heathkit Laboratory type Signal Generator definitely establishes a new performance standard for a kit instrument. An outstanding feature involves the use of a panel mounted 200 microampere meter calibrated both in microvolts and percent modulation, thereby providing a definite reference level for using the Signal Generator in design work, gain measurements, selectivity, frequency response checks.

DESIGN:

Additional design features are copper plated shield enclosure for oscillator and buffer stages resulting in effective double shielding. Fibre panel control shaft extensions in RF carrying circuits, thorough AC line filtering, careful shielding of the attenuator network, voltage regulated B plus supply, selenium rectifier, etc.

RANGES:

Frequency coverage from 150 KC to 30 MC all on fundamentals in five separate ranges. Output voltage .1 volt with provisions for metered external or internal modulation. Output impedance termination 50 ohms. Transformer operated power supply.

Investigate the many dollar stretching features offered by the LG-1 before investing in any generator for Laboratory or Service work.

NEW *Heathkit* BAR GENERATOR KIT

MODEL BG-1

$14.50 Shpg. Wt. 4 lbs.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test without waiting for transmitted test patterns. Panel switch provides "standby—horizontal and vertical position." The oscillator unit uses a 12AT7 twin triode for the RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will also provide an indication of horizontal and vertical sync circuit stability as well as overall picture size. Operation is simple and merely requires connection to the TV receiver antenna terminal. Transformer operated for safety.

HEATH company

BENTON HARBOR 15, MICHIGAN

SSB transmitter, high-level heterodyne unit, and filters and filter alignment. Two sections cover hints on better SSB operation. An index and bibliography complete this work.

The text material is lavishly illustrated and amplified by means of circuit diagrams, photographs, and oscillograms. Radio amateurs should find this book an especially valuable addition to their shack libraries as the circuitry and suggestions advanced by the author are worthwhile.

* * *

"VALVES FOR A.F. AMPLIFIERS" by E. Rodenhuis. Published by *Philips Technical Library,* Eindhoven. Available in the U.S. from *Elsevier Press Inc.,* 155 E. 82nd St., New York 28, N.Y. Price $2.25.

This is a practical, non-theoretical handbook for the audiophile, engineer, and experimenter who likes to "roll-his-own" amplifier, incorporating selected features from various commercial circuit designs.

The avowed purpose of this book is to enlarge the reader's knowledge of amplifiers in general and to stimulate his interest to the point where he will experiment with amplifier circuits on his own. Toward this end, the text material contains general hints on amplifier design, the application of tube data, the functions of the different stages of the amplifier, and concludes with detailed descriptions of eight amplifier designs.

Although all of the tubes discussed and specified in the circuits are made by *Philips,* American-made equivalents could be used or the circuit features adapted to standard U.S.-type components. —30—

Using Test Points

(*Continued from page 39*)

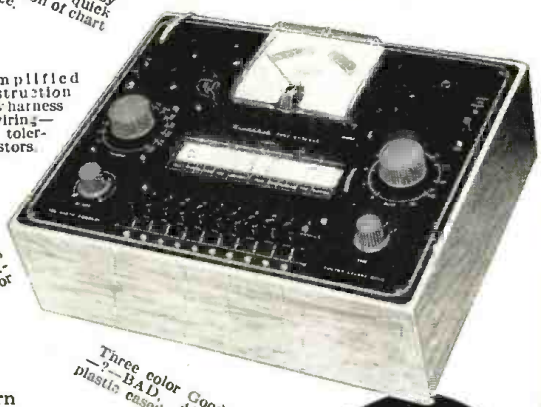
any component on the printed wiring board.

Additional test points are available by connecting to the exposed dip-soldered points around the tube sockets on the printed wiring boards.

In their 1955 TV receivers, many additional manufacturers have gone to the use of test sockets, primarily because of the simplifications it permits in their own production testing. The service technician who knows how to use these test points can save a great deal of time and often service a receiver quickly at the customer's home instead of having to lug it back and forth from the shop. The resulting reduction in servicing cost will be a credit to the service technician, a boon to the customer, and will increase the reputation of the manufacturer.

For color TV sets, the inclusion of test sockets above the chassis is still more important since the complexity of a color receiver is so much greater than the black-and-white set and service costs are correspondingly higher. —30—

Heathkit TUBE CHECKER KIT



The Heathkit TC-2 Tube Checker was primarily designed for the convenience of radio and TV servicemen and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron, and a blank socket for new tubes. Built-in neon short indicator, individual 3-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line-set control to compensate for supply voltage variations, all represent features of the TC-2.

Results of tube tests are read directly from the large 4½" Simpson 3-color meter. Checks emission, shorted elements, open elements, and continuity. Wiring procedure has been simplified through the use of multi-wired color coded cable providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts a "factory built" appearance to the instrument. New Construction Manual furnishes detailed information regarding tube set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

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

Heathkit PORTABLE TUBE CHECKER KIT

The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon proxylin impregnated fabric covering with a contrasting gray on the inside of the detachable cover.

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

Heathkit REGULATED POWER SUPPLY KIT

MODEL PS-2
$33.50
Shpg. Wt 15 lbs.

Here is a source of regulated D.C. voltage for circuit development work. Power supply voltage and current drain to the circuit under test are constantly monitored by the 4½" panel mounted meter. Separate 6.3 volt at 4 ampere A.C. filament source available. The regulated and variable output voltage will be constant over wide load variations, and hum ripple will not exceed .012% at 250 volts under a 50 MA load. Completely isolated circuit, standby switch, and other desirable features, make the Model PS-2 extremely useful in a wide variety of applications.

Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker Kit, will quickly check picture tubes for emission, shorts, etc. and determine tube quality. Consists of standard 12-pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

No. 355
$4.50 Shpg. Wt. 1 lb.

Heathkit DECADE RESISTANCE KIT

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

Twenty 1% resistors are decaded in 1 ohm steps to provide any value between 1 ohm and 99,999 ohms. Sturdy ceramic switches with silver plated contacts insure reliable service. Use the Decade Resistance in bridge circuits, meter multipliers, calibrations, or any application requiring a wide range of precision resistance values.

Heathkit AUDIO GENERATOR KIT

Here is an Audio Generator with features generally found only in the most expensive instruments. Sine wave coverage from 20 cycles to 1 Megacycle—response flat ±1 db from 20 cycles to 400 Kc—continuously variable and step attenuated output. Because the output voltage is relatively constant over wide frequency ranges, the AG-8 is ideal for running frequency response curves in audio circuits. Once set by means of the attenuator, this voltage may be relied upon for accuracy within ± 1 db. Instrument features low impedance 600 ohm output circuit and distortion less than .4 of 1% from 100 CPS through audible range.

MODEL AG-8
$29.50
Shpg. Wt. 11 lbs.

Heathkit DECADE CONDENSER KIT

The Heathkit Decade Condenser provides a ready source of capacity values from 100 mmf to .111 mfd inclusive in capacity steps of 100 mmf. Silver plated contacts on husky ceramic switches, assure positive contact for each switch position. Precision silver mica condensers ±1% accuracy for close tolerance accurate work.

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

HEATH company
BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* HIGH FIDELITY
PREAMPLIFIER KIT

Here is the exciting new Heathkit Preamplifier with all of the features you Audiophiles have asked for and at a down-to-earth price level. Beautiful satin gold baked enamel finish, striking control knobs and arrangement, attractive custom appearance and entirely functional design.

DESIGN:
Uses three twin triode tubes in a shock mounted chassis, 2-12AX7 and 1-12AU7. Features tube shielding, plastic sealed color coded capacitors, smooth acting controls, good filtering, excellent decoupling, low hum and noise level, and all aluminum cabinet. Special balancing control for absolute minimum hum level. Cathode follower, low impedance output circuit for complete installation flexibility.

SPECIFICATIONS:
Provides five switch selected inputs, 3 high level, and two low level, each with individual level controls—4 position LP, RIAA, AES, and early 78 equalization switch—4 position roll-off switch, 8, 12, 16 with one flat position. Separate tone controls, bass 18 db boost and 12 db cut at 50 CPS, treble 15 db boost, and 20 db cut at 15,000 CPS. Power requirements from Heathkit Williamson Type Amplifier power supply 6.3 volts AC at 1 ampere, and 300 volts DC at 10 MA. Over-all dimensions 12 9/16" wide x 5 1/8" deep x 3 5/8" high.

APPLICATION:
The new Heathkit WA-P2 Preamplifier has been designed to operate with any of the Heathkit Williamson Type Amplifiers and is directly interchangeable with the previous Model WA-P1 Preamplifier unit. Order your kit today and enjoy completely smooth control over the operation of your Hi-Fi system. Obtain the exact tonal balance of bass and treble with the precise degree of equalization you want. Note that the design of the WA-P2 accommodates the newly established RIAA curve.

MODEL WA-P2
$19.75
Shpg. Wt. 7 lbs.

HAM EQUIPMENT

Heathkit AMATEUR TRANSMITTER KIT

The Heathkit AT-1 Transmitter has established a high reputation and has been enthusiastically accepted by hundreds of experienced operators as well as beginners. Power input up to 35 watts for the novice and suitable as a standby exciter for your higher powered rig later on.

Model AT-1 can be crystal or VFO excited and operates on 80, 40, 20, 15, 11 and 10 meters. The prewound coils with the oscillator and amplifier are switched simultaneously by the rugged band switch. Meter switch allows a reading of the final grid and plate current on the panel mounted meter. Modulator input and VFO power sockets are provided as well as a key jack for CW operation. Other features include a crystal socket, standby switch, key click filter, AC line filter, good shielding and a 52 ohm coaxial output. The 425 volt, 100 milliampere power supply and 5U4 rectifier are more than adequate for the 6AG7 oscillator multiplier and 6L6 amplifier doubler.

MODEL AT-1
$29.50
Shpg. Wt. 16 lbs.

Brand NEW HEATHKIT VFO KIT

Smooth acting illuminated and precalibrated dial.

The new Heathkit VFO is the perfect companion to the Heathkit Model AT-1 Transmitter and it has sufficient output to drive any multi-stage transmitter of modern design. Good mechanical and electrical design insures operating stability. Coils are wound on stable, heavy duty, ceramic forms using Litz or double cellulose wire coated with Polystyrene cement and baked for humidity protection. Variable capacitor of differential type construction, especially designed for maximum bandspread. Kit is furnished with a carefully precalibrated scale which provides well over two feet of scale length. Smooth acting vernier reduction drive and illuminated dial provides easy tuning and zero beating.

Power requirements 6.3 volts AC at .45 amperes, and 250 volts DC at 15 mils. Just plug it into the power receptacle provided on the rear of the AT-1 Transmitter. Seven band coverage 160 through 10 meters with 10 volt average RF output. Uses 6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.

Seven band coverage 160 through 10 meters at 10 volt RF output.
6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.

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

Heathkit GRID DIP METER KIT

The invaluable instrument for Hams, servicemen and experimenters. Useful in TV service work, for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages. Use it for neutralization, locating parasitics, correcting TVI, measuring CL and Q of components, and determining RF circuit resonant frequencies. The variable meter sensitivity control, headphone jack, 500 microampere Simpson meter, continuous frequency coverage from 2 MC to 250 MC. Prewound coil kit and rack included.

LOW FREQUENCY COILS:
Low frequency range extended to 355 KC by the use of two additional coils. Complete with dial correlation curves. Set 341-A for GD-1B and set 341 for GD-1A. Shipg. wt. 1 lb. Price $3.00

MODEL GD-1B
$19.50 Shpg. Wt. 4 lbs.

Heathkit ANTENNA IMPEDANCE METER KIT

MODEL AM-1
$14.50
Shpg. Wt. 2 lbs.

Determine antenna resonance and resistance, transmission line surge impedance, and receiver input impedance. Works with one-half and one-quarter wave lines, half wave and folded dipoles, harmonic mobile and beam antennas. Resistance type SWR bridge —100 microampere meter—frequency range 0-150 MC—impedance range 0-600 ohms.

Heathkit ANTENNA COUPLER KIT

For the Heathkit AT-1 Transmitter or any comparable Amateur Transmitter. Will handle power up to 75 watts at its 52 ohm coaxial input. Matches a wide range of antenna impedances with its L type tuning network and neon indicator. A tapped inductance provides coarse adjustment and a transmitting type variable condenser sets it "right on the nose." Will operate on the 10 through 80 meter bands.

MODEL AC-1
$14.50
Shpg. Wt. 4 lbs.

HEATH company
BENTON HARBOR 15, MICHIGAN

New LOW PRICED HEATHKIT SINGLE UNIT Williamson Type *High* Fidelity AMPLIFIER KIT

Here is the newest Heathkit Hi-Fi Amplifier at the lowest price ever quoted for a complete Williamson Type Amplifier circuit. The W-4 Model has been designed for single chassis construction, and only for the new Chicago Transformer Company Model BO-13 "super range" high fidelity output transformer. This transformer, a new development in the Hi-Fi field, is being offered at substantial saving over transformers of comparable quality. It is outstanding in performance and on the basis of our tests, we find it equal in every respect to transformers used in the W-2 and W-3 Heathkit series.

LOW PRICES:

Through utilization of a single chassis with resultant economy obtained through elimination of duplicate sheet metal fabrication, connecting cables, plugs, sockets, and a new Chicago "super range" output transformer, a 20% price reduction has been made possible without sacrificing kit quality.

COMPONENTS:

The new Heathkit W-4 uses the same heavy duty power transformer and choke. It has all of the features of previous models including individual jacks and a wire wound control to balance the output tubes—plastic high quality capacitors and the exact circuitry previously utilized in Williamson Type Amplifiers. Intermodulation distortion and harmonic distortion are both at the same low level as in the W-2 and W-3 models.

CONSTRUCTION:

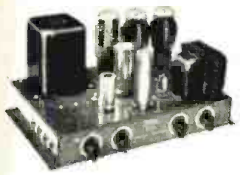
Here is the opportunity for even the economy minded Hi-Fi enthusiast to enjoy all of the advantages offered through Hi-Fi reproduction of fine recorded music. Simplified step-by-step Construction Manual completely eliminates necessity of electronic knowledge or special equipment. Assemble this Amplifier in a few pleasant hours.

COMBINATIONS AVAILABLE

W-4M with Chicago "super-range" transformer only. Single chassis main amplifier and power supply. Shipping weight 28 lbs. Express only **$39.75**

COMBINATION W-4 with Chicago "super-range" transformer only includes single chassis main amplifier and power supply with WA-P2 preamplifier kit. Shpg. wt. 35 lbs. Express only **$59.50**

NEW *Heathkit* 20 WATT High Fidelity AMPLIFIER KIT



MODEL A-9B

$35.50

Shpg. Wt. 24 lbs.

In keeping with the progressive policy of the Heath Company, further improvement has been made in the already famous Heathkit High Fidelity 20 Watt Amplifier. Additional reserve power has been obtained by using a heavier power transformer. A new output transformer designed and manufactured especially for the Heath Company, now provides output impedances of 4, 8, 16 and 500 ohms. The harmonic distortion level will not exceed 1% at the rated output.

FEATURES:

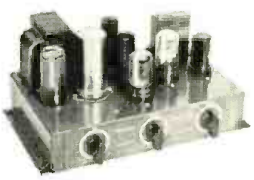
Outstanding features of the Heathkit 20 watt Amplifier include frequency response of ±1 db from 20 CPS to 20 KC. Separate (boost and cut) bass and treble tone controls. Four switch selected input jacks and a special hum balancing control. Flexibility is emphasized in the input circuits and proper equalization for all input devices is incorporated.

TUBE LINEUP:

12AX7 magnetic preamplifier and first audio amplifier. 12AU7 two stage amplifier with tone controls. 12AU7 voltage amplifier and phase splitter. Two 6L6 push-pull beam power output and 5U4G rectifier.

The Heathkit Model A-9B is excellent for custom installation and is designed for outstanding service at a very reasonable cost.

Heathkit SIX WATT AMPLIFIER KIT



MODEL A-7B

$15.50

Shpg. Wt. 10 lbs.

An outstanding value, this economically priced 5 watt Amplifier is capable of performance expected only in much more expensive units. Only 2 or 3 watts output will ever be used in normal home applications and Model A-7B will be more than adequate for this purpose.

SPECIFICATIONS:

Two switch selected inputs are available for crystal and ceramic phono pickups, tuner, TV audio, tape recorder, and carbon type microphone. Model A-7B features separate bass and treble tone controls, push-pull balanced output stages, output impedances of 4, 8, and 15 ohms, and extremely wide frequency range ±1½ db from 20 CPS to 20 KC. Not just a souped up AC-DC job. Full wave rectification, transformer operated power supply and good filtering, result in exceptionally low hum level.

MODEL A-7C

Provides a preamplifier stage and proper compensation for the variable reluctance cartridge and low level microphone. $17.50

Heathkit WILLIAMSON TYPE AMPLIFIER KIT

Here is the famous kit form Williamson Type *high fidelity* Amplifier that has deservedly earned highest praise from every strata of Hi-Fi music lovers. Virtually distortionless, clean musical reproduction, full range frequency response, and more than adequate power reserve.

OUTPUT TRANSFORMERS:

This outstanding Williamson Type Hi-Fidelity Amplifier is supplied with the famous Acrosound TO-300 output transformer. This quality transformer features the popular "ultra-linear" output circuit for clean maximum power level. Separate chassis for amplifier and power supply.

SPECIFICATIONS:

Frequency response within 1 db from 10 cycles to 100,000 cycles. Harmonic distortion at 5 watt output less than .5% between 20 cycles and 20,000 cycles. IM distortion at 5 watts equivalent output .5% using 60 and 3,000 cycles. Output impedances of 4, 8, or 16 ohms. Overall dimensions for each unit 7" high x 5½" wide x 11½" long.

CONSTRUCTION MANUAL:

This fine kit is supplied with a completely detailed step-by-step Construction Manual and the only effort required is the assembly and wiring of the pre-engineered kit. Even the complete novice can successfully construct this Amplifier and have fun building it.

COMBINATIONS AVAILABLE:

W-3 Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P2 Preamplifier.) Shipping weight 37 lbs. Shipped express only..... **$69.50**

W-3M Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer and Power Supply.) Shipping weight 29 lbs. Express only **$49.75**

HEATH company

BENTON HARBOR 15, MICHIGAN

Heathkit COMMUNICATIONS RECEIVER KIT

MODEL AR-2

$25.50

(Less Cabinet)

Shpg. Wt. 12 lbs.

An excellent example of typical Heath Company ability to produce top quality kit merchandise at ridiculously low prices, is the AR-2 Communications Receiver. Here is a transformer operated all-wave receiver with all of the desired features and none of the disadvantages commonly encountered in so-called "economy sets."

Receiver employs high gain miniature tubes and IF transformers, chassis mounted 5½" PM speaker, headphone jack, slide rule dial with Ham Bands plainly identified, and easy tuning with direct planetary drive. Continuous frequency coverage from 550 KC to 35 MC on 4 Bands, with electrical bandspread tuning and logging scales. Other features are RF gain control with AGC on-off switch—phone-standby-CW panel switch—prewound coils in a shielded turret assembly and copper plated chassis and shielding.

Uses 12BE6 mixer-oscillator, 12BA6 IF amplifier, 12AV6 detector-first audio, 12A6 beam power output, 12BA6 BFO oscillator, and 5Y3 rectifier. A lettered control plate is provided for the cabinet of your choice or you can order the optional Heathkit cabinet featuring the full size aluminum panel.

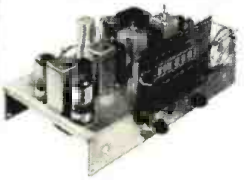
RECEIVER CABINETS

Proxylin impregnated fabric covered plywood cabinet available for BR-2 and AR-2 receivers. Includes aluminum panel, flocked reinforced speaker grill and protective rubber feet.

For BR-2 Receiver, Cabinet 91-9
Shipping weight 5 lbs. **$4.50**

AR-2 Receiver, Cabinet 91-10
Shipping weight 5 lbs. **$4.50**

Heathkit FM TUNER KIT



MODEL FM-2

$22.50

Shpg. Wt. 8 lbs.

Here is an FM Tuner that can be operated with your Hi-Fi Amplifier or through the "phono" section of the ordinary radio. Completely AC operated to eliminate problems usually encountered in "economy type" AC-DC tuner circuits. Features 8 tube circuit with separate mixer and oscillator, 3 double tuned IF stages followed by a limiter discriminator providing maximum sensitivity and selectivity across the full FM frequency band of 88 MC to 108 MC. The tuning unit is factory assembled and adjusted, thus eliminating tedious critical "front end" alignment problems. The attractive slide rule dial and vernier tuning combine to make the Heathkit FM-2 Tuner simple to operate.

Heathkit BROADCAST BAND RECEIVER KIT

MODEL BR-2

$17.50

(Less Cabinet)

Shpg. Wt. 10 lbs.

The Model BR-2 Broadcast Band Receiver is designed especially for the beginner without any sacrifice of quality. This receiver features a transformer operated power supply, high gain miniature tubes, sharply tuned IF transformers, new rod type built-in antenna, and a trouble-free planetary tuning system. Exceptional performance with unusually high sensitivity, good selectivity, and excellent tone quality from the 5½" PM chassis mounted speaker. Can be used either as a receiver, tuner, or phono amplifier. Uses 12BE6 mixer-oscillator, 12BA6 IF amplifier, 12AV6 detector, 12A6 beam power output, and 5Y3 rectifier.

HEATH COMPANY · Benton Harbor 15, Mich.

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HEATH COMPANY
BENTON HARBOR 15, MICHIGAN

WALNUT 5-1175

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- ☐ Freight
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QUANTITY	ITEM	MODEL NO.	PRICE

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 insure postage for weight shown.

ORDERS FROM CANADA and APO's must include full remittance.

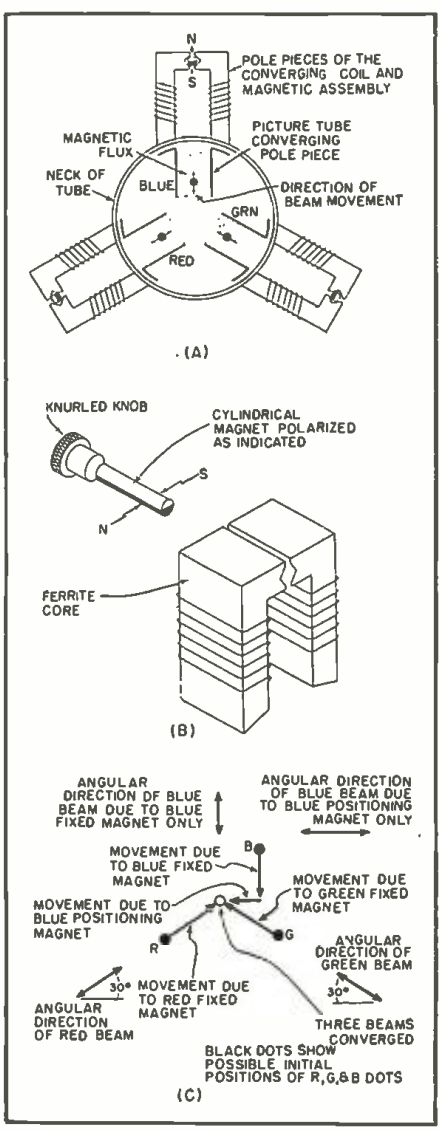
Motorola Color Receiver

(*Continued from page 74*)

which are internally associated with each grid No. 4. The magnetic fields set up by the coils are coupled through the glass neck of the tube to the internal pole pieces which serve to shape and confine the fields so as to affect only the particular electron beams to which the individual pole pieces correspond. For example, the change in convergence angle of the red beam is a function only of the current through the external coil which couples to the internal set of pole pieces adjacent to the red beams. Likewise, the currents through the green and blue external magnets affect respectively only the green and blue beams.

Each external coil possesses two separate windings to provide for horizontal and vertical dynamic convergence correction. For the static convergence ad-

Fig. 5. (A) External and internal convergence components of the CRT. (B) Detailed drawing of the convergence coil and magnet assembly. (C) Effect of the three fixed magnets and the blue positioning magnet on the three CRT beams.



justment, each coil has associated with it a small permanent magnet whose position can be varied.

A diagram of the individual static convergence magnets is shown in Fig. 5A. The heavy dots represent the individual electron beams as they pass through the gun on their way to the screen. The arrows at these beams indicate their direction of movement. Note that the red and green beams are confined to paths which make an angle of 60 degrees on either side of a vertical axis. The blue beam, on the other hand, can only move vertically, up or down.

Now it could readily happen that while the color dots of the green and red beams fall within the same trio, that of the blue beam does not. This means that while we can always cause the red and green beams (or color dots) to converge, it may not be possible to have the blue beam meet the other two. Still required is another adjustment, that of being able to move the blue beam from side to side (or laterally). To effect this, a special blue beam positioning magnet is also found on the neck of the tube. See Fig. 4. Now perfect convergence of the three beams at the center of the screen is always possible.

Note that no ion traps are used in this tube, principally because the color screen is aluminized. The layer of aluminum presents a barrier to any oncoming ions and prevents them from reaching and damaging the screen. Electrons, having only 1/1800th of the mass of an ion, encounter little difficulty in passing through this aluminum layer.

We would like to thank the *Motorola* Service Department for its cooperation in the preparation of this series. Particular thanks are due Mr. T. M. Alexander and Mr. Frank Uhrus.

-30-

PROBE SHIELDING

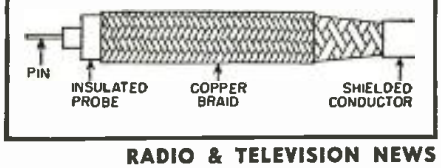
By HYMAN HERMAN

MOST shielded probes for oscilloscopes or v.t.v.m.'s do not provide shielding to cover the probe itself, usually of Bakelite or plastic. Hand capacity around such probes may cause changes in the readings.

The accompanying diagram shows how such shielding may be provided. The rubber insulation of the probe cable is removed for about one inch below the probe and a piece of copper braid, equal in length to the probe plus one inch, is slipped over the probe and the exposed braid of its cable. Now cover the braid completely with friction tape. Be careful that you do not allow the copper braid to touch the pin of the probe.

-30-

Copper braid, slipped over an ordinary probe, as shown, will shield the probe.



Oscilloscope Photography

(*Continued from page 71*)

Next, the floodlights are turned on, and a normal exposure is made.

The type of photo that would be obtained, at this point, is shown in Fig. 2 (left). Note that the screen of the oscilloscope shows black rather than the usual white.

However, a second exposure is then made without changing the film in the camera. The room is darkened by turning "off" both the floodlights and normal room lights. The scope mask is removed so that the pattern is visible, and the second exposure is made with the camera iris opened fully to use maximum lens speed. Special care must be taken not to move the position of the camera relative to the test equipment set-up when making the second exposure.

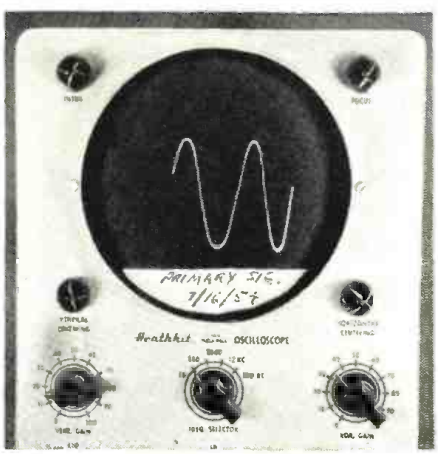
The second exposure, alone, would be a simple waveform photograph, as shown in Fig. 2 (center). However, since a double exposure has been made, the sharp waveform pattern is superimposed on the darkened scope screen, and the final negative contains both a clear equipment photo and a sharp, contrasty waveform pattern.

If desired, special masks may be used when making the first exposure. For example, a small tab may be included to identify the waveform pattern and the date on which the photograph was taken. A typical example of this technique is given in Fig. 3.

Other masks may be made up to give calibration information or similar data. A polar coordinate or rectangular grid pattern may be superimposed on the oscilloscope waveform by drawing the desired pattern on the black mask. Opaque white drawing ink is used. Using the same technique, arrows may be included to indicate the direction of pattern movement.

The photograph given in Fig. 4 is an additional example of the results that may be obtained using this technique. Here, a single photo is used to show, simultaneously, the waveform pattern

Fig. 3. Details on the operating conditions and date of film are recorded on small tab.

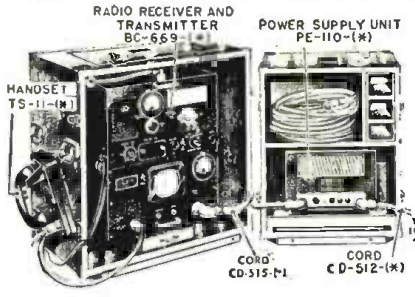


PRICES SLASHED ON BEST ELECTRONICS SURPLUS

SENSATIONAL VALUE!! 45 W. RADIOTELEPHONE FOR BOAT OR FIXED STATION

THE BIGGEST BARGAIN IN PLEASURE OR FISHING BOAT RADIOTELEPHONES!! These units are moving fast, but luckily we obtained a good quantity of them, and can repeat our ad-offer in the Nov., '54, Radio Television News. This Radiotelephone Transmitter-Receiver (BC-669, part of SCR-543) is beautifully and ruggedly built. Designed for rough military service and engineered for maximum efficiency, it will provide trouble-free long-range communications from boat, vehicle, portable or fixed station installations. Both Transmitter and Receiver operate in the frequency range of 1680 to 4460 KC, and both are **crystal-controlled on all six channels** in this range. Manual tuning of the receiver is also provided. Power Output (Phone) is rated nominally nt 45 watts.

Transmitter operation is performed with a minimum of controls, after installation adjustments have been made, consisting of: ON-OFF Power Switch, CHANNEL SELECTOR Switch to proper position, and ANTENNA TUNING Control rotated for maximum indiction in RF Meter. This latter control may be eliminated (knob removed) without detriment by following simple instructions furnished. Also furnished are instructions and drawing for circuit modification in anticipation of new FCC regulations concerning harmonic suppression of transmitters operating in the 2 and 3 MC marine band. Operation of the 45-Watt Radiotelephone may be from 110 V. AC, 110 V. DC, 32 V. DC, 24 V. DC, or 12 V. DC. Complete constructional data and diagrams are furnished for building any of the above power supplies at minimum cost. For those who prefer to purchase ready manufactured power supplies, Telemarine will be glad to furnish quota-



tions for any of the above voltage inputs. Each set is supplied with 12 crystals (6 for X-mit, 6 for receive) for operating on 1746, 2082, 2280, 2340, 3422.5 and 4255 KC. Receiving crystals differ by 385 KC (IF frequency). Most of these crystals can be reground to marine band frequencies. Receiver uses high-efficiency 10 Tube Superhet circuit with RF Stage for maximum selectivity, built-in loudspeaker. Static Filter (Noise Eliminator) Circuit with Switch, and RF Gain Control. Transmitter uses 8 Tubes (2-807's in Final) with 100% Plate Modulation, and Metering Switch with multi-range milliameter for instant checking of any part of transmitting circuit.

LOOK AT THESE FEATURES!

- COMPLETE COVERAGE 2-3 MC MARINE BAND
- 6 CRYSTAL CHANNELS, X'MIT & R'CVR
- OPTIONAL MANUAL TUNING OF RECEIVER
- FULL 10-TUBE SUPERHET R'CVR with RF STAGE
- 8 TUBE X'MTTR, 100% PLATE MODULATION
- BUILT-IN SPEAKER, WITH ON-OFF SWITCH
- STATIC FILTER CIRCUIT & SWITCH CONTROL
- METER & METER SWITCH FOR CHECKING & ADJUSTING ALL TRANSMITTING CIRCUITS
- RUGGED DESIGN & CONSTRUCTION

LOOK AT THESE LOW PRICES!

45-WATT RADIOTELEPHONE (BC-669A, B, or C Models), complete with tubes, crystals (as specified), schematic diagram, Connecting Cord CD-515 (to Power Supply), Modification and Power Supply Constructional Data. **USED, GOOD CONDITION.** Shpg. wt. 185 lbs. **$69.50 EACH**

Same as above, but **LIKE-NEW CONDITION**, w/Instruction Book. **$89.50**

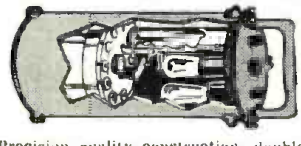
SAME AS ABOVE, NEW UNUSED CONDITION Export Packed. Shpg. Wt. 400 lbs. **$139.50**

MODELS BC-669 D or E, Same as Above, but provides also CW (telegraphy) transmission and reception (incorp. BFO). **NEW, EACH** **$169.50**

TS-11 HANDSET, with appropriate plug connector. **EACH** **$14.50**

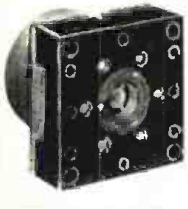
110 V. 60 C., AC POWER SUPPLY. EACH $89.50

CONDENSER MICROPHONE With 2-Stage Pre.-Amp.



Real, Precision quality construction, double Helmholtz Resonator type, with combination microphone and amplifier built-in cylindrical brass case 16 x 6 ins. Uses types 30 and 32 tubes in amplifier. Employs acoustical low-pass filter plugs (removable) for 5-25 cycle response: removing plugs (threaded) and venting cylinder case will result in high-quality, wide-range studio-type microphone. As is, excellent for vibration testing, percussion noises, shock sounds, oil exploration work. Original use—Sound (Artillery) Ranging Eqpt. Model T-21/6R-3-C. NEW UNITS. Shpg. wt. 25 lbs. **SLASHED TO ..... $11.95 EACH**

50-60 W. SPEAKER UNIT



Western Electric Speaker units, for horn or baffleboard mtg. Shock and blast proof diaphragm, will handle up to 60 watts. Response to 7,000 cps, favoring high freq. Impedance 13 ohms. Dim.: 6" x 6" x 4¼" deep. Throat opening — 1⅝" dia. Alnico 5 slug wt. 6 lbs.

Shpg. wt. 20 lbs. **SLASHED TO ..... $11.95 EACH**

32 VDC-110V AC CONVERTER

Mfd. by Kato Engineering, for marine or farm installation. Rotary type, compact and ruggedly built for continuous duty. Rubber shock mounting on filter case, with complete input and output filtering. Output 110 volts, 60 cycles AC. .225 KVA, but will operate efficiently on loads up to 300 watts. New units. Shpg. wt. 60 lbs. **PRICE, EACH $39.95**

INFRA-RED IMAGE "SNOOPERSCOPE" TUBE EXTRA-SPECIAL!!

We've sold thousands of them to Labs, experimenters, Industrials, studios, etc. By using Infra-Red rays, this tube enables you to see in the dark. No scanning, no amplifiers, just a high-voltage power supply is all you need with this tube. Shows image in greenish-white on 1⅜" screen. For night photography, signalling, sniper or sniper scopes, underwater detectors, etc. British mnfr. SOLD IN LOTS OF 6 ONLY! Literature and diagrams furnished with each sale. Shpg. wt. 2 lbs.

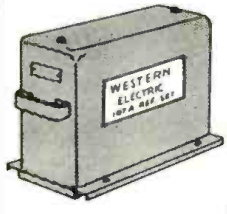
Slashed to 6 for $15.00

FRONT-END LENS, for Infra-Red Tube.
Bausch & Lomb ..... Ea. $10.00
Plain, Mounted Type ..... Ea. 7.00

EXPORTERS, GOVERNMENT AGENCIES, INDUSTRIALS!

We have a large stock of Transmitters, Receivers, Walkie-Talkies, VHF Equipment, Ship & Shore Communications, FM Broadcast Stations, Radar, Accessories, etc. Write and tell us of your requirements. Descriptive literature and prices available upon request.

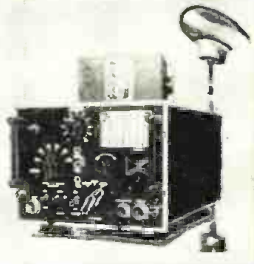
SELECTIVE RINGER for MOBILE or SHIP-TO-SHORE RADIOTELEPHONES



Permits Phone Operator to call your Radiotelephone exclusively, when operator has a call for you, by ringing a bell or lighting a light. Designed & Mfd. by Western Electric, MODEL 107A, modern, compact and efficient. Can be attached to any receiver, complete Instruction Book supplied. Dim.: 15⅞" long, 8½" high, 5⅛" wide. Shpg. Wt. 25 lbs. **NEW UNITS.** Reg. value $245.00 each.

OUR LOW PRICE— EACH $85.00

SUPER-SONIC SIGNAL RECEIVER AND DIRECTION-FINDER FOR MARINE OR AIRCRAFT



This is an outstanding Direction-Finder Receiver for boat or aircraft owners, at an unusually low price for such high-quality equipment. **VERY POPULAR AS A SUPERSONIC RECEIVER.** Tunes from **15 to 70 KC.** and 100 KC to 1750 KC, all in 6 bands, covering maritime radio direction-finding, aeronautical navigation and full broadcast band frequencies. You can fix position on any station operating in those frequencies, as well as on broadcast stations, and use it for broadcast band reception. 8 tube superheterodyne, receives CW and tone signals. Loop supplied with either 34" or 55" extension shaft (specify), 24 v. DC Dynamotor w/filter, instruction manual (less cables) etc., Mfd. by RCA. All NEW eqpt. Shpg. wt. 225 lbs. **SLASHED TO ..... $59.50 EACH**

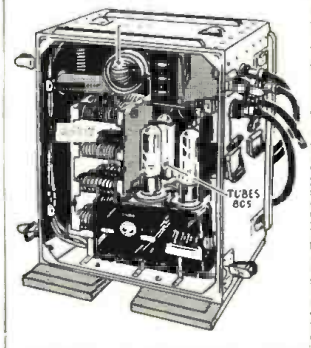
SPECIAL BARGAIN! MODULATION PLATE & INPUT TRANSFORMERS, for 50-75 W. Ham Rig, designed for 2-6L6 in Push-Pull (AB1) to modulate single 814. Plate transf. Pri. Imped. 3,500 ohms, Sec. imped. 8,000 ohms. Input Tranf. Pri. 3,500 ohms ct., Sec. #1—to grids of 616's, Sec. #2 used for sidetone pickup. Fully Shielded, Compact. Shpg. wt. 8 lbs. **PAIR $7.85**

All Above Material Subject to Prior Sale. 25% Minimum Deposit with All C.O.D.'s. Min. Order —$5.00. All Prices F.O.B. Our Address.

— TELEMARINE — COMMUNICATIONS CO.

3030 W. 21st Street, Brooklyn 24, N. Y.
Cable Address: Telemarine N. Y.
Phone: ES 2-4300

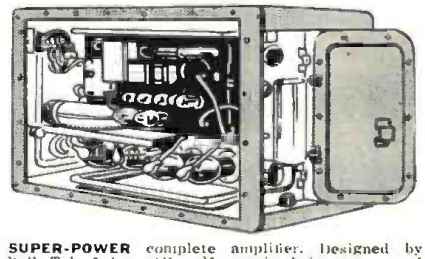
600 W. A.F. POWER AMPLIFIER



Designed by Bell Telephone Laboratories, ruggedly constructed 600 Watt Audio Power Amplifier. Ideal for use in airports, shipyards, or wherever high intensity sound may be required. Excellent for conversion to Modulator Unit for modulating 1 KW transmitters. Comprises push-pull audio power stage utilizing 4—805 power triodes in push-pull parallel, with built-in motor blower for cooling. High voltage power supply uses selenium rectifiers, no tubes. Requires 40-60 watt pre-amplifier to drive to full capacity. Input impedance 250/500 ohms, output impedance 13/6.5 ohms (to speakers). Operates from 115 or 230 Volts, 3 phase 50/60 cycles AC. Dimensions of wooden chest 24⅝"x28⅝"x21⅛". Supplied with tubes, connecting cable, schematic diagram, etc. Shipping weight 290 lbs. **PRICE EACH, SLASHED TO $169.50**

W.E. Pre-Amplifier for above, 60 W. output. Dim: 24⅛"x22⅝"x18⅛". Shipping weight, complete with tubes 100 lbs. **PRICE, EACH $119.50**

250 WATT BEACHMASTER AUDIO AMPLIFIER



SUPER-POWER complete amplifier. Designed by Bell Tel. Labs. All self-contained in waterproof metal case, with blower system for ventilation, weatherproof receptacles, etc. Ideal for large auditoriums, airports, baseball parks, etc., or easy to convert to modulator for 500 Watt Transmitter. Operates from 110 V. 50/60 cycles AC. Uses total of 14 tubes, including 2-805 triodes in push-pull power stage and 1-6E5 magic-eye tube to indicate gain. Like-new condition equipment. Dim. 26½" x 16¼" x 19". Shipping weight, complete with tubes, 190 lbs. Supplied with connecting cables and schematic diagram. **PRICE EACH, SLASHED TO $169.50**

LOUDSPEAKER for above, consisting of 9 horns with units mounted on metal square frame, with tripod for support. Dim: 23" x 22¼" x 18". Shipping weight 235 lbs. **PRICE $110.00**

DYNAMOTOR SPECIALS

DM-35, 12 v. DC input, 625V. at 225 ma., int. duty. Exc. cond. ..... **EACH $17.50**

DY-10, 12.5/25 V. DC input, output 360 V. at 355 ma., int. duty. Exc. Cond. ..... **EACH $19.50**

DM-28, for BC-348 Receivers. 28 V. DC in, 224 V. at 70 ma. out. Exc. Cond. ..... **EACH $9.95**

DM-32/DY-2A, for ARR-2 Receivers. 28V. DC in, 250V. at 60 ma. out. Exc. Cond. .... **EACH $4.95**

obtained, all test equipment used in the experimental set-up, actual lead connections, and all equipment control settings.

Camera Settings: Actual exposure time will vary with the film, lens, and *f*/stop employed. The photos of Figs. 2, 3, and 4 were made with a 2¼ x 3¼ *Speed Graphic,* using "Super XX" cut film. Two No. 2 photoflood bulbs in satin finished reflectors were placed about 4 feet to either side of the test equipment, approximately as shown in Fig. 1.

The first exposure, with floodlights on was 1/10 sec. at *f*/32. The second exposure, recording the waveform pattern, was 1/10 sec. at *f*/5.6.

Other Applications: Although developed primarily for obtaining oscilloscope pattern plus equipment photographs, the "double exposure" technique described may be used in other applications. It may be used, for example, to obtain "families" of characteristic curves or multiple waveform patterns without the need for step function generators, electronic switches, or any other similar specialized equipment.

The basic technique may be applied equally well to the photography of other cathode-ray tube displays, *i.e.,* radar scopes, television screens, etc.

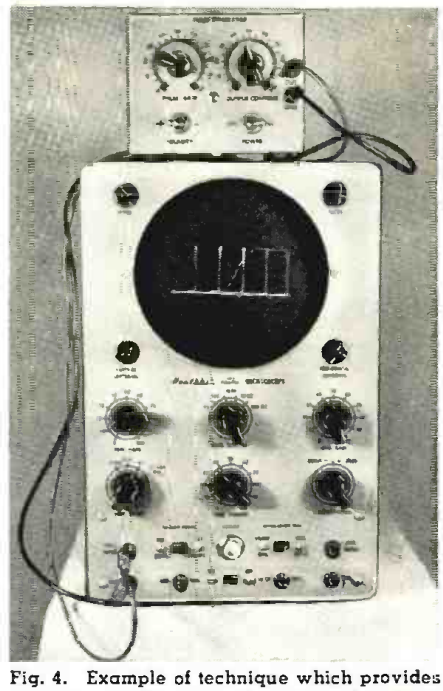


Fig. 4. Example of technique which provides complete details on equipment and pattern.

It should prove especially valuable in the preparation of instruction manuals on the use of any device employing a cathode-ray tube. —30—

POTENTIOMETER SUBSTITUTION BOX

By RUFUS P. TURNER, K6AI

MOUNTED potentiometers are handy accessories. They can be used in circuit development in the laboratory, and as substitutions for volume controls, tone controls, rheostats, etc., in the service shop. The smooth, continuous variation of resistance provided by a potentiometer is preferred in some applications to the more accurate step variations of the decade box.

Many a technician has resolved to make up a set of mounted potentiometers, but failed to follow through. Too, single mounted units, unless they are expensive *Helipots,* are apt to find their way into permanent equipment.

A satisfactory solution is to mount a number of standard-range potentiometers on a single chassis with a selector switch, as shown in Fig. 1. The unit shown uses 11 potentiometers selected for their often-needed resistance values. The reader may make any other desired selection of resistance values and tapers. A 2-pole, 11-position, non-shorting rotary switch (S_1-S_2) connects the two outside binding posts successively to the resistance windings. All sliders are wired together and connected to the center binding post. Thus, either rheostat or potentiometer type of connections are available for each unit. —30—

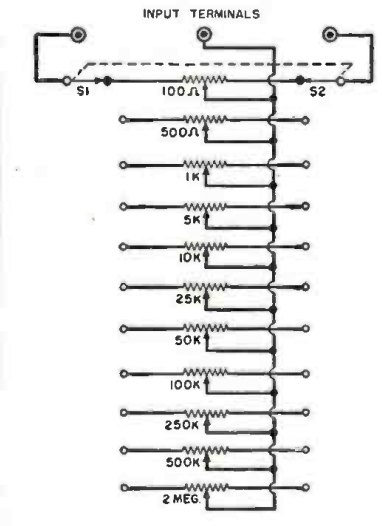
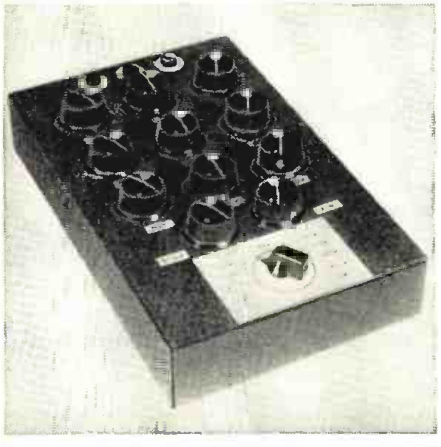
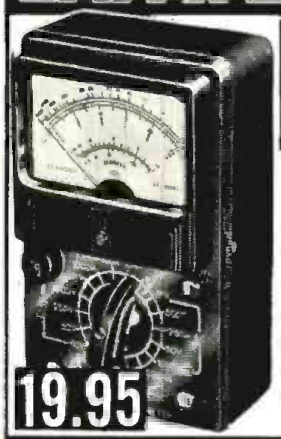


Fig. 1. Schematic and over-all view of the 11-unit pot substitution box. The chassis measures 11" x 7" x 2".



LAFAYETTE'S SPECTACULAR MULTITESTER VALUES



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.

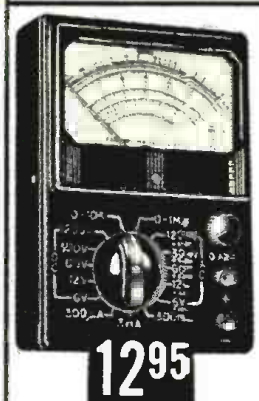
RW-30G ..... NET **19.95**

In lots of 3 **19.25**

NEW POCKET AC-DC VOM MULTITESTER
1,000 ohms per Volt

This instrument is one of the best buys that Lafayette has ever offered in a Wide Range AC-DC MULTITESTER. An ideal portable unit that meets the need for a compact, yet rugged test instrument. Has ease of operation usually FOUND ONLY IN MORE EXPENSIVE INSTRUMENTS. Has 1000 ohms/volt sensitivity on both AC or DC. Uses full 3" rectangular meter with large easy to read scale. Uses 1% precision resistors, jeweled D'Arsonval microamp meter movement. Ranges: AC-DC and output volts 0-5, 0-25, 0-250, 0-1000V; DC current 0-1, 0-10, 0-100, MA; Resistance 0-10K and 0-100K ohms. In handsome sturdy bakelite case. Size: 4¾" x 3¼" x 1⅝". Supplied Complete with test leads and batteries. A Must for every serviceman, shop, Laboratory or experimenter—and at Lafayette's Price you can afford to own one. Shpg. Wt. 3½ lbs.

MODEL RW-27C—Complete In Lots of 3 **9.45** Single, ea. **9.95**



SENSITIVE AND ACCURATE AC - DC MULTITESTER
2000 OHMS PER VOLT ON BOTH DC AND AC

An unusual buy in a very accurate and sensitive VOM. Features single selector switch for all ranges. Has 3 ", sensitive 140 microamp meter, 2000 ohms per volt on both AC and DC, 21 full scale ranges, consisting of AC-DC Voltage Ranges: 0-6; 0-12; 0-60; 0-300; 0-1200 Volts; DC Current Ranges: 0-300 ua; 0-3 MA; 0-300 MA; Resistance Ranges: 0-2 K ohms; 0-2 Megohms; Decibels: 0 db +6 db; +20 db; +34 db; +46 db (0 db - 0.774V);

Extreme versatility and accuracy. 1% precision resistors; beautiful plastic front with metal bottom for ruggedness and shielding. Size 3⅝" x 5¼" x 1½". Shpg. Wt. 3 lbs.

MODEL RW-360 Complete

In lots of 3 **12.45**

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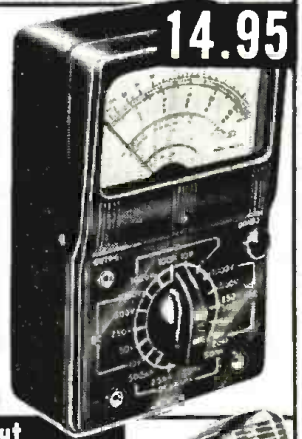
2,000 Ohm per Volt Sensitivity on both DC and AC



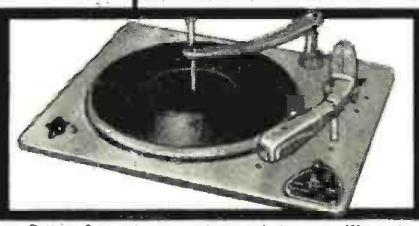
- High Sensitivity 3¼" 160 Microamp Meter Insures Accuracy
- 25 Full Scale Ranges
- Sloping Panel for Easy Reading
- 4 Resistance Ranges on Two Separate Scales
- 5 Output Ranges to Measure AC with DC present
- Convenient Pocket SIZE 3¾"x 5¾"x 2-2/5."

This unusual Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter. Features extreme versatility, accuracy and ruggedness. In an attractive bakelite front panel, with metal bottom for ruggedness and shielding. Single switch selects all ranges; 1% precision resistors used throughout. An outstanding instrument, for the professional, serviceman or Laboratory. FULL SCALE RANGES: DC Volts: 0-10; 0-50; 0-250; 0-500; 0-1000. AC Volts: 0-10; 0-50; 0-250; 0-500; 0-1000. Output Volts: 0-10; 0-50; 0-250; 0-500; 0-1000. DC Current: 0-500 microamps; 0-2.5 MA; 0-25 MA; 0-250 MA; Resistance: 0-1K; 0-10K; 0-100K; 0-1 Meg; Decibels: +22 and +50 db (0 db - 0.755V - 600 ohm). COMPLETE with test leads and BATTERIES shpg. wt. 4 lbs.

RW-29Y ...NET **14.95** ..... In lots of 3, ea. **14.25**

Collaro
THE WORLD'S FINEST 3 SPEED AUTOMATIC RECORD CHANGER

SPECIAL **29.50** LIST PRICE ~~54.50~~



Lafayette scores again with an almost unbelievable price on the Collaro 3-speed Automatic record changer. We made a spectacular buy and we are passing the savings on to you. Here's the finest changer made. Manufactured in England—with a world-wide reputation. It plays all sizes and all speeds automatically. It's packed with quality features that the Hi-Fidelity enthusiast will appreciate: Jam-proof ball bearing mounted tone arm; automatic shut-off after last record; powerful fan cooled hum-shielded 4-pole motor with self-aligning oilite bearings; automatic muting switch; weighted ball-bearing mounted constant speed turntable; rubber drive couplings—and more! Base size 14¾" x 12¼". Depth below base 2½". Shpg. Wt. 19 lbs. Available either less cartridge with plug-in shell or with famous turnover Ceramic or G.E. Triple-Play cartridge.

COLLARO Model 3/531 changer ..... Net **29.50**

COLLARO Model 3/531 with Turnover Ceramic cartridge ..... Net **33.50**

COLLARO Model 3/531 with G.E. Triple Play RPX-050 cartridge installed ..... Net **34.50**

45 RPM SPINDLE

Slips on in place of regular spindle, eliminating use of center inserts on 45 RPM records.

GSA Spindle ..... Net **3.23**

High Output Dynamic Microphone
Worth Many Times Its Price

At Last! A Hi-Fi Dynamic Mike for tape recorders, etc.—at a price you'd expect to pay for a good crystal mike! **14.95**

Lafayette went abroad to obtain a high quality DYNAMIC MICROPHONE at a price that is 70% less than any comparable dynamic microphone on the market today. Exceptionally fine for public address, recording and other general purpose use. Substantially flat response, 60-10,000 cps, assures faithful reproduction of speech and music. Impedance 40,000 ohms ±15% at 1000 cps. Output Level —55 db. Die cast metal case finished in light grey and fine chromium. Compact and light weight. Net Wt. 1 lb. Head at fixed tilt of 15°, equipped with 6 ft. well shielded low-loss special vinyl-jacketed cord. Standard ⅝"-27 thread. Dimensions 1-23/32" high, 2" wide, 3⅝" deep. Shpg. Wt, 3 lbs.

PA-19...Singly, ea. **14.95**...In lots of 3 **14.45**

CARDWELL UHF CONVERTER SALE!

List ~~42.50~~

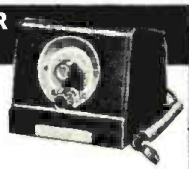
Net **13.95** ea. Lots of 3

Singly **14.45** ea.

Outstanding Value! The Cardwell ES-1 UHF converter covers the entire UHF spectrum—channels 14-83. Has 6AF4 oscillator, 6CB6 IF amplifier and 1N72 crystal diode. Features printed circuit oscillator, high overall gain (3 to 4 times), high sensitivity, constant L/C ratio tuner, 25-1 gear drive. Has AC cord and plug. 3-pos. switch for UHF, VHF and OFF. Handsome wood cabinet 8⅛ x 6½ x 3½" with easy reading dial. Shpg. Wt. 4½ lbs.

CARDWELL ES-1 Converter—Lots of 3 each.....13.95 | Singly each.....14.45

RADIART TV BOOSTER
QUANTITY LIMITED



List 29.95

6.45 ea. in lots of 3

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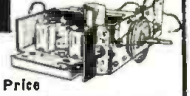
A special purchase enables Lafayette to offer Radiart Model TVB-1 at a fraction of their original cost. High signal-to-noise ratio greatly minimizes ghosts, snow and interference. Wide Band Amplification insures sharp pictures, free from smear. Attractive styled polished Mahogany cabinet. For 115 Volts, 60 cycles. Shpg. Wt. 4 lbs.

RCA 807 TUBES
QUANTITY LIMITED BRAND NEW JAN. SPECS. STOCK NO. SP-70

1.29

CROSLEY UHF FRONT END



- Mallory 3 Gang Inductuner
- 6AF4 — 6BZ7 and 1N72
- Parts Alone Worth Twice the Price

UHF front end covers all channels 14 through 82, using the famous Mallory continuous tuning inductuner. Original replacement for Crosley part 154698-1-1 used in Crwsley series EU chassis 393 and 394. Ideal for building UHF converters, etc. Output feeds into channel 5 I.F. Concentric shaft includes fine tuning. Built-in antenna switch operates off tuning shaft. Comes complete with 1N72 diode, 6BZ7 and shock mounted 6AF4 tubes. Size: 8 x 5 x 3½. Shpg. Wt. 5 lbs. Quantity limited.

TL-25.....Lots of 3, ea. 4.45

Singly, ea. 4.95

BINOCULARS NEVER BEFORE AT THIS PRICE

IMPORTED DIRECT

Prism-Coated Lenses

- All-Metal Construction
- Individual Focus
- Leather Case & Straps

F-105, 8 x 30 with case....NET 19.95
F-15, 7 x 35 with case....NET 22.50
F-103, 7 x 50 with case....NET 24.95
F-104, 12 x 50 with case....NET 32.50

} with order, Add 10% Fed. Tax

TIMER-SWITCH SALE

Automatically turns on radios, television sets, toasters, coffeemakers, etc.—at any pre-set time within 12 hour period; also tells time. Built-in single-pole switch handles up to 15 amps, 115 volt. Requires 3½" diameter round hole. Depth behind dial face 2¼". Shpg. Wt. 1½ lbs. MS-62, for 110V/60 Cy AC

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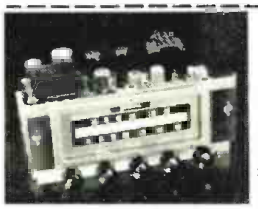
NEVER BEFORE AT SUCH LOW PRICES! EVEN SAVE ON COAXIAL SPEAKERS AND RECORD CHANGERS



JACKSON AM9A

9-TUBE HI-FIDELITY

12 Watts Audio
Dual Tone Controls

$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson Model AM9A, 12 watt high fidelity audio amplifier and broadcast tuner combined, at less than you would normally pay for the amplifier alone. Push-pull 6V6 output. Frequency response from 30 to 15,000 cps. Inputs for crystal or G.E. variable reluctance pickup and crystal or dynamic microphone. Separate bass boost and treble tone controls. Radio-phono switch on front of chassis. Shielded output transformer matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power transformer. 9½" illuminated slide rule dial with etched glass scale. 3 gang condenser with tuned R.F. stage and loop antenna. Receives broadcast 550 to 1650 kc. Size 13" long, 6" high and 9½" deep. Complete with tubes: 2-6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2-6V6 and 5Y3. Knobs, escutcheon, diagram and instructions included.

Model AM9A, Hi-Fi amplifier and tuner. Ship. wt. 9 lbs. Sale price $39.95
Model AM9A with our CU-14Y 12" coaxial PM speaker, both for $49.95.
Model AM9A with our P15-CR 15" coaxial PM speaker, both for $59.95.

11-TUBE FM-AM HALLICRAFTERS

HALLICRAFTERS S-78A

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 73/8" 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 $400 to $600 radio combinations. Has input for crystal phono pickup. Self-powered preamplifier necessary for G.E. variable reluctance cartridge, $3.95 extra.

5-78A Hallicrafter 11 tube FM-AM chassis. Ship. wt. 22 lbs. $69.95
5-78A Hallicrafter with our CU-14Y 12" coaxial PM speaker $79.95
5-78A Hallicrafter with our P15-CR 15" coaxial PM speaker $89.95

GARRARD—COLLARO—WEBCOR 3-SPEED RECORD CHANGERS

$65.00 LIST COLLARO 3/532 $38.95

Here are top values in modern up-to-date 3 speed automatic record changers. New Webcor model 114-43, 3 speed automatic changer with RPX-050 G.E. cartridge. Size, 13½" x 12". Ship. wt. 12 lbs. Sale price only $29.95.

Regular $65.00 list Collaro model 3/532, 3 speed automatic record changer made in England. Intermixes 10 and 12" records of 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, 12½" wide and 6¾" above motor board, 27/8" below. Available in green, grey, cream and gold hammertone. Ship. wt. 20 lbs. Regular net, $48.75. Special sale price, $38.95 less cartridge. Large 45 RPM spindle, $2.50 extra. 3/532 Collaro changer with G.E. Golden Treasure RPX-052 cartridge, $58.95.

RC-80 Garrard "Triumph," 3 speed automatic changer. 13¾" wide, 15½" deep and 8" high, 2½" below motor board. Net price, less cartridge, $48.51. 45 RPM spindle $3.43 extra. RC-80 with G.E. RPX-052 Golden Treasure cartridge, Net $68.51. RC-80 with crystal flip-over cartridge, only $52.46.

RC-90 Garrard "Crown," 3 speed automatic changer. 13½" x 15½", 5¾" above motor board and 37/8" below. Net price, less cartridge, $68.11. With crystal flip-over cartridge, $72.06. With G.E. RPX052 Golden Treasure, $88.11. 45 RPM spindle, $3.43 extra.

24" - 27" Mahogany TV Cabinet

SALE PRICE **$39.95**

WALNUT RADIO PHONO CABINET

SALE PRICE **$59.95**

Large mahogany open face cabinet for 27" or 24" television chassis. 44" high, 30⅛" 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.

WALNUT RADIO-PHONO-CABINET. Made for $800.00 Class Capehart. Cost Over $200.00 to Build. **$59.95**

No. K-275 (right illustration). Walnut radio-phono cabinet 42" h. 42" w. 22" deep. Made for Capehart selling for $800. Radio chassis area 14" h. 11½" w. Changer compartment 14" x 26" w. 12" baffle completely enclosed. Cabinet weighs approx. 175 lbs. Ship. wt. 275 lbs. Sale price $59.95.

21" Mahogany Television-Phono Cabinet

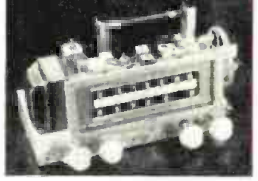
RT-21MA $49.95

RT-21MA. Mahogany Television-Phono combination cabinet with half doors, for 20" and 21" TV chassis and record changer. 36½" high, 39¼" wide and 22" deep. Baffle cut for 12" speaker. TV compartment 21½" high, 21⅛" 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. No. A13-9, ball bearing changer drawer slides, $1.39 pr., extra.

DRT-21M $59.95

DRT-21M. Deluxe flame grain mahogany Television-Phono combination cabinet for 20" and 21" TV chassis and record changer. Beautiful full door style with matching front panels and piano finish. 37" high, 40½" wide and 22¾" deep. Baffle cut for 12" speaker. TV compartment 21½" high, 23½" wide and 19" deep. Will hold most 20" and 21" TV chassis. Changer shelf 15" x 17" with 9" height clearance. Ship. wt. 90 lbs. Stock No. DRT-21M. Sale price only $59.95. 21" mask and safety glass available at $6.95 extra. (Requires fitting to cabinet) No. A13-9, ball bearing changer drawer slides, $1.39 pr.

HI-FI FM-AM TUNER AND 10 WATT P.P. 6V6 AMPLIFIER



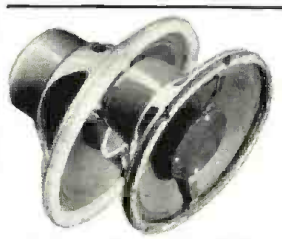
10 W. AMP.

BOTH FOR **$49.95**

9 TUBES-PLUS 2 RECTIFIERS PHONO INPUT

New, high fidelity self-powered FM-AM tuner with 10 watt amplifier (Push-pull 6V6's) on separate chassis. All you need is a record changer and one of the speakers shown below, to have a complete home music system. 3 ft. cable connects tuner to amplifier. Tuner has input for crystal phono pickup. (If one of the changers with a G.E. variable reluctance cartridge is purchased, we will include the necessary pre-amp at no extra charge). Self-powered tuner has 6 tubes plus rectifier (12AT7, 6BE6, 2-6BA6, 6AT6, 6AL5 and 6X4). Amplifier has 3 tubes; 2-6V6's, 6SN7, plus rectifier. Full superhet circuit with AVC and 3 position tone control. 9" illuminated slide rule dial with gold color escutcheon and matching knobs. His "High-Q" ferrite stick loop antenna for AM and separate FM antenna. Radio FM, AM, phono selector switch, tone control, volume control-off-on switch are on the tuner chassis. High fidelity response, 50 to 17,500 cps. Receives broadcast 540 to 1600 kc and FM, 88 to 108 mc. Output transformer will match any of the speakers listed below. This high fidelity FM-AM tuner and 10 watt amplifier is comparable with competitive units selling for $100.00 and more. Stock No. FA9-2CR, tuner and amplifier complete with all tubes, knobs, instructions and diagram, Ship. wt., 22 lbs. Special sale price, only $49.95. CU-14Y, 12" coaxial PM speaker, $10.00 extra. P15-CR, 15" coaxial PM speaker, $20.00 extra, when ordered with tuner-amplifier. Collaro 3/532, 3 speed automatic intermix changer with crystal flip-over cartridge, $42.95 extra.

McGee's Famous 12 AND 15 INCH COAXIAL P.M. HIGH FIDELITY SPEAKERS

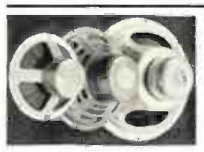


$12.95 12-Inch Model CU-14Y

$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 connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each, two for $25.00.

Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps. and up to 17,500 cps. Full 21½ oz. Alnico V magnet in the 15" woofer. Specially made, axially 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.



HIGH FIDELITY SPEAKERS

8" BLUE STREAK	$ 6.95
12" JENSEN P-12P	$15.95
15" WOOFER	$18.95

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. It has tone quality equal to many high priced imported speakers. Has 8 oz. Alnico V magnet with wide range curvelinear cone and 8 ohm voice coil. This speaker has a beautiful tone at low volume levels. 8 watts continuous with peaks up to 12 watts. Response essentially flat from 35 to 12,500 cps. Ideal for use with a woofer for a hi-fi speaker system. Perfect for high fidelity radios, amplifiers and professional music systems. Ship wt., 6 lbs. Model HF-8J. Sale price, $6.95.

Model P-12P, 12" Jensen Concert, High Fidelity wide range speaker. Has 14½ oz. Alnico V magnet with 1¼". 8 ohm voice coil. Heavy ribbed, easy moving molded cone. Will take 18 to 25 watts of audio. Ideal for P.A. systems as well as a mid-range speaker for a high fidelity speaker system. Frequency response, 50 to 12,500 cps. Model P-12P, 12" Jensen Concert PM speaker, Ship. wt., 8 lbs. Sale Price $15.95.

Model SP-15P, 15" "Blue Streak" High Fidelity low frequency woofer speaker. This is an ideal woofer for a high fidelity speaker system. Use a cross-over network for best results. Has 21½ oz. Alnico V magnet, with 1¼", 8 ohm voice coil. Has free floating cone of one piece type construction. Will respond to frequencies down to 20 cps. and up to 10,000 cps. Takes 18 watts with peaks up to 25 watts. This speaker used with the 8" "Blue Streak" or both the 8" and 12" speakers described above makes a top quality high fidelity speaker system. Model SP-15P, 15" "Blue Streak" woofer speaker, Ship. wt., 12 lbs., Sale Price, $18.95.

TELEVISION CONSOLE CABINETS AT LESS THAN FACTORY COST!

FOR YOUR TV CHASSIS—MODELS FOR 27 INCH TO 16 INCH CHASSIS

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.

21" Mahogany Cab. ... $24.95
(d) No. 21-OFM, 21" Mahogany open front. 37" h. 25½" w. 20½" deep. Chassis area 24" w. 21½" h. 18¾" deep. Baffle for 10" speaker. Small overall, but plenty big enough for 21" set. Made for a $295 TV set. Ship. wt. 65 lbs. Sale Price $24.95.

17" Mahogany Full Door Cab. ... $29.95
(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 for 10" speaker. Ship. wt. 80 lbs. On sale at less than it cost a famous TV factory. Sale price $29.95.

17" Walnut ½ Door Cabinet. ... $24.95
(f) No. AH-85A. Walnut with half doors. 36" h. 20¾" w. 21½" deep. Chassis area 19" w. 18¼" h. 18¾" deep. Blank panel. Will hold most 17" sets. Baffle cut for 10" speaker. Ship. wt. 65 lbs. An attractive well proportioned cabinet on sale at only $24.95.

17" TV Cab. with Phono Drawer. . $19.95
(g) No. SE-21. TV-Phono comb. 40" h. 24" w. 18½" deep. Blank panel. TV chassis area 19" h. 20½" w. Changer drawer 19¾" w. 13" deep. Baffle for 10" speaker. Mahogany finish. Ship. wt. 75 lbs. Sale price $19.95.

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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 2⅜" deep with 3" diameter hole in front. Many ways this attractive clock and cabinet could be used, such as mounting a small bell below the clock for use as a kitchen clock and timer. Clock has sweep second hand and 15 amp. 125 volt switch to turn on appliances at any pre-set time. Case available in Ivory, Green or Yellow. Stock No. MCT-63. Sessions Clock-Timer with case of your color choice. Sale price only $3.95.

RC-600 REGENCY UHF CONVERTER $16.95

UHF converter SCOOP! Brand new RC-600, Regency UHF converters. Special sale price only $16.95. Regular dealers net was $37.46. All channel UHF, 14 thru 83. Only 100 to sell. Model RC-600. Ship. wt. 6 lbs. Special sale price only $16.95.

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 is 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.

FAMOUS STANDARD COIL CASCODE TUNERS

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 4½" 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.

SALE PRICE $12.95

2 FOR $25.00

No. 3103-5, 41 mc Standard Coil cascode 12 channel tuner with 41 mc I.F. for intercarrier sound circuits. With 6BK7 and 6J6 tubes. 3⅛", 4½" or 6" shaft. Sale price, $12.95 ea., 2 for $25.00.

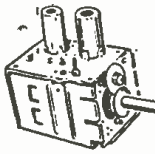
No. TV-4001-7, 41 mc Standard Coil cascode 12 channel tuner with 13th position for use with separate UHF tuner. 6¾" shaft. With tubes 6BQ7 and 6J6. Used in Sentinel, MW, Arvin, etc. Sale price, $12.95.

STANDARD COIL PENTODE TV TUNERS $9.95

SC-947 Standard Coil Pentode 12 channel tuner, as used by Emerson 650D, 655, etc. Fine tuning shaft insulated from ground. Filaments shunted with resistor for .6 amp drain. 2¼" shaft. With tubes 6BC5 and 6J6. Sale price, $9.95.

SC-948 Standard Coil Pentode 12 channel tuner with 6BC5 or 6AG5 and 6J6 tubes. Millions of TV sets now in use have this tuner. 1¾", 2⅞", 3", 4" or 5" shaft length. You can replace that old tuner cheaper than it can be repaired. Sale price, $9.95.

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.



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, F21CDL8H, 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 TUBE SARKES-TARZIAN, RCA, GEN'L. INST.

TV-53735, 3 tube Sarkes-Tarzian, 12 channel tuner, with 2-6AG5 and 6C4 tubes. 3" shaft. Used in Air King 700 series. Sale price, $7.95.

Type 3, 3 tube Sarkes-Tarzian 12 channel tuner with 6C4, 6BH6 and 6AG5 tubes. Use with separate sound or intercarrier. Has converter coil. 2⅞" shaft. Sale price, $7.95.

Famous RCA 201E1, 13 channel tuner with 3-6J6 tubes. Brand new as used in RCA 630 chassis. Stock No. RCA-13P, Sale price, $7.95.

RCA 4P-12, 12 channel printed circuit tuner used in Hallicrafters. With 6J6 and GC86 tubes. 6½" shaft. Sale price, $9.95.

GI-44 General Inst. 12 channel tuner with 6BC5, 6AG5 and 6J6 tubes. 5" shaft. 21 mc I.F. Sale price only $4.95.

TUNERS FOR EXPERIMENTERS, BUILDERS $2.95

Bargain priced tuners, less tubes for the builders and experimenters. Ideal for building a field strength meter, etc. Type 4 Sarkes-Tarzian, has screw driver slot fine tuning instead of concentric shaft, $2.95 less tubes.

RCA-13X, 3 tubes RCA 201E1, has been removed from sets and may require some repair. $2.95 less tubes.

GI-13X, 3 tube Gen'l. Inst. 12 channel tuner. Removed from sets, will need repair. $2.95 less tubes.

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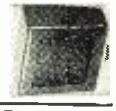
Now, buy a full 10" PM speaker with Alnico V magnet with our top quality 10" leatherette wall baffle, both for only $5.49. Baffle is finest lock joint construction with rounded corners, quality covering and plastic grill cloth. Stock No. 10RN, 10" speaker and baffle, $5.49 each, 2 for $10.00.

BOTH FOR $5.49

2 for $10.00



12" PM speaker with same quality 12" wall baffle, only $7.49 each, 2 for $15.00.

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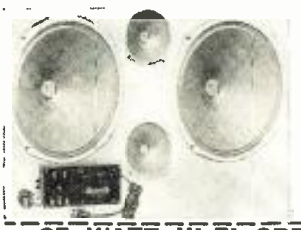
25 WATT HI-FI SPEAKER SYSTEM $24.95 AND MAHOGANY SPEAKER CABINET $79.95



2-12" Woofers
2-5" Tweeters
Power Supply and L-C Cross-over Network

ALL FOR $24.95 WITH CAB.

25 WATT HI-FI SPEAKER SYSTEM $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, less console baffle 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.

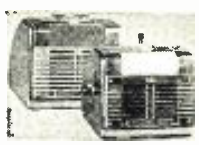
SPEAKER SYSTEM INSTALLED IN CABINET $79.95

High Fidelity Speaker system installed in mahogany console speaker cabinet. A complete high fidelity speaker system contained in a beautiful hand rubbed mahogany console speaker cabinet. This ¾ door style speaker cabinet is 43" high, 31" wide and 23" deep. This cabinet was intended for a 24" TV set and cost over $100 to build. We have added a heavy laminated baffle, cut for the 4 speaker system and matching mahogany color plastic grill cloth that is acoustically correct for this speaker system. The baffle portion of this cabinet contains 9.4 cu. ft. of space. It could easily be made into a top quality bass reflex baffle with the addition of a back and the proper acoustical lining. Full shelf below speakers is 27" wide and has panel 41½" high ideal for installation of a high fidelity amplifier and preamplifier. Bottom section of the cabinet is cut for two 10" speakers which were used with the TV set. This space could easily be converted for a number of uses. Speaker system described above is shipped installed in cabinet. Only two wires to connect to the output of your radio or amplifier. Model CSP-121CRM, High Fidelity Speaker System installed in mahogany console cabinet. Shipping wt. 105 lbs., Sale price, $79.95.

Model CSPS-121M, High Fidelity speaker system; less cross-over network, installed in mahogany console cabinet, Sale price, $69.95.

3-STATION INTERCOM MASTER $16.95

SUB-STATIONS $3.95 EACH



Powerful 3 station intercom master housed in a chrome plated metal cabinet 7½" x 6" x 5". Full 3 tube amplifier for AC-DC operation. Press-to-talk switch is on top of cabinet. Volume control, off-on switch and station selector are located on either side. May be used with one to three sub-stations. Master is quiet except when talk-listen switch is pressed, or when call-back switch is pressed at the sub. Ship. wt. 10 lbs. Model MPM-A3, 3 station master, $16.95. Matching sub-station, Model PM-AS, complete with 5" Alnico V PM speaker and call-back switch. $3.95 each or 3 for $10.00. Requires 3 wire intercom cable, $1.95 per 100 ft., 500 ft. for $8.95.

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.

6-TUBE 2 BAND RADIO KIT $14.95

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.

22 WATT HI-FIDELITY AMPLIFIER KIT COMPLETE WITH TUBES $29.95

8 Tubes—Push-Pull Output As Featured In Esquire Article

22 watt, 8 tube High Fidelity amplifier kit with push-pull output tubes. A complete kit of parts to build this fine quality amplifier. Includes 3-7E5, 2-12AT7, and 2 Western Electric WT-52 (6A3) output tubes. All triode circuit minimizes harmonic distortion. Has inputs for Radio tuner, crystal or variable reluctance phono pickup and crystal or dynamic microphone. Output transformer matches 8 ohm voice coil. Will match any of the high fidelity speakers shown on this page. Twin electronic bass and treble tone controls, with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 20 to 18,000 cps. This is the very best quality amplifier kit we make. 22 watt, 8 tube all triode amplifier kit, complete with all parts, tubes, diagram and instructions. Model 7X5, ship. wt., 25 lbs., Net price, $29.95.

21" BLOND TV-RADIO-PHONO CABINET—SALE PRICE $49.95

Blond mahogany combination TV-Radio-Phono cabinet. Has full doors with panel cut for 20" or 21" TV chassis. Has space for radio chassis, record changer and record storage. Beautiful blonde finish with matching grill cloth and gold color hardware. TV compartment is 20½" high, 24¾" wide and 21¼" deep. Chassis was intended to mount on side. Radio changer space will hold changer 13¼" x 14" and radio chassis 8" high and 13" wide. Baffle cut for 12" speaker. Overall cabinet size, 38" high, 42½" wide and 24¼" deep. Ship. wt., 85 lbs. Stock No. DJB-21R, Sale price $49.95.

78 RPM-AMPLIFIED RECORD PLAYER $8.95

3-TUBE AMPLIFIER

78 RPM amplified player kit. Leatherette cabinet, 6 x 9" speaker. Buy this kit for less than the parts cost. Only $8.95 buys this 78 RPM record player. Completely wired 3 tube amplifier with 12BF6, 35W4 and 50B5 tubes. Separate tone and volume controls. Leatherette covered cabinet 9½" x 12" x 18½" high. Made to set on the floor. Has heavy 6 x 9" speaker, crystal pickup, phono motor, and amplifier. All you do is fasten the speaker, motor and amplifier in the cabinet. Cabinet is pre-cut, no holes to drill. Only a few minutes required to assemble. Complete with simple instructions. Stock No. CPR-78K, ship. wt. 15 lb. Sale price $8.95. Shipped via express only.

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"Ultra-Linear" Amplifier

(*Continued from page* 47)

which are not the inherent faults of the circuits, but are due to the fact that the optimum transformer was not used.

In this push-pull parallel design, circuit considerations and transformer design have been integrated to provide a circuit of excellent stability—a circuit in which the feedback could be increased by 6 db without encountering instability either on resistive or speaker load.

However, some combinations of loading can lead to ringing or other transient disturbances under conditions of high level operation. This can be prevented completely by the addition of a 250 $\mu\mu$fd. capacitor across one-half of the output transformer primary (from blue-white lead to red lead). The need for this expedient is the exception rather than the rule.

Special circuit considerations such as staggering at the low end and the introduction of local current feedback by splitting the driver stage cathodes in order to increase stability at high frequencies have been incorporated in this design. In addition, the output transformer was designed to have a bandpass flat plus or minus 1 db from 10 cps to 100 kc. with a smooth phase characteristic tailored to the phase characteristic of the amplifier. The transformer, the *Acrosound* TO-330, also was designed to provide high power at low distortion over a very wide band. The transformer combinations of bandwidth, preservation of operating characteristics at all power levels, and maintenance of push-pull balance over a very wide band all combine with the basic circuit configuration to give good stability and unusually outstanding performance characteristics.

The push-pull parallel circuit provides better results than would be anticipated on the basis of doubling the output stage capabilities. Since the TO-330 transformer is more efficient than the lower powered unit designed for a single pair of output tubes, more than twice as much power is available from the push-pull parallel circuit than from the regular push-pull amplifier using the same design criteria. Thus, it is practical to reach levels in excess of 60 watts before the intermodulation distortion reaches 1 percent—if four normal quality KT66 tubes are used. With selected tubes, the IM can be kept below .5 per-cent at 60 watts. Conventional commercial advertising of the power capability of the amplifier would classify it as a 65 or 70 watt amplifier with a specification of "peak power in excess of 100 watts."

As with all amplifiers, a mismatch of output impedance such as putting a 64 ohm load on the 16 ohm tap to simulate speaker behavior at the bass resonant frequency results in a decrease of power capability. However, this also results in a decrease in distortion. For

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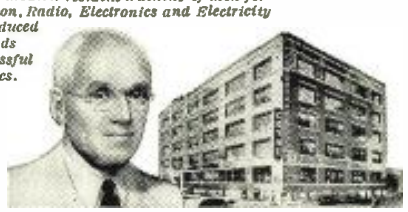

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example, under matched impedance conditions, the IM distortion of one of these amplifiers at 24 watts is .14 per-cent (based on a 40 cps and 7 kc. signal mixed 4:1). With the mismatched condition, the total power output is reduced to less than 40 watts, but the IM at 24 watts is .07 per-cent—a reduction to one-half. Such low values of distortion exceed the capabilities of most measuring equipment.

The amplifier passes more than 50 watts of power without visible distortion on the scope at any frequency from 20 cps to 30 kc. Frequency response, of course, is far greater than this power curve indicates; and because normal frequency response is plus or minus 1 db from 2 cps to 200 kc., the square wave transmission at any frequency from 20 cps to 20 kc. is excellent.

The amplifier requires only 1.3 volts to drive to full output. This makes it practical for use with any preamplifier, as any commercial unit can supply the necessary signal voltage.

The combination of attributes available in this push-pull parallel design is unique. It offers more power, at lower distortion, over a wider bandpass than can be obtained by any conventional circuits.

It is realized that measured performance does not make an amplifier sound good. Of course, poor measurements generally indicate poor listening quality; but the converse is not true. Therefore, since measurements correlate imperfectly with listening qualities, it is necessary to make the listening test the final and most important test of merit. The performance of the push-pull parallel circuit remains superior on listening also.

Heavy bass passages have better definition and sound better damped on the push-pull parallel amplifier than on others. This is due apparently to more than the additional power capability alone. It seems to be also due to the high damping factor of 16, the fact that varying speaker impedances do not pull the power capability down to below a satisfactory level, and to the fact that distortion is at as low values as have ever been achieved outside the laboratory.

In the middle and upper frequency regions, the absence of intermodulation effects and the undistorted reproduction of transient signals make for a smoothness and clarity which is apparent in less listener fatigue. After continued exposure to the quality of the push-pull parallel circuit, it is difficult to listen to other circuits without becoming aware of their previously unnoticed shortcomings.

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—30—

OLSON'S PENNY PROFIT POLICY MEANS GREATER BARGAINS

ARVIN MAHOGANY TV BASE

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Just place a Table Model TV set on this base and it looks like a console. Fully finished and polished mahogany sides and front. Brass ornaments set off front panels. Equipped with four E-Z roll casters. Entire base made by cabinet craftsmen. Size 22" wide x 21" deep x 17" high. Brand new in factory-sealed air cushion cartons. Shpg. wt. 15 lbs. Must be shipped by Express because of size.

First Quality Plastic Base Recording Tape

1200 Ft. Tape on 7" Dia. Reel

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Famous Brand—Reg. $3.50—Now at 71% discount. Freq. response 50-15,000 cps—¼" wide—fits all recorders. Shpg. wt. (one dozen) 10 lbs.

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Value packed with 200 ½-watt, 20—1 and 2 watt; and 12—5 to 25 watt wirewound resistors worth over $23.50. 5—10—20% tolerances. Includes IRC, Clarostat, Centralab, etc. 100% Olson Guaranteed. Shpg. wt. 2 lbs.

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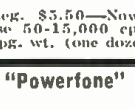

STOCK NO. X-448 **$5.95** SET

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6 complete sets, each....$4.50
12 complete sets, each....$3.95

Works up to one mile. Durable, dependable. Lifetime electro-magnet carbon. Gold-plated diaphragm carbon mike. Connects in 2 seconds—place on table or mount on wall. Complete—you get 2 telephones with built-in buzzers 2 cradles, 2 batteries, 50 ft. double cable. Handsome Gift Carton. Money-back Guarantee if not twice as Good as you Expected! Shpg. wt. 4 lbs.

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STOCK NO. X-403 **$1.19** EA.
3 FOR $2.95, SINGLE..

Ideal for running model cars, boats, remote control devices, etc. Operates on 3 to 6 Volts DC. 5 pole armature, bronze bearings and Alnico 6 Magnet. Shaft dia. 3/32". Size 1½ x ¾ x ¾". Shpg. wt. 1 lb.

DELUXE SEALED UNIT MOTOR

Single **$1.99** EA.

3 for $5.00
Stock No. X-407

Same fine features as Motor described above and in addition the entire motor is encased in a TRANSPARENT Polystyrene Case with dual shaft. Phosphor bronze terminals. 1½" high x 1" wide x 1¼" deep. The ideal motor with hundreds of uses.

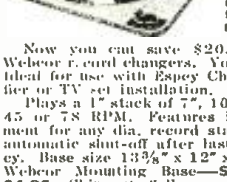
Type 39/44 R.F. Amplifier Pentode Tubes

Brand new original factory packing, 1 tube to a carton, 50 to a case. Stock up on this Regular $2.80 list tube at less than a dime a piece. Manufactured by Tung-Sol, RCA and General Electric. 6.3 V.—.3A. Shpg. wt. 16—2 lbs.

STOCK NO. Z-228 **6 FOR ONLY 67¢**

CARTON OF 50 ONLY $4.77

NEW WEBSTER-CHICAGO (Webcor) All-Speed Automatic Diskchangers



With Crystal Turn-over Cartridge and 2 Precious Tip Needles. STOCK NO. RA-157 ..... **$28.95**

With GE V.R. Turn-about Cartridge and 2 Precious Tip Needles. STOCK NO. RA-158.... **$32.95**

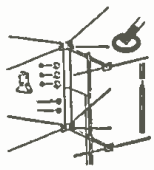
Now you can save $20.00 on the latest model Webcor record changers. Your choice of either model. Ideal for use with Espey Chassis or any radio, amplifier or TV set installation.

Plays a 1" stack of 7", 10" or 12" records at 33⅓, 45 or 78 RPM. Features include automatic adjustment for any dia. record stack, improved spindle and automatic shut-off after last record. For 115 V. AC cy. Base size 13⅜" x 12" x 8¼". Shpg. wt. 13 lbs. Webcor Mounting Base—STOCK NO. X-363, each $4.95. Ship. wt. 3 lbs.

GIANT TV ANTENNA KIT

Stock No. AU-24

REG. $31.95 **$12.99**



Complete kit—nothing more to buy. For best reception on all VHF channels. Rustproof Aircraft Aluminum. Contains: 2 six-element conical bays, 1 pair Q bars, 2 five ft. 1¼" mast sections, 60 ft. 300 ohm lead-in, 3 standoff insulators, 2 screw-eye standoffs, 1 mounting base, 1 guy ring, 1 clamp ass'y., 1 pipe strap, 4 lug bolts and full instructions. Save—order 12 sets— only $119.50. Shpg. wt. each 13 lbs. Express only.

Electron-O-Jr. Sound System Kit

Stock No. RA-179 **$6.95** Reg. $19.95

CAN BE ASSEMBLED IN TWO HOURS

Now build and operate a complete 1-tube plus rectifier-amplifier P.A. Sound System and easily learn principles of electronics. Includes 5" PM Speaker, Dual Electrolytic Condenser, 75 ma Selenium Rectifier, 3 Resistors, 2 Switches. Volume control and knob. Input and Output Transformers, Carbon granule Microphone. 12A6 Tube, 50 ft. 2-conductor Cable, Hook-up wire. Solder and all necessary clips, sockets, hardware, panels and punched forms to make amplifier cabinet and speaker baffle. Simple instruction book included. Operates on 115 Volts AC or DC. Comes in 4-color gift carton. Shpg. wt. 10 lbs.

Nationally Advertised Tester—SUPER METER

STOCK NO. TE-47 **$16.95**

Combination Volt-Ohm-Milliammeter PLUS capacity, Reactance, Inductance & Decibels Complete with Instructions and Test Leads. Measures capacity and leakage of paper and electrolytic condensers. Look at all these Ranges—DCVOLTS: 0 to 7.5/75/150/750/1500, AC VOLTS: 0 to 15/150/300/1500/3000. DC CURRENT: 0 to 7.5/75 MA and 7.5 AMPS. RESISTANCE: 0 to 10,000/100,000 ohms 0 to 10 megs. CAPACITY: .001 to .2 MFD .1 to 20 MFD. REACTANCE: 150 to 25,000 ohms 15,000 ohms to 2.5 megs. INDUCTANCE: .35 to 70 Henries 35 to 7000 Henries. ELECT. LEAKAGE: 0-100,000 ohms 100,000 to 10 megs. DECIBLES: −10 to +18 db. +10 to +38 db. +30 to +58 db. Round cornered molded case measures 3 x 6 x 2¼". Operates on 115 Volts AC. Shpg. wt. 4 lbs.

Giant 0-1 MA Meter

STOCK NO. X-419. **$4.99** EA.

We guarantee these meters to be the best value in precision instruments we have ever offered. Every one 100% guaranteed. Size 3¼" x 4½". Mounts on surface of panel. No big holes to drill. Equipped with zero adjustment on front glass. Genuine Arsonval movement. Plastic case beautiful mottled brown.

TV IF Transformer Kit

STOCK NO. AS-134 KIT OF 10 TRANSFORMERS. **$1.99**

Contains 10 Popular Width Transformers. Sound IF Transformers. Video IF Transformers. Some are dual. Equipped with iron tuning slugs. Genuine RCA and Dumont. Brand New. Value $8.50. Shpg. wt. 2 lbs.

Hermetically Sealed Vibrators

STOCK NO. VB-52. EACH, ONLY **69¢**

3 FOR $2.00

A 6 volt, synchronous, single-reed vibrator—draws only 6 amps. 1⅝" dia. x 3¾" long. Octal Base. Shpg. wt. ½ lb. ea.

3 for $2.50

CATHODE RAY 'SCOPE TUBE

3CP1/1808P1

BRAND NEW RCA—REG. $14.50

STOCK NO. Z-230 **99¢** EA.

A 3" 'Scope at our low price is unheard of. A great value for experimenters, labs, engineers, hams, students, industry, etc. In addition to the usual two pairs of electrostatic deflecting electrodes, this tube has a radial-deflecting electrode, which may be used if desired. This arrangement provides for observation and photography of recurrent and transient phenomena in polar coordinates. Medium persistence, green fluorescence. Shpg. wt. 3 lbs.

Full operating instructions and base layout included.

Espey HI-FI AM-FM RADIO CHASSIS

Complete with 10 Matched Tubes, Knobs, Escutcheon, Antennas and Hardware, Only

STOCK NO. RA-166 **$49.95**

Espey Chassis with 12" Magnavox Speaker—STOCK NO. AS-117—ONLY.... $52.50

Olson scoops the nation with this tremendous Hi-Fi Buy. Regularly sells for $147.50, but Olson put cash on the line so you could save money on the one chassis designed for Quality Installations. Every chassis packed in original factory-sealed carton. 100% Double-Guaranteed by Olson and the Manufacturer. Five of the ten matched tubes are dual-purpose—giving you the equivalent of 15 tube performance. This brilliant AM-FM radio is equipped with the built-in Pre-amplifier for GE or any low variable reluctance or any standard crystal phono pickups. Features special drift compensator, universal phono input, 3-position equalizer for finest record playback, beam power amplifiers for powerful audio and RCA-Hazeltine licensed circuits. Chassis finished in high-lustre and measures 13½" wide, 7¾" high and 10" deep. Front panel neutral grey to match any decor. Dual edge lit slide-rule dial. 115 V. AC 60 cy. Full instructions and mounting diagrams included. Shpg. wt. without speaker 25 lbs., with speaker 32 lbs.

SALE! ONLY 200 AMPLIFIERS

A fine amplifier and we figured your cost down to the last penny. We have only 200. Gives full clear tones. Look at these features which are found on much more expensive instruments. Inputs for BOTH reluctance cartridge or crystal cartridge. Also handles a radio tuner and a crystal microphone. Has built-in pre-amplifier. Equipped with output transformer. Excellent volume control, tone control and switch. Has power outlet for record player motor which shuts motor off automatically when amplifier is turned off.

Delivers 5 watts continuous. Completely assembled with matched parts and wired. Ready for use. Tubes included: 6SL7 (Dual Tube), 6V6 and 6X5. Chassis is heavy gauge and beautifully finished. Size 9 x 5 x 6". Shpg. wt. 12 lbs.

EXTRA: Included is a transparent plastic engraved and drilled front panel which can be mounted on any cabinet.

8-WATT PEAK OUTPUT

Stock No. AMP-21 **$18.07**

"Golden Classic" TRI-FI REPRODUCER

LEATHERETTE COVERED

Stock No. S-186 **$29.95**

Blonde—Stock No. S-187—$33.95
Mahogany—Stock No. S-188—$33.95

20 WATTS—20 TO 14,000 CYCLES

A new conception in High-Fidelity Reproduction. Outperforms any speaker arrangement costing 3 times the price. Contains 3 speakers with a crossover network that separates the function of each speaker. Speaker number one reproduces only the extremely Bass notes. Speaker number two delivers the entire middle register with utmost clarity while Speaker number three, a special tweeter reproduces the high frequencies only.

The "Golden Classic" will recreate a tone balance which is unbelievable. Delivers full 20 watts with complete frequency range of 20 to 14,000 cycles. Reproducer is completely enclosed and each internal chamber is insulated with proper sound absorption material. Terminals on back of cabinet. Size 11" x 24" x 10". Shpg. wt. 20 lbs.

SPEAKER & BAFFLE COMBINATION

Perfect for Extension Speaker Use

May Be Purchased Separately

5" PM Speaker, STK. NO. S-5.....,$1.79
Baffle Box, Leatherette Covered, STK. NO. K-70 ..... 1.11
Grille Cloth, STK. NO. X-481..... .20

If purchased separately, this outfit would cost $3.10. However, Olson has a special deal on the kit—you get a beautiful brown leatherette covered wood case with proper opening for a 5" speaker, an Alnico 5—5" PM Speaker and grille cloth—all for only $2.66. Shpg. wt. 4 lbs.

STOCK NO. AS-141. COMPLETE KIT, SPEAKER, BAFFLE & GRILLE CLOTH, ONLY **$2.66**

¼" ELECTRIC DRILL

Limited Quantity—Reg. $19.95 Made by Famous Manufacturer

Brand New—

Factory Sealed Cartons

Never before could Olson make an offer like this. A precision Electric Drill with cast handle and gear box and a spun steel housing. Has a capacity of ¼" in steel and ½" in hardest wood. The no-load speed is 1600 RPM and full load speed is 700 RPM. Armature is dynamically and statically balanced for vibrationless operation. Armature is wound with triple formex wire. Gears are hobbed steel. Perfectly balanced pistol grip handle. Trigger switch can be locked down. These are brand new drills and worth much more. Every one is packed in a factory sealed carton with the manufacturer's guarantee. Equipped with 6' heavy duty Belden cord and rubber plug. Equipped with precision built three-jaw hand type chuck. Shpg. wt. 6 lbs.

STOCK NO. TL-41 **$9.96**

With Hand-type Chuck & Drill With Jacobs Chuck. List..$24.95

Similar to above Drill except with Jacobs gear type chuck and drill is satin finished.

STOCK NO. TL-42 **$13.22**

HOW TO ORDER

Send remittance with order (Add for postage 5¢ for each dollar's worth ordered—10¢ for each dollar's worth if you are more than 1000 miles away. OLSON REFUNDS EVERY CENT NOT USED. Or send no money—we'll ship C.O.D. and you pay mail or expressman for merchandise and postage. ALL MERCHANDISE 100% GUARANTEED. PLEASE—MINIMUM ORDER $3.00.

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275-F East Market St., Akron 8, Ohio

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Send to address below for Free Bargain Catalog.

OLSON RADIO WAREHOUSE | **275-F EAST MARKET ST., AKRON 8, OHIO**

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-96, 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.....

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 Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system,* the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover. .....

$47.50 NET

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

SUPERIOR'S NEW MODEL TV-40

C.R.T. TUBE TESTER

★ **A complete picture tube tester for little more than the price of a "make-shift" adapter!!**

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base *(ion trap need not be on tube).* Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

★ **Tests *all* magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!**

SPECIFICATIONS:

- Tests *all* 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.
- Tests for open elements.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only .....

$15.85 NET

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.
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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 TV-11.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TV-40.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

SWL Preselector

(*Continued from page* 41)

loops. The author used two lugs under the mounting screws for C_1 as a tie-point for all such leads.

A short length of RG-59/U run from the output post of the selector switch through a grommet in the rear of the cabinet serves to connect the unit to the receiver antenna terminals. Small cable clamps will be useful in keeping the coax against the sides of the cabinet.

Since the layout of the components necessitated running the output coupling capacitor back past the tube socket to reach the selector switch, C_6 was run from pin 5 of the tube socket to a nearby terminal strip and a piece of RG-59/U was used to complete the connection to the switch.

It will be noted from the photographs that a capacitor of rather large physical dimensions was used for C_2. This was simply because it happend to be handy in the "junk box" and one of the midget types would be just as satisfactory. Although one of the new ferrite-core r.f. chokes was used in the plate circuit, one of the more common types should work just as well.

Operation

To place the unit in operation, first connect the output lead to the receiver—the inner conductor being attached to the antenna terminal and the braid to the receiver chassis. If the receiver has provisions for both single wire and doublet antennas, the output lead should be connected to the terminal designated for a single wire antenna.

Assuming the antenna being used is the single wire type, connect it to "A" on the preselector terminal strip and connect a jumper between "B" and "C". With the selector switch in the "straight-through" position, tune the receiver to a weak station in the range covered by the preselector. Then turn on the preselector power switch, advance the gain control to the "maximum" position, and set the selector switch to the proper coil. Now slowly rotate C_1.

As the unit is tuned closer to the frequency of the station being received, an increase in volume will be noted and will reach a maximum when the preselector is tuned to the same frequency as the receiver. Since the tuning characteristics are rather broad, it will be possible to tune the receiver to several stations in the same band without having to readjust the preselector.

The unit will seem to function better on weak signals than on strong ones. Actually, this is due to the tendency of the receiver's a.v.c. circuit to level off strong signals and is no reflection on the ability of the preselector to handle its job efficiently and according to specifications.

The builder may wish to calibrate

the dial so as to speed the process of tuning to a station of known frequency. In the simplest form this would merely consist of noting the dial settings for six or seven stations of known frequency in each of the two bands.

If a more thorough job is desired and an r.f. signal generator is available, it may be connected to the antenna terminals of the preselector and used to provide calibration points every 500 kc.

To do this, adjust the generator for a modulated signal of the desired frequency (say, 6.0 mc.) and with the selector switch at "straight-through", tune the receiver for maximum output, keeping the volume control set as low as possible. Then turn the selector switch to the proper coil, tune the preselector for maximum receiver output, and make a mark at this point on the dial. Repeat this procedure at 6.5 mc., 7.0 mc., and so on.

An a.c. voltmeter connected across the speaker voice coil terminals will give a more reliable indication of output than trying to judge by ear. If a readable voltage cannot be obtained without advancing the volume control considerably, connect the voltmeter between the plate of the receiver output tube and ground, with a 0.1 μfd., 600 volt capacitor in the plate lead to block the d.c. component.

While the performance of the unit may not be in the same class as the more expensive commercial models using several tubes, the author has found it greatly increases the ability of his receiver to "reach out and pull them in." Signals which are completely unintelligible become strong and clear when this SWL preselector is switched on. -30-

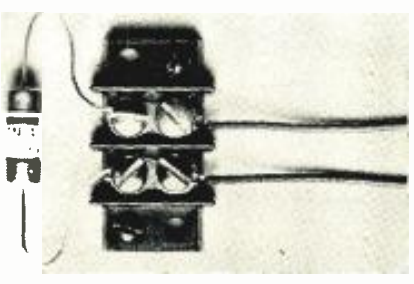
GERMANIUM DIODE LEADS

By ARTHUR TRAUFFER

WHEN experimenting with germanium diodes, the continual connection and disconnection of leads messes them up and eventually breaks them off short. Then, when soldered connections are made to the short leads there is danger of damaging the diode.

As shown in the photo, the author saves his leads by connecting the diodes to a two-terminal Cinch-Jones barrier type terminal strip. Thus, quick connections can be made to the diodes without any soldering, and the strips can be screwed onto a breadboard or bolted to a chassis. -30-

How the leads on a germanium diode can be conserved and constant soldering avoided.



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Guaranteed to oscillate!
Your choice of frequencies!
Largest selection in the world!

NUMBERS LISTED ARE FUNDAMENTAL FREQUENCIES IN KILOCYCLES

ALL CRYSTALS TESTED FOR ACTIVITY! 1-DAY SERVICE FOR EVERYTHING IN STOCK!

FT-243

Lots of 10 or more. Ea. . . . . .
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Individually. Ea. 99c

69c

1015	2490	2855	3150	4395	5820	6473.3	7350	7625	7860	8083.3	8310	8550
1110	2495	2860	3155	4445	5825	6475	7358.3	7630	7866.7	8090	8316.7	8558.3
1129	2505	2865	3160	4450	5850	6500	7366.7	7633.3	7870	8091.7	8320	8560
1150	2510	2870	3165	4495	5860	6506.6	7373.3	7640	7873.3	8100	8325	8566.7
1195	2515	2875	3170	4535	5892.5	6525	7375	7641.7	7875	8106.6	8330	8570
1525	2520	2880	3175	4540	5900	6540	7383.3	7650	7880	8108.3	8333.3	8573.3
1900	2525	2885	3200	4580	5907.5	6550	7391.7	7658.3	7883.3	8110	•8340	8575
1915	2530	2890	3202	4610	5925	6573.3	7400	7660	7890	8116.7	8341.7	8580
1930	2535	2895	3205	4620	5955	6575	7406	7666.7	7891.7	8120	8350	8583.3
1940	2545	2900	3210	4635	5975	6600	7406.6	7670	7900	8125	8358.3	8590
1950	2550	2905	3220	4680	5995	6606.6	7408.3	7673.3	7906.6	8130	8360	8591.7
1965	2557	2910	3225	4695	6000	6625	7416.7	7675	7908.3	8133.3	8366.7	8600
2015	2560	2915	3230	4710	6006.6	6640	7425	7680	7910	8140	8370	8606.6
2017	2565	2920	3235	4735	6025	6650	7433.3	7683.3	7916.7	8141.7	8375	8608.3
2020	2570	2925	3240	4780	6040	6740	7440	7690	7920	8150	8380	8610
2025	2575	2930	3290	4785	6042	6773.3	7441.7	7691.7	7925	8158.3	8383.3	8616.7
2035	2580	2935	3300	4815	6050	6815	7450	7700	7930	8160	8390	8620
2040	2585	2940	3310	4820	6073.3	6840	7458.3	7706.6	7933.3	8163.4	8391.7	8625
2055	2590	2945	3320	4840	6075	6873.3	7466.7	7708.3	7940	8166.7	8400	8630
2060	2595	2950	3340	4845	6100	6906.6	7473.3	7710	7941.7	8170	8406.6	8633.3
2065	2650	2955	3410	4852.5	6106.6	6940	7475	7716.7	7950	8173.3	8408.3	8640
2090	2655	2960	3420	4880	6125	6973.3	7483.3	7720	7958.3	8175	8410	8641.7
2105	2660	2965	3455	4900	6140	7000	7491.7	7725	7960	8180	8416.7	8650
2125	2665		3465	4930	6142	7006.6	7500	7730	7966.7	8183.3	8420	8658.3
2130	2670	2975	3500	4950	6150	7025	7506.6	7733.3	7970	8190	8425	8660
2135	2675	2980	3510	4995	6173.3	7040	7508.3	7740	7973.3	8191.7	8430	8666.7
2140	2680	2985	3525	5035	6175	7050	7510	7741.7	7975	8200	8433.3	8670
2195	2685	2990	3640	5090	6185	7073.3	7516.7	7750	7980	8206.6	8440	8673.3
2300	2690	2995	3655	5127.5	6200	7100	7520	7758.3	7983.3	8208.3	8441.7	8675
2305	2695	3005	3680	5165	6206.6	7100	7525	7760	7990	8210	8450	8680
2320	2705	3010	3700	5180	6225	7106.6	7530	7766.7	7991.7	8216.7	8458.3	8683.3
2350	2710	3015	3760	5235	6235	7125	7533.3	7770	8000	8220	8460	8690
2355	2715	3020	3800	5245	6240	7140	7540	7773.3	8006	8225	8466.7	8691.7
2360	2720	3025	3885	5285	6250	7150	7541.7	7775	8006.6	8230	8470	8700
2365	2750	3030	3940	5295	6273.3	7160	7550	7780	8008.3	8233.3	8473.3	8706.6
2370	2755	3035	3955	5305	6275	7173.3	7558.3	7783.3	8010	8240	8475	8708.3
2375	2760	3040	3980	5327.5	6300	7175	7560	7790	8016.7	8241.7	8480	8710
2390	2765	3045	3990	5335	6306.6	7200	7566.7	7791.7	8020	8250	8483.3	8716.7
2415	2770	3050	3995	5385	6315	7206.6	7570	7800	8025	8258.3	8490	8720
2430	2775	3055	4045	5397.5	6325	7225	7573.3	7806.6	8030	8260	8491.7	8725
2435	2780	3060	4095	5435	6335	7240	7575	7808.3	8033.3	8266.7	8500	8730
2440	2785	3065	4110	5545	6340	7273.3	7580	7810	8040	8270	8506.6	8733.3
2442	2790	3070	4135	5582.5	6350	7275	7583.3	7816.7	8041.7	8273.3	8508.3	8740
2450	2795	3075	4175	5587.5	6362	7300	7590	7820	8050	8275	8510	8741.7
2455	2815	3095	4215	5645	6373.3	7306.6	7591.7	7825	8058.3	8280	8516.7	8750
2460	2825	3100	4220	5687.5	6375	7308.3	7600	7830	8060	8283.3	8520	
2465	2830	3110	4255	5730	6405	7316.7	7606.6	7833.3	8066.7	8290	8525	
2470	2835	3130	4295	5760	6406.6	7325	7608.3	7840	8070	8291.7	8530	
2475	2840	3135	4300	5775	6425	7333.3	7610	7841.7	8073.3	8300	8533.3	
2480	2845	3140	4330	5782.5	6440	7340	7616.7	7850	8075	8306.6	8540	
2485	2850	3145	4340	5800	6450	7341.7	7620	7858.3	8080	8308.3	8541.7	

FT-243

Lots of 10 or more. Ea. . . . . .
Lots of 5 or more. Ea. 39c
Individually. Ea. 49c

34c

4035	4980	5660	5773.3	5880	6273.5	6400	6725	6875	7475	7673.3	7825
4080	5030	5675	5780	5906.7	6275	6406.6	6750	6900	7506.6	7675	7873.3
4165	5205	5700	5806.7	5940	6300	6425	6775	6925	7525	7706.6	7875
4190	5300	5706.7	5840	5950	6325	6673.3	6800	6973.3	7573.3	7725	7906.6
4280	5437.5	5725	5852.5	5973.3	6350	6675	6806.6	6975	7575	7773.3	7925
4397.5	5485	5740	5873.5	6240	6373.3	6700	6825	7450	7606.6	7775	7973.3
4490	5500	5750	5875	6250	6375	6706.6	6850	7473.3	7625	7806.6	7975

CR-1A

Lots of 10 or more. Ea. . . . .
Lots of 5 or more. Ea. . . 74c
Individually. Ea. 79c

69c

6350	6510	6740	7010	7180	7670	8013	8250	8290	8374
6380	6530	6750	7020	7230	7790	8155.7	8272	8308	8392
6450	6550	6890	7160	7550	8007	8200	8284	8340	8400

FT-171

Lots of 10 or more. Ea. . . . . .
Lots of 5 or more. Ea. . . . 89c
Individually. Ea. 99c

79c

			2123	2280	2415	2630	3010.5	3500	3667.5	3825	3995	4255	5492.5
			2125	2282.5	2435	2665	3175	3510	3682.5	3870	4012.5	4280	6000
			2131	2290	2442.5	2725	3202.5	3520	3695	3880	4037.5	4310	6210
			2145	2300	2467	2780	3205.5	3550	3700	3945	4050	4345	7165
			2150	2305	2470	2835	3215	3562	3712.5	3950	4080	4350	7950
			2155	2320	2532.5	2911	3237.5	3569	3760	3955	4097.5	4360	8000
1151.8	1940	2045	2191	2340	2545	2940	3250	3570	3790	3966.5	4110	4400	9200
1562.5	2010	2065	2220	2360	2550	2967	3322.5	3580	3807.5	3970	4112	4735	9590
1738	2030	2082	2258	2390	2557	2990	3400	3637.5	3810	3975	4177.5	5200	
1746	2040	2105	2260	2405	2582	3010	3422.5	3660	3812.5	3980	4245	5225	

TERMS All items subject to prior sale and change of price without notice. MINIMUM ORDER: $2.50. All CRYSTAL orders MUST be accompanied by check, cash or M.O. WITH PAYMENT IN FULL. No C.O.D. CALIFORNIA BUYERS add sales tax. INCLUDE APPROXIMATELY 5c PER CRYSTAL FOR POSTAGE. ALL CRYSTAL ORDERS—INDICATE SECOND CHOICE FREQUENCIES WHEREVER SUBSTITUTION MAY BE MADE.

NOVICE BAND

FT-243 FUNDAMENTAL FREQUENCIES

Lots of 10 or more. Ea. **99c**
Individually. Ea. $1.25

YOUR CHOICE OF FREQUENCIES!

80 METERS 3701, 3702, 3703 through 3748 in steps of 1 KC.

40 METERS 7176, 7177, 7178 through 7198 in steps of 1 KC.

DOUBLING TO 40 METERS: 3588, 3589, 3590 through 3599 in steps of 1 KC.

SINGLE SIDE BAND—FT-241-A

Low Frequency Crystals **79c**

Lots of 10 or more. Each. . . . . .
Lots of 5 or more. Each. 89c
Individually. Each. 99c

400	442	446	450	453	456	459	463	466	470	474	477
440	444	447	451	454	457	461	464	468	472	475	479
441	445	448	452	455	458	462	465	469	473	476	480

MISCELLANEOUS & SHIP BAND FREQUENCIES

81.95	KC. Octal tube type (Used in SCR-584 & SPM-1)	$3.99
200	KC. FT-241 CR2/U	1.99
200	KC. Type DC-15 in octal tube base type holder	1.99
327.8	KC. No. D-168342. (Used in TS-102/AP)	9.95
500	KC. FT-241	1.99
1000	KC. Type DC-9, in octal tube base type holder	3.45
2000	KC. FT-243	1.99
2009	KC. DC-34	2.99
2110	KC. DC-34	2.99
2126	KC. DC-34	2.99
2142	KC. DC-34	2.99
2166	KC. DC-34	2.99
2174	KC. DC-34	2.99
2182	KC. DC-34	2.99
2182	KC. FT-243	2.99
2206	KC. DC-34	2.99
2500	KC. FT-243	1.99
2559	KC. DC-34	2.99
2567	KC. DC-34	2.99
2629	KC. DC-34	2.99
2632	KC. FT-243	2.99
2637	KC. DC-34	2.99
2637	KC. FT-243	2.99
2638	KC. DC-34	2.99
2638	KC. FT-243	2.99
2670	KC. FT-243	2.99
2647	KC. FT-243	2.99
2670	KC. DC-34	2.99
2738	KC. type 1-C	2.99
2738	KC. FT-243	2.99
2738	KC. MC-7	2.99
2891	KC. DC-34	2.99
2907	KC. DC-34	2.99
2951	KC. DC-34	2.99
2973	KC. DC-34	2.99
2977	KC. DC-34	2.99
2983	KC. DC-34	2.99
3000	KC. FT-243	1.99
3021	KC. DC-34	2.99
3023	KC. DC-34	2.99
3043	KC. DC-34	2.99
3053	KC. DC-34	2.99
3053	KC. DC-34	2.99
3088	KC. FT-243	2.99
3093	KC. DC-34	2.99
3093	KC. FT-243	2.99
3098	KC. FT-243	2.99
3103	KC. FT-243	2.99
3123	KC. DC-34	2.99
3125	KC. DC-34	2.99
3188	KC. FT-243	2.99
3193	KC. DC-34	2.99
3193	KC. FT-243	2.99
3198	KC. FT-243	2.99
3203	KC. FT-243	2.99
5000	KC. FT-243	1.99
10.000	KC. Type SR-5 Bliley, in CR-1 holder	1.99

COMPLETE SETS!

SCR-508 Set of 80 FT-241 crystals $25.00	SCR-609 Set of 120 FT-243 Xtals. $48.00
SCR-509 Set of 80 FT-243 crystals $32.00	SCR-610 Set of 120 FT-243 Xtals. $48.00
SCR-510 Set of 80 FT-243 crystals $32.00	TRC-1, TRC-3, TRC-4. . . . . P.U.R.
SCR-536 Set of 2 FT-243 crystals P.U.R.	SCR-608 Set of 120 FT-241 Xtals. $48.00

DC-34 & DC-35 CRYSTALS

Your Choice. Ea. only 99c

Pin Spacing ¾". Pin Diameter .1875".

			2240	2415	2643	2894	3161	3480	3750	3905	4055	4215	4435
			2255	2422	2665	2895	3190	3485	3760	3920	4065	4235	4440
			2258	2435	2685	2899	3201	3500	3765	3925	4080	4240	
			2275	2446	2710	2925	3270	3520	3770	3935	4085	4255	
			2280	2466	2711	2926	3279	3540	3775	3940	4090	4275	
1690	1890	2090	2295	2467	2725	2960	3280	3550	3790	3950	4095	4280	
1705	1910	2105	2300	2478	2732	2971	3297	3575	3792.5	3960	4097.5	4305	
1720	1930	2106	2315	2491	2745	2980	3311	3580	3807.5	3965	4115	4310	
1738	1950	2131	2326	2500	2764	3000	3317	3610	3825	3985	4130	4325	
1746	1970	2155	2335	2510	2775	3010	3365	3630	3830	3995	4135	4335	
1770	1990	2175	2340	2527	2776	3027.5	3385	3650	3850	4012.5	4150	4345	
1790	2010	2195	2355	2540	2807	3077.5	3390	3655	3855	4015	4155	4350	
1810	2030	2202	2360	2586	2816	3095	3395	3665	3870	4020	4175	4370	
1830	2050	2215	2375	2587	2831	3117	3412.5	3680	3885	4030	4177.5	4380	
1850	2075	2220	2390	2605	2851	3149	3422.5	3695	3890	4035	4192.5	4397.5	
1870	2082	2235	2395	2625	2853	3155	3462	3700	3895	4050	4210	4415	

U. S. CRYSTALS, INC.,

805 S. UNION AVE.,
LOS ANGELES 17, CALIF.

U.S. CRYSTALS SMASH ANNIVERSARY SALE!

100 GOVERNMENT SURPLUS CRYSTALS ASSORTED FREQUENCIES

SPECIAL PACKAGE DEAL $9.95

PACKAGE CONSISTS OF

80 . . . . . FT-243

10 . . . . . FT-171

10 . . . . . DC-34-35

IMMEDIATE SERVICE!

SAME DAY SHIPMENT!

(Shipping weight: 5¾ lbs.)

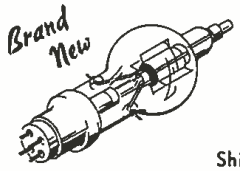
100 CRYSTALS MIXED FREQUENCIES!

AT LEAST **20** HAM BAND FREQUENCIES! TO OPERATE ON 160, 80, 40, 20, 10, 6 AND 2 METERS FOR OPERATION ON FUNDAMENTAL OR HARMONIC FREQUENCY.

With these low, give-away prices, these crystals are not subject to operational guarantee.

RK-65

PENTODE TRANSMITTING TUBE



$9.95

Shipping weight: 3 lbs.

500 WATT CARRIER OUTPUT

REQUIRES ONLY 6 WATTS GRID DRIVING POWER . . .

Operates Similar To Types 4-125A & 4-250A

	Class C Amp.	
Fil. Volts 5.0		
Fil. Amp. 14.0	Telegraphy	Telephone
Plate Voltage	3000	2500
Screen Voltage	400	—
Screen Resistor, Ohms	—	30,000
Grid Voltage	—100	—150
Plate Current, Ma.	240	200
Screen Current, Ma.	70	60
Grid Ma.	22	10
Approximate Grid Driving Power, Watts	6.0	6.3
Approximate Output Power Watts	510	380

Buy Now and Save!

Shipping wt. 29 lbs.

78-B MEASUREMENTS CORP. TEST SET

Modulation 400 and 8200 cycles. Two Bands: 15-25 MC and 190-230 MC. Operates on 117 V AC—25 to 60 cycles.

NEW CONDITION **$49.95**

LELAND ELECTRIC MOTOR

Complete with Reduction Gear Box; reduces to 60 R.P.M. Motor Rating 110/220 V AC 60 Cycles. 1725 R.P.M. ¼ h.p. BRAND NEW **$29.95**

Shipping wt. 63 lbs.

Sensational package offer of 3 RECEIVERS! Complete With Tubes & Dynamotors!

75 MC. RECEIVER
Shipping wt. 13 lbs. Used, clean. Ea. $4.95

RU-17 RECEIVER
T.R.F. Medium freq. Shipping wt. 12 lbs. Used. Ea. $2.95

ARC-5 RECEIVER
3 to 6 MC. Less dial plate. Shipping wt. 10 lbs. Used, clean. Ea. $4.95

ALL THREE RECEIVERS $8.95

Shipping wt. 41 lbs.

MISCELLANEOUS SPECIALS!

2 MFD. 6,000 V. CONDENSER. Used. Ea. $6.95
2 MFD. 5,000 V. CONDENSER. G.E. Pyranol. BRAND NEW. Each. $5.95

PLATE TRANSFORMER
American Trans. Co. INPUT: 115 VAC, 60 cycles. 525 KVA. 2240/1120 V. SEC. 500 MA. Brand new! Shipping wt. 55 lbs. **$14.95**

ZENITH MODEL DC-18-A 1,000 KC CRYSTAL
Built-in 12 V. automatic thermostatic controlled heating unit. 8-pin octal base. Ea. **$5.95**

NOTE: All orders must be accompanied by check, cash or money order with payment in full. No C.O.D. California buyers: Add sales tax. Check your postal zone and add sufficient postage. For items weighing more than parcel post limit (20 lbs.) shipment will be made via railway express freight collect.

NEW CODE PRACTICE TAPE! Reduced!
REELS NO. 10, 13, 14. Ea. 99c
PACKAGE DEAL! ALL 3 REELS. . . . $1.75
Shipping wt. 5 lbs.

U. S. CRYSTALS, INC.,

805 S. UNION AVE., LOS ANGELES 17, CALIF.

Now!

KAY-TOWNES
brings you complete

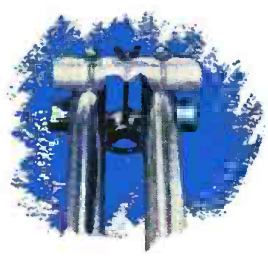
Protection from the Rear

Plus

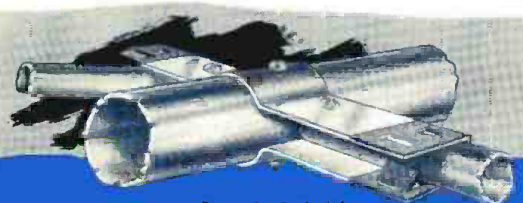
Quick Rig!

THE first SNAP-OUT ANTENNA WITH THE EXCLUSIVE DOUBLE LOCK FEATURE!

Boom also folds to take less room in storage and for ease of installation. Sure-grip mast clamp holds in gale-force winds . . . will not slip or crush.



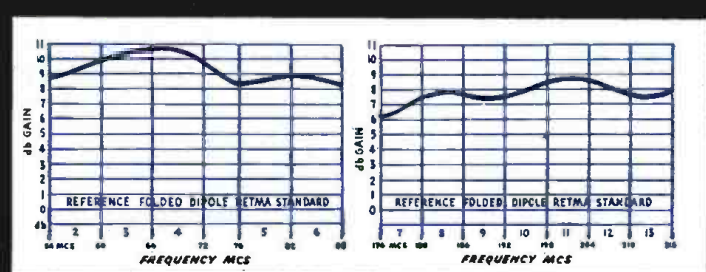
Exclusive with KAY-TOWNES Elements will not droop, sag or fold up on a Kay-Townes Antenna . . . they're nested and *double locked* in position to stay in position.



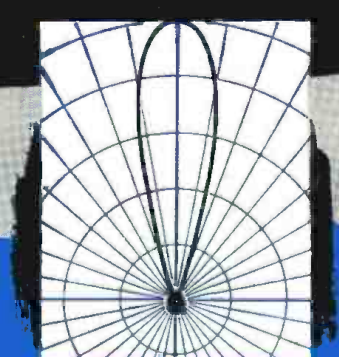
Patents applied for

New features that make the K-T "REAR-GUARD" America's most advanced TV Antenna!

- ★ *Completely Preassembled, it's mechanically safe!*
- ★ *It snaps in place to stay in place! Elements are double locked in position! A K-T Exclusive!*
- ★ *No bolts or nuts to tighten on elements!*



Front to back ratio is better than 25/1 forward lobe 30° or better standing wave ratio 1.2:1 average.

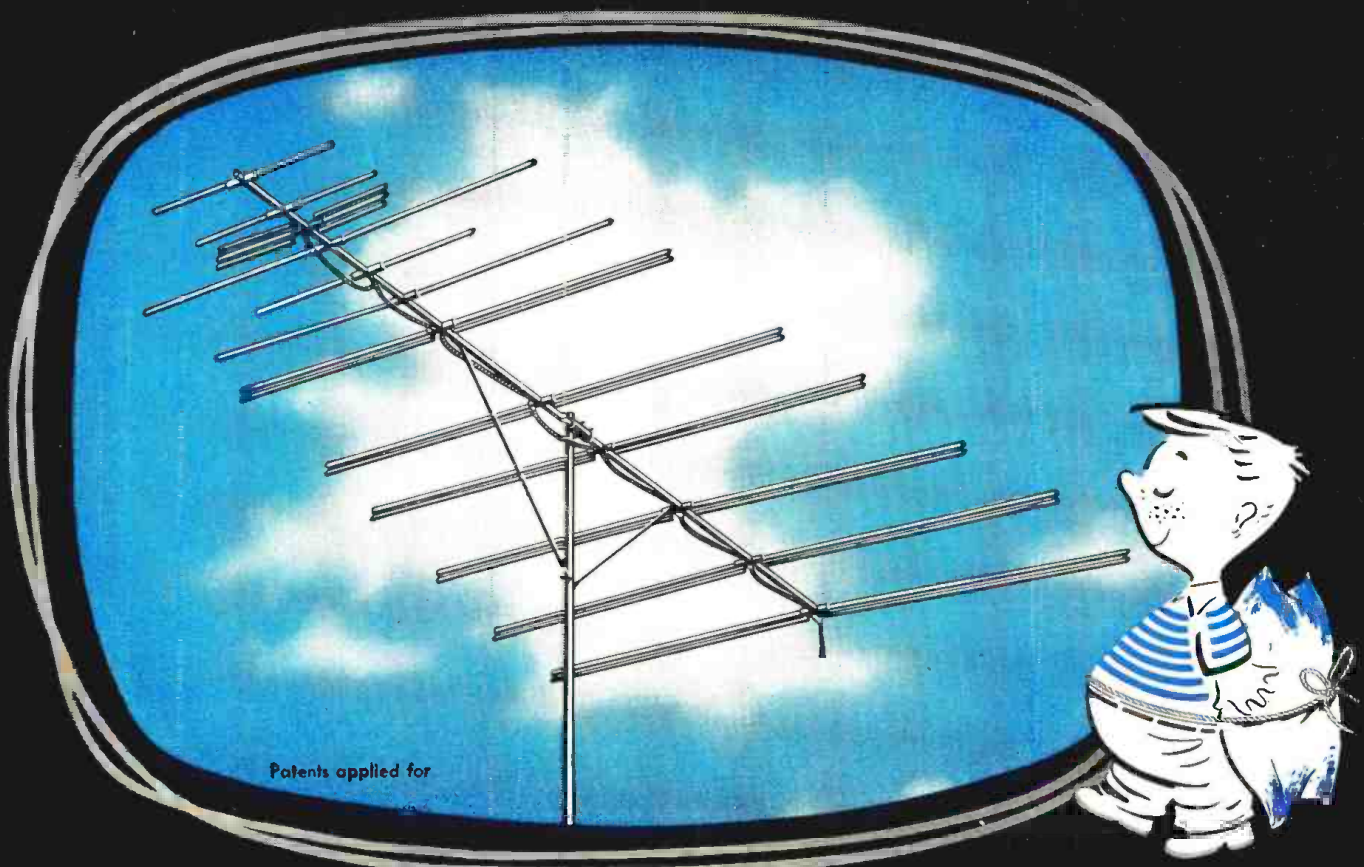


CHANNEL 2 THROUGH 13
RADIATION CURVE
REPRESENTING ALL
VHF CHANNELS
Over 20 to 1 ratio on ALL Channels

For Quality . . .

Manufactured
and distributed
in Canada by
Delhi Metal Products, Ltd.
Delhi, Ontario

REAR GUARD



THE ANTENNA DESIGNED TO REJECT UNWANTED SIGNALS FROM REAR AND SIDES!

In areas where many local stations or stations from near-by cities interfere with reception, ordinary antennas cannot filter out unwanted signals from sides and rear . . . *BUT* the KAY-TOWNES REAR-GUARD, with a front to back ratio far in excess of 20 to 1, is designed for *this* particular job . . . to give quality reception even in problem areas.

Add to the REAR-GUARD'S pin point selectivity such *exclusive* K-T features as double locked and nested elements that cannot droop or sag, Sure-Grip Mast Clamp that holds in gale-force winds without slipping or crushing, extra rigid construction and wood dowel pins and crimped ends that relieve metal fatigue due to vibration . . . they all add up to *America's most wanted TV Antenna.*

. . . for Performance look to KAY-TOWNES!

The First Name in TV Antennas

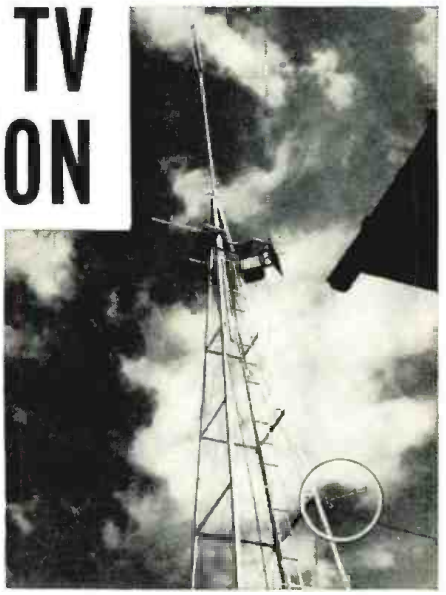
KAY-TOWNES

ANTENNA COMPANY

BOX 593B, ROME, GEORGIA

Use the K-T Line of television accessories

"SATELLITE" TV TRANSMISSION SYSTEM



The 60-foot tower used to mount Sylvania's "satellite" TV antennas. The structure carries a microwave receiving dish, a u.h.f. (channel 82) transmitting antenna, and two channel 22 receiving antennas for feeding television receivers in the laboratories.

A RESEARCH program, originally designed to provide the answers to some of the u.h.f. transmission and reception problems, shows promise of "paying off" in the low-cost TV station field.

Sylvania Electric Products Inc. of Emporium, Pa. has successfully developed an experimental "satellite" TV transmission system which is designed to provide video reception in areas where good signals are now blocked by mountains, hills, etc.

Under the satellite system of television, transmitted signals are picked up from one or more distant television stations. Those signals are amplified by the satellite station, and then are re-transmitted on a different television channel.

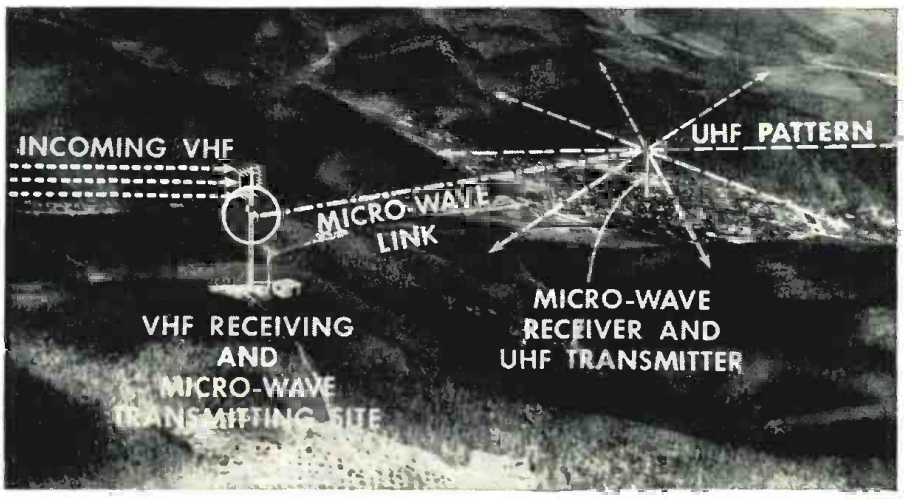
As a result of this successful experimentation, *Sylvania* some time ago petitioned the FCC to adopt rules, regulations, and standards for satellite TV broadcast stations.

At the present time the company has a satellite system in operation at Emporium, a hilly community of 3600 population in north-central Pennsylvania. The antenna is fixed 1000 feet above the community and 1½ miles, line-of-sight, from the town proper. Transmission equipment was installed and, with FCC approval, the first unattended satellite operation of experimental KG2XDU began transmitting to Emporium.

Since the original station was set up two years ago, the station has made direct off-the-air pickups of the regular broadcast signals on experimental u.h.f. satellite channel 22. Since March 1953, *Sylvania* has also operated a second u.h.f. satellite station in downtown Emporium (KG2XEL operating on channel 82), which, *via* microwave beam from the tower on the hill, has rebroadcast the programs from WJAC-TV. Occasionally, programs of WBEN-TV (Buffalo) and WFBG-TV (Altoona) are rebroadcast. Both KG2XDU and KG2XEL are low-powered stations with a nominal 10-watt transmitter output.

These experiments have indicated that satellite transmitters operating with 10 watts output power and approximately 175 watts e.r.p. will provide acceptable broadcast service within a radius of six miles without any appreciable change in the interference conditions of existing stations. —30—

Sylvania's tower for its satellite TV operation in Emporium, Pa. The tower supports the channel 22 transmitting antenna, a channel 6 (Johnstown, Pa.) receiving antenna, and a microwave link transmitting antenna. The small box directly behind the parabolic antenna contains the microwave transmitter used with this satellite system.



G-C RADIO-TV SERVICE CEMENT
Repair speaker cones, voice coils, etc. Waterproof.
No. 34-2 2 oz. tube List $0.60

G-C BAKELITE CEMENT
Cement broken cabinets, knobs, panels, all plastics.
No. 32-2 2 oz. bottle List $0.85

G-C FABRIC & GRILLE CLOTH CEMENT
Cement cloth to metal, plastic or wood. Fast-drying.
No. 22-2 2 oz. bottle List $0.65

G-C ACRYLIC CEMENT
Cement Lucite, Plexiglas, other acrylics. Fast-drying.
No. 40-2 2 oz. bottle List $0.65

G-C TELEVISION TUBE KOAT
Recoat scratched or peeling picture tubes. Fast-drying.
No. 49-2 2 oz. bottle List $0.95

G-C RED-X TV CORONA DOPE
Prevents TV high voltage corona shorts. Fast-drying.
No. 50-2 2 oz. bottle List $1.20

G-C KOLOID ACRYLIC SPRAY
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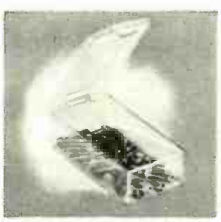

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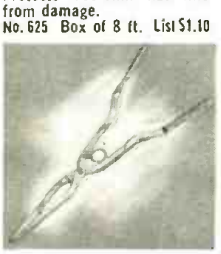

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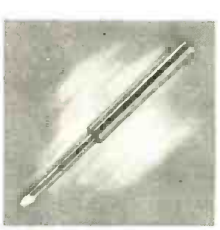

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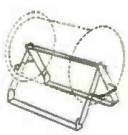

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(*Continued from page 48*)

quent wiriness in the strings and occasional transient distortion to mar an otherwise good engineering job. If you are in the mood for some light musical fare, try this recording. A little cut in the treble and a slight boost in the bass helped the NARTB curve and made the disc sound better to *my* ears. Good surfaces in my copy.

OFFENBACH
SUITE FROM BLUEBEARD
SUITE FROM HELEN OF TROY
Ballet Theatre Orchestra conducted by Joseph Levine. Capitol P8277, RIAA curve. Price $5.95.

This disc will be warmly welcomed by balletomanes who have been lamenting the non-existence of a recording of "Bluebeard," and who want a little more sonic splendor for their "Helen of Troy." Two of the most amusing ballets ever written, the music of which is full of gaiety and excitement. Dorati has expertly arranged Offenbach's scores for adoption to the ballet, with highly listenable results. "Helen of Troy" receives a better performance from Dorati in the earlier *Victor* disc, but Levine is no slouch and he has the advantage of a more modern sound. In "Bluebeard," Levine shows that deft touch, that light-handedness which endows his ballet readings with such charm and grace. Excellent sound in both ballets, with nice clean string tone and superb woodwind reproduction, especially outstanding. The RIAA curve did not need adjustment.

COOK ROAD RECORDINGS
CARIBEANA (No. 8003)
MARIMBA BAND (No. 5007)
AMERICAN STORYTELLERS (No. 5009)
CAMP HAS A BALL (No. 5005)
CALLIOPE AND CAROUSEL (No. 5010)
VOICE OF THE SEA (No. 5011)

This is a group of most unusual recordings from Emory Cook, the "Sounds of our Time" man. Recorded by Cook on travels from Maine to Mexico, it is material far off the beaten track to put it mildly! A lot of the recording was done with spring drive tape recorders, and other equipment of lesser quality than is usual with Mr. Cook. However, he is honest enough to state on the back of his amusing record jackets that the fidelity is highly variable. He uses a coding system so you can ascertain before you buy if the subject is "low-fidelity" or otherwise. Frankly, much of the material holds little interest for me, but don't let that deter you. These require subjective listening to the nth degree. I find the most listenable and interesting of the group is the "Marimba Band," "American Storytellers" and the "Voice of the Sea." The "Marimba" in this case is a 23-foot monster played by six men! In a group of traditional Latin-American scores the quite-hi-fi sound of this instrument is something to experience. In "American Storytellers" you have some rambling tales of whaling and shipwreck by a couple of real salty old "down-easters". Nothing here but voice and the atmospheric ticking of the ship's clock, but the colorful dialogue spoken and the "down-east" accent weave quite a spell. The *piece de resistance* is the "Voice of the Sea." This recording started a near riot at the N. Y. Audio Fair. Positively the greatest record for practical jokers in existence. Dig this dirty deal! . . . invite some quiet, culture-loving friends (preferably those belonging to your wife) over to your home for an evening of classical music. When they are nicely settled and

glowing from a few dollops of "Old Stepfather," furtively place the "Voice of the Sea" on the turntable of your super-Razzma-Tazz Sound System, and just as furtively, turn the gain on your 60-watt amplifier all the way up! Now watch the fun! As your friends listen attentively for the first notes of a nice quiet Mozart piano sonata, a series of terrifying blasts smite them! When you have finished scraping them off the wall, and have calmed their nerves with some more of "Old Stepfather," explain quietly to them that your amplifier didn't blow up . . . it was merely the Queen Mary's whistle sounding as she left her pier and headed to sea! Yessir, if your sound system is big enough and rugged enough, this is the doggondest sound ever. The rest of the disc has other harbor whistles and sounds of the sea, including the deafening whine of blowers in a U. S. Navy cruiser. Crazy man, crazy! The other side of the disc is devoted to the sounds of waves on different kinds of beaches, including the highly dramatic thunder of storm waves. All in all, if you can overlook possible divorce actions growing out of your playing this disc, it is quite an adventure in sound!

PROKOFIEV
ALEXANDER NEVSKY
Vienna State Opera Orchestra and Chorus, Ana Maria Iriarte, mezzo-soprano conducted by Mario Rossi. Vanguard VRS451, NARTB curve. Price $5.95.

Here is an absolutely astonishing recording, ranking in quality with the finest work being done today. If you are not familiar with this incredible score, listen to it for a thrilling experience. Those of you who know the work will be glad to learn that this is in every aspect a worthy successor to the old Ormandy-*Columbia* version. There may be those who would have preferred a new English version, but listen to this disc in the original Russian and see how much better this language is suited to the music. Ana Maria Iriarte, who did such fine work in the *Angel* "El Amor Brujo," is heard on this disc in the same role sung by Jennie Tourel in the earlier version. Miss Iriarte may not have the great power and resonance, the vocalism of a Jennie Tourel, but in beauty of tone and in dramatic expressiveness she need bow to no one. Mario Rossi seems to have a natural affinity for modern scores and, as far as I'm concerned, gives a more fluent, more cohesive reading than does Ormandy. And if Mr. Rossi's orchestra has less polish and precision than the fabulous Philadelphia, it makes up for this in spirit and enthusiasm. The old *Columbia* was a good recording for its day, but the sound on this *Vanguard* is outstanding, a veritable *tour-de-force*. From what I hear, I surmise that a variation of the microphone-suspended-over-the-podium technique has been used. The microphone employed is the new *Siemens* variable pattern condenser type, and I would guess it was set for omnidirectional pickup. This mike is similar to the *Telefunken* in characteristics, and is considered by some to be superior. One thing is very apparent . . . *Vanguard* engineers know how to get the best from this mike. Superbly clean string tone is a feature of this disc as is the super brilliant brass. Some of the brass sonorities, especially those at the beginning of the first movement, and before the "Battle on the Ice" scene are fantastic. Percussion is tremendous, very sharp and accurate. Snares, tympani, and above all . . . the bass drum, are reproduced with startling clarity. The over-all sound is very wide range, virtually distortion-free. Dynamic range is among the greatest on records. Choral work was excellent and a good balance between vocal and orchestral elements was carefully maintained. Acoustic perspective was proper for maximum "presence" with a minimum of reverberatory blur

and fusion. This recording is a prime example of the kind of quality that can be obtained by a small company willing to properly utilize the tools and techniques which are available today. There are several big companies whose recorded sound is badly in need of renovation, who could profit by this example . . . if they would bring their heads out of the political sand. This recording is unreservedly recommended.

WILLIAMS, VAUGHN
SYMPHONIES #1, #4, #5, #6
London Philharmonic Orchestra conducted by Sir Adrian Boult. London LL972/3, 974, 975, 976. RIAA curve. Price $5.95 each disc.

A few months back *London* issued its monumental limited edition of all the symphonies of Vaughn Williams. They have now made the symphonies separately available, which will be good news to all those who couldn't plunk down the $55.00 for the limited edition. I reviewed the great "Sinfonia Antarctica" last month and now will take up the matter of the remaining symphonies. The first or "Sea Symphony," one of Vaughn Williams most robust works, is also the only symphony in which he employs chorus and soloists (unless one includes the brief wordless choruses of the "Sinfonia Antarctica"). There is in fact some question as to whether the "Sea Symphony" is a symphony at all, but rather a cantata. Arguments aside, it is a profoundly beautiful work, based on the poems of Walt Whitman. The choral work of the London Philharmonic Choir is magnificent and an excellent job is done by soloists Isobel Baillie and John Cameron. The 4th Symphony is the most "modern" of Vaughn Williams' works. Violence is its theme, the anger of the composer at the senselessness of war, the motive force. A bitter and an accusing work, its almost unrelenting discord is terrifying in its passionate intensity. The 5th Symphony has peace as its theme, but paradoxically was written during the war years. Perhaps the simplest and yet the most complex of the philosophies of Vaughn Williams, it is seldom performed in this country. This in itself is strange, since the work has a great appeal and some of Vaughn Williams' most supremely beautiful writing. The finale is one of the most moving in all symphonic literature. The 6th Symphony is perhaps the best known of Vaughn Williams' works in this country. This is probably due to the championing of the work by Leopold Stokowski, and his recording of it early in the LP era. Again we have a work of violence which is, however, tempered by the quiet eerie mysticism of the finale-epilogue. I most heartily agree with Dr. Stokowski when he says, "the epilogue of the Vaughn Williams 6th Symphony is one of the great experiences in music." Once you hear it, you will never forget it. There is something basic, something elemental and almost "other worldly" in the hushed measures. Practically the whole of the epilogue is played pianissimo, getting softer and softer, until it trails off into nothingness. Needless to say, a quiet copy, and hum and hiss-free amplifier is a great asset in listening to this passage. The musicianship in the entire series is exemplary. The composer was in attendance at all of the recording sessions and perhaps in tribute to him, everyone concerned went "all out" and gave of their best. Sir Adrian's conducting is an absolute marvel, considering the musical range and complexities of these widely varied symphonies. His sense of balance is uncanny and his handling of dynamics (one of the most important elements in Vaughn Williams' works) contributes much to the success of his readings. The orchestra played as if inspired, and truly, this might have been the case. *London* has given all of these symphonies the benefit of

their best engineering. String tone has evidently been given special attention, as it is so important in these works. Really clean and wide range with none of the harsh "phony-fi" edginess. Big sonorous brass sounds and splendidly "live" woodwinds throughout the symphonies. High percussion, especially cymbals, come through with crystal clarity. Tympani and bass drum are cleanly reproduced, and the bass drum in the "Scherzo" of the 6th symphony is especially notable for its impact and realism. As you may have guessed, I am a devotee of Vaughn Williams, hence this rather long review. It takes a little time to acclimate one's self to this great composer, but once you do, his hold is extraordinary. By any and all means, try to listen with an open mind to these symphonies. I think you will find it an ultimately rewarding experience. None of the discs required curve adjustment and, generally, surfaces were good.

CORELLI
CONCERTO GROSSO IN D
VIVALDI
CONCERTO IN F
CLEMENTI
SYMPHONY IN D
Virtuosi di Roma conducted by Renato Fasano. His Master's Voice, LMHV-2, RIAA curve. Price $5.95.

It's kind of hard to keep up with the Virtuosi di Roma. They were first heard on the old *Cetra-Soria* label, then on *Decca,* and here they are on a new orthophonic *HMV*! The one thing that has remained constant, however, is their incomparable skill and artistry. On this disc they play works by three of the great Italian composers whose musical contributions are just now being realized. A virtual renascence is taking place with these composer as discoveries of much of their work is now being catalogued and published. The music here is all charm and grace, and highly listenable. Fasano has not lost his magic touch with his men, and the performances are truly miracles of tone and precision. Some of the most extraordinary string tone ever engraved on a disc. Sweet, clean, edgeless strings, very wide range and blessed with near perfect acoustics, this is the kind of string tone one wants in all recordings and which one is so seldom granted. The album is beautifully packaged and deserves mention. A beautiful full color reproduction of a Madonna and Child painted by Crivelli is included. RIAA curve was OK.

HAYDN
SYMPHONY #100
SYMPHONY #102
London Philharmonic Orchestra conducted by George Solti. London LL-1043, RIAA curve. Price $5.95.

London is once more to be commended for "upgrading" their catalogue. This disc represents a more modern sound than their earlier version with Edward Van Beinum. Of course, I am referring here to the "Military" symphony, as the previous disc had Haydn's 104th rather than the present 102nd symphony. While the 102nd receives a splendid reading at the hands of Solti and the sound is of the highest quality, it is the "Military" symphony that most people will be interested to hear. Why? Because any version of this work will inevitably be compared to one of the most famous recordings in the LP catalogue, namely the *Westminster* edition with Hermann Scherchen. At the time of issue, the *Westminster* disc was a "hi-fi" miracle. The famous tympani and triangle section of the second movement was used to demonstrate countless thousands of sound systems. Whether this percussion should be played forte, as it was in the *Westminster,* is open to debate and the controversy still

rages. I liked the disc when it was first issued. If Dr. Scherchen was wrong or right, the sound was thrilling and a refreshing change if nothing else. But time and techniques march on, and the second movement is not the whole ball of wax. On over-all quality of sound, this *London* version is certainly the best available. Much wider in range, virtually distortion-free and with superior acoustic perspective, this will probably appeal to those who like their Haydn "straight." The tympani and triangle are in the second movement all right. And they are very clean and accurate, but not obtrusive. Solti continues to amaze with his versatility. He seems equally at home and at ease with this Haydn as he is with Bartok. His reading is more graceful and free-flowing than Scherchen's and he maintains a better orchestral balance. If you don't own this work, try this and the *Westminster,* too.

SAINT SAENS
SYMPHONY #3
Hague Philharmonic Orchestra, F. Asma, organist, conducted by Willem Van Otterloo. Epic LC3077, NARTB curve. Price $5.95.

Thousands of hi-fi fans have been eagerly awaiting a new modern-sounding recording of this work. Well, here is modern wide range sound, but I'm afraid it will have little attraction for these people. You see, the old Charles Munch-*Columbia* version was one of the most famous demonstration records in the early days of LP. Principal reason for this was some extremely low organ pedal in the first movement. The hi-fi boys were pretty proud when their speaker systems would reproduce these great, but rather low-level pedals. Outside of the fact that I like the Munch reading better, this is a much cleaner, more wide range sound than the *Columbia;* but alas, and alack, no big pedals newly revealed in the richness of modern hi-fi. Whether the organist in the *Columbia* overplayed them, or the organist in this disc underplayed them; or whether the organ is not right for the same sound or the acoustics of the hall not right, the fact remains . . . they just don't sound out on this disc. However, if the pedals are not the be all-end all sort of thing with you, this recording is quite enjoyable. Strings are little wiry at times, and some distortion creeps in here and there, but these are minor annoyances. If you are not familiar with his music, I can recommend it to you for some very exciting listening. Some treble cut and bass boost helped the NARTB curve considerably.

BEETHOVEN
FIDELIO
NBC Symphony Orchestra conducted by Arturo Toscanini with Rose Bampton, Jan Peerce, Eleanor Steber. Victor LM-6025, RIAA curve. Price $11.90.

Those people who have been patiently waiting for *Victor* to release the December 1944 broadcast performance of this work will find that their wait has been most worthwhile. *Victor* has accomplished a minor miracle in making this disc quite modern sounding. Sure, you can tell that the range is restricted and dynamics not what they should be, but at least there is no dead sounding "Studio 8H" to contend with! Vocal and instrumental definition is more than acceptable. The performance needs little recommendation. It blazes with the power of a Toscanini at the height of his interpretive genius. It has been a long time since I have heard the "Leonore" overtures sound so "right." Jan Peerce and Eleanor Steber never sang better, and it is a pity Miss Bampton is so poorly represented in the LP catalogue. She had quite a voice! Those of you who have been struggling along with the old *Oceanic* recording, will find this superior in every

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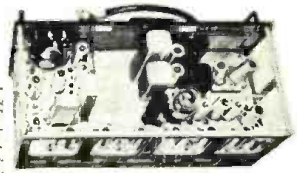

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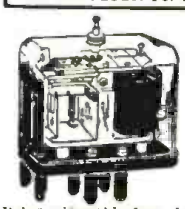

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aspect. A wonderful performance, which causes one to reflect, rather sadly, that we are nearing the end of the supply of Toscanini treasures.

BIZET
CARMEN SUITE
GOUNOD
BALLET MUSIC FROM FAUST
St. Louis Symphony Orchestra conducted by Vladimir Golschmann. Capitol P8288, RIAA curve. Price $5.95.

This is the 8th recording of the "Carmen Suite," and in most respects the best. I still prefer the Beecham reading, but Golschmann does an excellent job, and I am really splitting hairs on this choice. Soundwise this must be judged the best available, in spite of the good quality of the recent Kostelanetz, which strictly speaking is not "the suite from Carmen," but (as *Columbia* terms it) an "orchestral scenario." In the "Faust" ballet music, Golschmann has no competition whatsoever. To his excellent sense of balance and rhythm, he adds a splendid knowledge of the dynamics involved in this score. In both the "Carmen" and the "Faust," string tone is quite clean, there is some superb brass playing and reproduction, and plenty of rousing percussion of notable accuracy. The RIAA curve did not require adjustment. Typical quiet *Capitol* surfaces.

BAND MUSIC
LA FIESTA MEXICANO
WORKS BY MENNIN, PERISCHETTI, VIRGIL THOMSON, HOWARD HANSON
Eastman Symphonic Wind Ensemble conducted by Frederick Fennell. Mercury MG40011, RIAA curve. Price $5.95.

Calling all hi-fi bugs, afficionados, audiophiles, and just plain music lovers! This recording is guaranteed to separate the men from the boys. If your equipment is the McCoy, you've nothing to worry about. If your equipment is "phony-fi," watch out! Fred Fennell and his band have whipped up their greatest hi-fi storm yet. Positively awe-inspiring dynamics. Shattering percussion, especially the bells in the "Fiesta Mexicana." Huge brass sonorities and miraculous woodwind reproduction of great precision and articulation. I had a tape of the "Fiesta" at the N. Y. Audio Fair, and some of the more "gone" bugs would sit by the hour listening to it, a glazed look in their eyes. The "Fiesta Mexicana" is an extremely colorful work, based on Mexican folk material and with an absolutely fascinating Aztec derivation, employing a fabulous variety of percussion instruments. The other works are highly listenable, and receive the same meticulous attention and superb musicianship from Mr. Fennell and his extraordinary group. Nuff said! If you are a lover of the hi and the fi, this is a *must!*

VERDI
MISSA DA REQUIEM
Orchestra and Chorus of La Scala conducted by Victor De Sabata with Elizabeth Schwarzkopf, Oralia Dominguez, Giuseppe Di Stefano, and Cesare Siepi. Angel 3520-B, RIAA curve. Price $11.90.

It never rains, but it pours in this LP era. Here we have the extraordinary situation of *three* new performances of Verdi's great "Requiem" in the space of two months! In spite of the fine Toscanini performance and the praise that has been lavished on it, I am going to strike out boldly and state my preference for this *Angel* recording. If De Sabata has not the incandescence of Toscanini, his drive and energy is still more than adequate, and he has blessings not af-

forded Toscanini. For one thing, I like the soloists in the *Angel* version better than those on the *Victor*. Choral honors are about evenly divided. Toscanini has the edge with his magnificent NBC Symphony, but the La Scala orchestra is not far behind. It is in the sound department where the superiority of the *Angel* is most apparent. A remarkable recording, with beautifully clean strings, richly resonant brass. The much greater frequency response of the *Angel* is probably responsible for the much more articulate vocal sections. Schwarzkopf sounds like an "angel" (no pun intended) and Siepi's voice shows up to great advantage. The "Dies Irae" section is one of the most heart-stopping things ever recorded! The tremendous blasts of percussion, the vast energy of the chorus and the awe-inspiring dynamics are quite overwhelming.

SHOSTAKOVICH
SYMPHONY #10
New York Philharmonic Orchestra conducted by Dimitri Mitropoulos. Columbia ML4959, NARTB curve. Price $5.95.

I do not intend to discuss this work from any standpoint of ideology *versus* music. I leave that to the pedantic. I have always liked the strength and vigor of this composer's works, and this new symphony is no exception. It has all of Shostakovich's familiar devices . . . the powerful largo, the spritely scherzo and the whirlwind of his presto-finales. Much more pedal writing in this than in his other works, and this heavy bass line has been a challenge to the *Columbia* engineers who have met it quite successfully. This disc contains some of the finest sound *Columbia* has yet recorded. Splendid string tone, the frequent contrabass coming through quite cleanly. Brass is bright and punchy, percussion sharp and accurate. The dynamic range is impressive and the work is afforded nice "live" acoustics. As far as I'm concerned this recording is in every way superior to the Russian effort on *Concert Hall Society*. Mitropoulos is a wizard with complex modern scores, such as this, and he seems surer of his ground than Mravinsky, the conductor on the *Concert Hall* disc. The NARTB curve was adequate as is. Good surfaces.

Tape Review

BLOCK
BALLET CONCERTO FOR PIANO AND ORCHESTRA
PROKOFIEV
CLASSICAL SYMPHONY
Hamburg Philharmonic Orchestra conducted by Hans-Jurgen Walther with Sondra Bianco pianist. AudioVideo AV-1511, 5" reel, 7½ ips, half-track.

The first in a new series by a pioneer in the pre-recorded tape field, this is one of the best tapes I have heard from a commercial source. All the material is very wide in frequency and dynamic range. I could detect no distortion, other than an occasional overload. Tape background hiss was high enough to notice, but not really annoying. The Bloch work is quite interesting and is well played by Miss Bianco. The sound of the piano is remarkably life-like. Bright and clean, with transients reproduced better than I have yet to hear on a disc. The Prokofiev work is afforded the same splendid reproduction. Strings have that fabulous cleanness and lack of edginess which is a characteristic of their sound from tape. Unhappily, the performance of the "Classical Symphony" leaves much to be desired, but if your interest is primarily in the sound, this will suit your needs perfectly. Tape was packaged neatly, but lack of a printed leader could cause a lot of confusion. More of the new *A-V* material next month.

—30—

MANUFACTURERS' LITERATURE

The various listings presented in this section are for your convenience. The bulletins, unless otherwise indicated, are available to all our readers. For prompt attention write directly to the manufacturer for this literature.

STROMBERG-CARLSON FOLDERS

The Sales Promotion Department of *Stromberg-Carlson Company's* Sound Equipment Division, Rochester 21, New York has issued two printed pieces for audio dealers.

The colorful consumer folder, H-16, is in envelope stuffer size and illustrates and describes the complete line of "Custom 400" hi-fi components and cabinets. The second publication, S-102, is a 6-page catalogue-folder featuring the division's full line of amplifiers, microphones, speakers, housings, reentrant horns, drivers, and other packaged sound equipment items sold over the counter.

TIME DELAY RELAY

Complete details on the new *A. W. Haydon Co.* line of special time delay relays are given in the new bulletin just released by the firm.

Technical data and specifications on these motor-driven, adjustable relays are included in Bulletin A.W.H. TD500 which is available from the company at 232 N. Elm Street, Waterbury, Conn.

DYNAMOTOR DATA

A condensed catalogue covering the company's line of commercial, military, and mobile dynamotors is now being offered by *Gothard Manufacturing Company,* 2110 Clear Lake Avenue, Springfield, Illinois.

This new publication, Bulletin No. 410, contains much valuable information on d.c.-to-d.c. power conversions as provided by the various units in the line.

A copy of the catalogue is available without charge by writing to Howard B. Elder, sales manager of the firm.

SPECIAL AMATEUR CATALOGUE

Harvey Radio Company, Inc. of 103 West 43rd Street, New York 36, N. Y. has recently issued a compact 100-page catalogue designed especially for the amateur radio fraternity.

In addition to listing thousands of ham items, ranging from transmitters to solder, this booklet also carries details on multi-band antenna construction (which originally appeared in RADIO & TELEVISION NEWS), an article on mobile noise suppression, control circuits for mobile operation, and circuit details on an antenna coupler.

SIGHTMASTER HI-FI DATA

Sightmaster Corp., New Rochelle, N. Y. has released its new "1955 High-Fidelity" catalogue and unit plan program.

The "do-it-yourself" matched unit plan of the company provides an amplifier, record player with diamond needle, and deluxe speaker system for a package price. These matched units fit into each other as do all accessory items incorporated in the line.

The catalogue pictures and describes all of the items currently available in the line.

CLOSED-CIRCUIT TELEVISION

The Engineering Products Division, *Radio Corporation of America,* Camden, N. J. has just issued a 4-page folder entitled "How to Read a Blueprint at 500 Feet."

The new publication tells how closed-circuit television is applied to achieve effective work coordination and two-way visual communication between widely separated buildings.

The folder describes the simplicity and functions of the "TV Eye", a low-cost closed-circuit television system made by the company. Several applications for such a system are outlined along with details on accessory equipment required for special applications.

Copies of the folder are available from the company. Specify Form 3R2436.

CATALOGUE SHEETS

Cinema Engineering Company, division of *Aerovox Corp.,* 1100 Chestnut Street, Burbank, California has issued two new catalogue sheets for the trade.

One of the sheets covers the company's sealed resistor networks and includes descriptive and illustrative material as well as application data. The second bulletin describes the line of "PW" resistors for automation and printed wiring.

The bulletins are obtainable from the factory or the company's factory representatives.

RAYTHEON TUBE DATA

The Receiving Tube Division of *Raytheon Manufacturing Company,* Newton 58, Massachusetts has announced the availability of its new Industrial Tube Characteristics booklet.

The new publication includes details on 450 industrial type tubes comprising 17 distinct tube classes ranging from subminiature and miniature tubes to transistors. The booklet contains over 20 pages of technical data and basing information.

B-A'S NEW CATALOGUE

Burstein-Applebee Co., 1012-14 McGee Street, Kansas City, Missouri has released its 1955 catalogue covering

an extensive line of components for the dealer, technician, radio amateur, experimenter, engineer, and laboratory technician.

This 164-page publication is lavishly illustrated with photographs and line drawings of the products. A complete index facilitates location of specific components.

"BUSINESS BUILDERS"

The second edition of the "Business Builders Catalogue," an expanded issue featuring more than 50 items essential to radio and television service dealers, has been announced by *CBS-Hytron* of Danvers, Mass.

The 12-page catalogue covers all types of items from service tags to shop tools, from stationery to signs. Among the new "business builders" listed are two illuminated signs, one outdoor and one indoor, a 4-way tool, etc.

The catalogue, PA-37, is available without charge from distributors or the company direct.

STEPPING RELAY BULLETIN

Guardian Electric Manufacturing Company has announced the publication of its completely new "Stepping Relay Bulletin," P-84.

This 12-page booklet contains illustrations, dimensional drawings, technical chart data, and general information on 12 new steppers, including midget, high speed, vibration resistant, and interlock types for add-subtract, continuous rotation, electrical reset, and other applications.

Copies of the new bulletin are available from the firm at 1621 W. Walnut Street, Chicago 12, Illinois.

NEWARK CATALOGUE

A new, 196-page components catalogue has been announced by *Newark Electric Company,* 223 West Madison Street, Chicago 6, Illinois.

This listing of thousands of electronic products, components, and equipment also includes a 64-page high-fidelity section and the largest listing of electronics items in the company's 20-year history.

The catalogue is bound in varnished stock for durability. It is available free on request.

ROTATOR BROCHURE

An 8-page, 2-color brochure, complete with photographs, diagrams, and charts has just been released by *JFD Manufacturing Co., Inc.,* 6101 16th Ave., Brooklyn 4, N. Y.

The report evaluates engineering efficiency, construction, and design, of the company's "Roto-King" rotator. The brochure is available without charge. Specify form #288 when writing for this publication.

TV COIL REPLACEMENTS

J. W. Miller Company, 5917 S. Main Street, Los Angeles 3, California is now offering copies of the new "TV Technician's Coil Replacement Guide #155."

This 20-page publication cross-refer-

FIRST INDOOR ANTENNA DESIGNED FOR COLOR!

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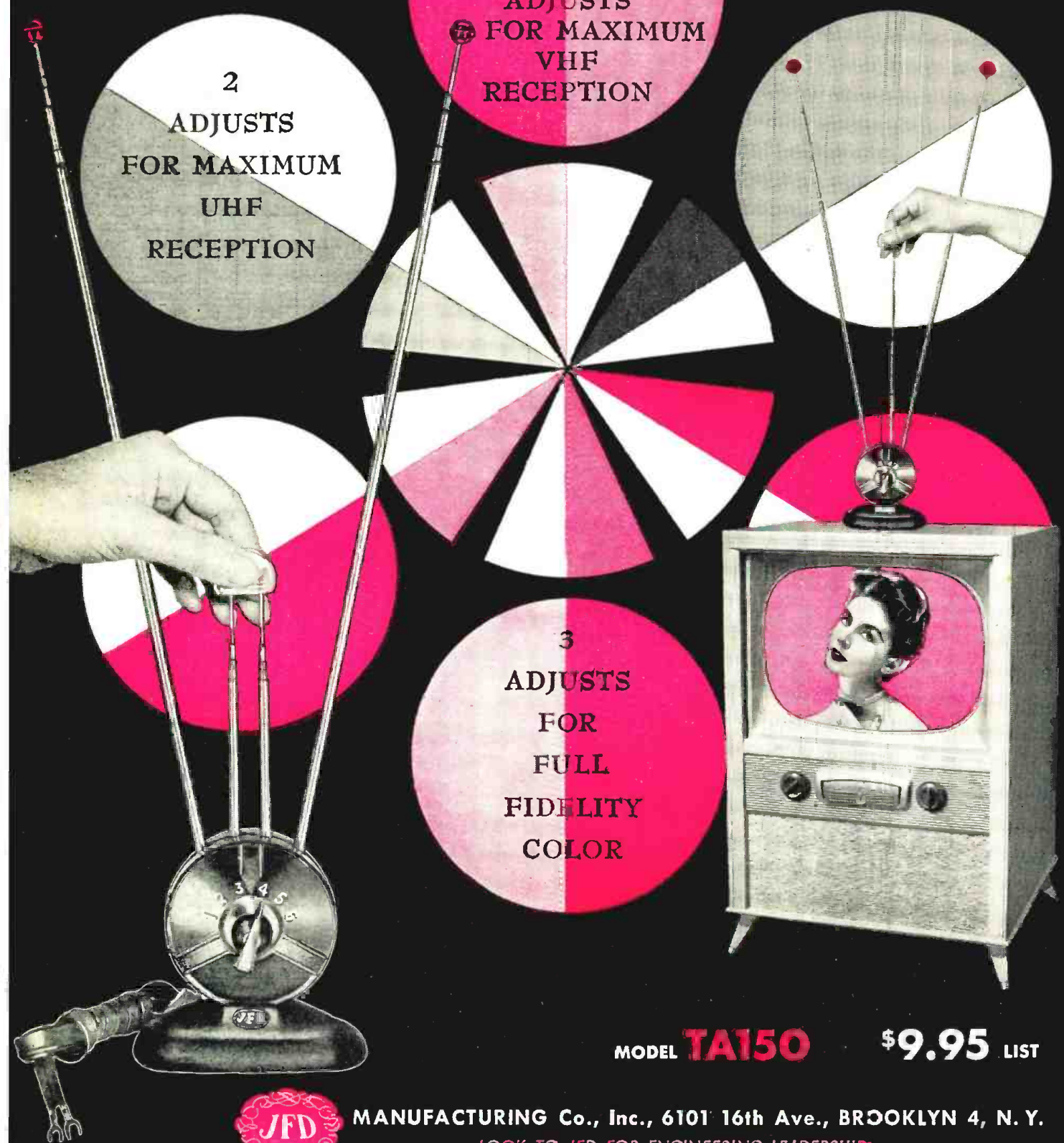


MODEL TA150 **$9.95 LIST**

JFD MANUFACTURING Co., Inc., 6101 16th Ave., BROOKLYN 4, N. Y.

LOOK TO JFD FOR ENGINEERING LEADERSHIP

ences all of the set manufacturers' coil numbers with the *Miller* replacement numbers. Included in this catalogue are listings for picture i.f. transformers, sound i.f. transformers, horizontal oscillator and sync control coils, adjustable ion traps, video peaking coils, and adjustable linearity and width controls.

The company will forward a copy of this guide without charge upon written request.

TURNER PRODUCTS

Turner Company, 900 17th Street N.E., Cedar Rapids, Iowa has announced publication of its new general catalogue covering microphones, phonograph pickup cartridges, microphone interiors, and microphone accessories.

Catalogue No. 961-A lists the names and addresses of all the company's representatives on the front cover. In addition, the publication provides detailed ordering information on dynamic, carbon, crystal, and ceramic replacement cartridges for the company's microphones.

In all, 40 models of various types and impedances are described, with stock numbers assigned for ease in ordering.

ELECTRONICS DICTIONARY

Allied Radio Corporation has announced publication of a completely-revised edition of "A Dictionary of Electronic Terms," containing over 3500 terms used in television, radio, and industrial electronics.

The new publication, edited by Gordon R. Partridge, associate professor of electrical engineering, Purdue University, answers the need for an accurate, up-to-date reference source of words used in the rapidly expanding electronics field.

Over 150 illustrations and diagrams of components, equipment, and electronic circuits are included. The book, which measures 6" x 9" and runs 72 pages, is available from the company at 100 N. Western Ave., Chicago 80, Illinois. Specify stock number 37 K 756 and enclose 25 cents to cover handling and mailing costs.

TUBE DESIGNATIONS FOR HAMS

The November-December issue of "*G-E* Ham News" carries an article on tube type designation systems for receiving, cathode-ray, industrial, and transmitting tubes as established by a joint committee of the RETMA and the NEMA.

Also included is a section on designations for germanium diodes and transistors. This material has been prepared for the radio amateur. Copies of this particular issue are available from the company's tube distributors or from the "*G-E* Ham News," *General Electric* Tube Department, Schenectady 5, N. Y.

MOSLEY BOOKLETS AND CATALOGUE

Mosley Electronics Inc., 8622 St. Charles Rock Road, St. Louis 14, Mo. has issued two new booklets of interest to the industry as well as a new general catalogue which covers its line.

The booklet, "TV Outlets and Wiring Supplies," lists and describes the company's line of TV accessories such as lead-in entrance insulators, line connectors, wall outlet plates, and wiring supplies.

The second publication, "Amateur Radio Equipment and Electronic Components", covers crystal adapters, plugs, sockets, line connectors, etc. in addition to details on the company's two- and three-element 20-meter "Vest Pocket Beams" and the new two-element 40-meter version of this antenna.

The new '54-'55 general catalogue, "TV Antenna Accessories", includes data on several new items recently added to the firm's line, including a complete series of wall outlets which provide terminal facilities for two antenna lead-ins plus rotator control terminals for four-, five-, or eight-wire cable; a new single wall plate which accommodates three separate lead-ins, and many others.

RMS INDOOR ANTENNAS

A multi-colored, 8-page catalogue devoted exclusively to its line of indoor antennas is now being offered to jobbers by *Radio Merchandise Sales, Inc.,* 2016 Bronxdale Ave., New York 62, N. Y.

This catalogue illustrates the complete indoor antenna line and includes list prices. Quantities of this catalogue, for distribution, are available from the *RMS* director of advertising.

TRIAD REPLACEMENT DATA

Triad Transformer Corporation, 4055 Redwood Ave., Venice, California has issued a new TV guide listing its replacement transformers for television use.

The catalogue recommends the company's correct replacement items for receivers made by over 100 manufacturers and covers 5800 models. Copies of catalogue TV-55 are available from the company's jobbers or the company direct.

#190 TAPE

The story of "190 Tape," the new "Extra-Play" magnetic recording tape, is contained in Bulletin 30 of "Sound Talk," available from *Minnesota Mining & Manufacturing Co.,* St. Paul 6, Minnesota.

This bulletin traces the history of the tape's development and provides physical specifications, magnetic specifications, frequency response graphs, and data on layer-to-layer signal transfer.

A copy of Bulletin 30 is available on request.

1955 HEATH CATALOGUE

Heath Company, Benton Harbor, Michigan is now offering copies of its new 1955 catalogue.

As compared to last year, the new catalogue features seven new "Heathkits," four radically redesigned kit models, and color and control knob restyling of most of the remaining instruments. In all, the new catalogue

describes more than 55 kits, including test instruments, amateur equipment, audio equipment, etc.

Numbering 48 pages, this publication contains complete technical specifications and schematics for the full line of "Heathkits".

DUBBINGS AUDIO SERVICES

A new 12-page bulletin has been issued by *The Dubbings Company,* 21-10 45th Street, Long Island City 4, New York.

Bulletin C describes the complete range of tape and disc recording services offered by the company's audio laboratory for broadcast stations, sound studios, businesses, record companies, pre-recorded tape firms, and hi-fi enthusiasts.

The bulletin covers the various types of dubbings in use, and presents price lists for small and large quantities. Included are tape recording, multiple tape duplication, disc recording, disc masters and pressings, off-air monitoring, and editing.

The company's line of audio test products is also described. These include test records, test tapes, and test level indicators.

PERMO NEEDLE GUIDE

Permo Incorporated, 6401-33 Ravenswood Ave., Chicago 26, Ill. is now offering copies of its "Cross Reference and Needle Guide" for the replacement phono needle trade.

The 12-page folder includes an illustrated index with the needles pictured and information on what cartridge each of the needles fits. The guide is complete and "industry-wide" in that the products of *Permo, Fidelitone, Duotone, Jensen, Miller, Recoton,* and *Walco* are all listed.

Copies of this handy reference are available without charge.

For your copy, write the company or contact a *Permo* distributor. -30-

GIVE YOUR THUMB A REST

By DONALD H. ROGERS, ex-W2MLF

PUSH-TO-TALK operation is one of the simplest operating conveniences that can be designed for a phone transmitter. It does have the one drawback, however, often lamented on the air, that your thumb gets tired and produces an occasional interruption of carrier by slipping off the button.

Three ways of solving this problem were found after a little casting around and experimenting. They all afford quick-change conversation, and one of them is pretty sure to suit the requirements of the average ham station.

The first way is to mount an ordinary toggle or slide switch on the handle of the microphone, instead of a push-button. It should be clamped on in a good position for the thumb of your microphone hand; a short trial will show just where. This system has the one disadvantage that the throw of the switch usually jars the microphone slightly, so that your carrier comes on the air with a ringing sound, and possibly an overmodulation peak. A little rubber padding will reduce the effect.

The second way is to use two buttons arranged in a standard motor starter circuit, as shown in Fig. 1. This circuit requires the relay which you will probably use anyway in order to limit either the current or the voltage present on the mike. It is arranged so that pressing the "Start" button momentarily closes the relay, which locks itself up through the parallel pair of contacts and stays closed until the circuit is broken by pressing the "Stop" button. The two buttons should be clamped at a convenient point on the mike stand.

The third system is to change the mechanical adjustment of your present push-to-talk switch so that it becomes a toggle switch with two positions, one each side of dead center. Fig. 2 shows a typical war surplus desk stand mike and the simple conversion required for toggle action. It has a rocking thumb piece whose leverage is transferred through a link in the stem to the contact springs below. Adding a small saddle of sheet metal at the right point on the spring as a new pivot causes the arm to go past dead center when operated. Then adding an extension on the button provides a surface to press on for return to the "Off" position. The rocking action is very easily mastered and quite convenient.

It will usually pay to connect the switch leads to the transmitter through a suitable plug, so that the mike can be disconnected easily.

Once you have used one of these systems you will never again be without the rag-chewer's delight, a push-to-talk button that stays pushed. The only thing that could beat it would be a self-pushing button. -30-

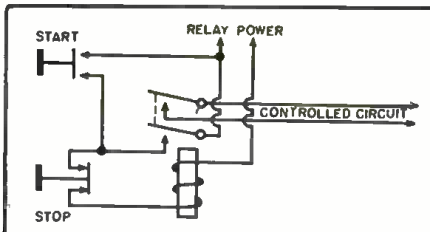


Fig. 1. One method of increasing operating convenience by installing two buttons on the mike and using a simple relay circuit.

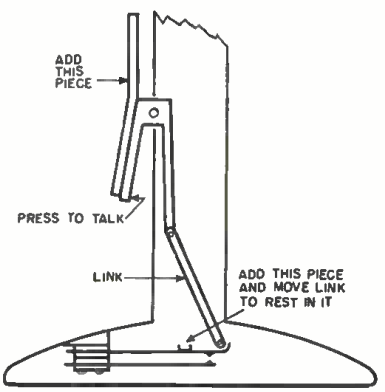


Fig. 2. A second method of improving the mike—one involving mechanical changes.

Add One More Band

(*Continued from page 53*)

coils, connect a fairly heavy piece of copper braid, with a copper plated alligator clip at the end. This braid should be long enough to reach the extreme end of either coil. Now, finish assembling the antenna, installing the top section and the can, if one is used. The coils are now ready for checking and tuning.

This modification should have no appreciable effect on the performance of the original coil. This may be easily checked. Attach the alligator clip to the bottom screw on the lower coil; this shorts out the lower coil, and permits the top low-frequency coil to operate normally. Turn on the transmitter and check the loading. If the system loads much differently than before the lower coil was added, check continuity through the system, and check to make certain all connections have been made as prescribed. When satisfied with the operation of the original coil, proceed to tune the new high-frequency coil. Attach the alligator clip to the top of the low-frequency coil—in the case of the "canned" *Master-Mobile* type coil, the bottom of the can is already connected to the top of the coil, and makes a convenient point for this connection. This shorts out the upper coil. Now, with the transmitter operating on the band for which the new coil was wound, carefully prune the coil, one turn at a time, until the transmitter starts to load properly. When the point has been reached where the loading is beginning to increase, try adjusting the turns spacing to complete the loading, for a point will be found where the removal of one more turn might be one turn too many!

That's all there is to it. To change bands, it is only necessary to change the alligator clip from the end of one coil to the other. With this coil, on 20 meters, under a 75-meter *Master-Mobile* coil, and a 20 watt transmitter in the car, some surprising reports have been had from Canada while operating along the Overseas Highway through the Florida Keys, and the writer works KZ and other Central American stations as readily as any W contacts are made. From the standpoint of low cost, ease of construction, and efficient operation, you'll not find any easier way to add one more band to your mobile antenna!

Some experimenters frequently experience considerable difficulty in getting their mobile antennas to load on one or more bands, although they may load well on others. This can usually be traced to the fact that the coax transmission line is of such a length that it acts as a ¼ wave transformer, which will be the case if the line is near any odd multiple of a quarter wave long. Since mobile whips are quite low impedance, and most mobile transmitter output circuits are de-

signed to work into low impedance loads, a step-up transformer between transmitter and antenna will effectively prevent loading.

In cases where difficulty is experienced, the length of the coax should be checked. A quarter wavelength of coax line can be found from the formula:

Line length (in inches) = 1948/*f (in mc.)* A coax line which figures within a foot or so of any odd multiple of this value, on any band which you intend to work, should be carefully avoided. -30-

Limiting Amplifier

(*Continued from page* 63)

a certain fraction of the output voltage and is re-inserted in the cathode circuit of the first stage. The actual fraction is determined by the proportions of the resistor making up the voltage divider consisting of the series 30,000 ohm resistor and the 1500 ohm cathode resistor. Roughly 5% of the output voltage to ground appears at this cathode. Since the feedback voltage must not exceed the cathode-to-ground voltage of the stage in which it is inserted, this fraction cannot exceed approximately 3 volts. Thus the source used to derive this fraction cannot then exceed approximately 60 volts. The output consists of the total of both halves, so there is then effectively a maximum of 120 volts peak-to-peak available. The gain of the following speech amplifier or modulator should be adjusted so that less than 55 volts r.m.s. sine wave is required to completely modulate the transmitter.

The meter circuit is similar to the usual bridge type, upward-reading "S" meters used on communications receivers. It is so connected that it will swing upward when the plate current on the 6L7 tubes decreases with limiting action. This indicator should be calibrated and adjusted so that with 10 db of measured compression, it will read half scale. Actual compression is the measured difference in change of level occurring in the output for a given change in input level. For instance, if the input level is raised 20 db and the output level increases only 15 db, the unit has gone into 5 db of compression. This meter sensitivity is adjustable by means of R_{21} and R_{25}. The two adjustments interlock, so that changing the sensitivity by adjustment of R_{25} necessitates a re-adjustment of R_{21} to set the electrical zero scale when the unit is not under compression. The resulting scale will be nearly logarithmic in nature.

The unit is housed in a small cabinet that can rest on the operating table next to the receiver. The power supply is mounted remotely along with other supplies in the transmitter so no trouble would be experienced with hum induction from the transformers and chokes.

Parts layout is not critical but should follow conventional wiring practice and

placement of parts typical of audio amplifiers. It is advisable to keep lead lengths short.

All resistors in the push-pull stages should be accurately matched with an ohmmeter as closely as possible. Substitute values may be used for those shown if the exact resistor values are unobtainable except in the case of certain resistors so indicated in the parts list. In general, however, the values chosen should not depart more than 20% from the values given and in particular no substitutions should be attempted that will drastically affect the feedback loop. Deviations in this part of the circuit will create distortion characteristics that are unpredictable and will affect circuit stability. Operating voltages should be adhered to exactly. For slightly different supply voltage, adjust the operating circuit voltages to the same *percentage* of the total supply voltage available.

Tubes should be chosen, for exact match, with a transconductance tube checker. The 6L7 tubes in particular should be chosen for the same gain characteristics for each corresponding control grid.

A power supply of extremely low source impedance is required, preferably regulated. Common coupling from a supply of high source impedance will result in a low-frequency oscillation having a repetition rate of about 1 cps or longer. A suggested regulating arrangement is shown in Fig. 6.

For proper operation, the initial adjustment to be made after the circuit voltages have been proportioned to the values shown, is that of the proper adjustment of the balance control in the cathode circuit of the 6L7 tubes. This resistor, R_1, is to provide dynamic balance so that control surges will not appear as thumps in the output. At extreme settings or with poorly matched tubes it is possible that the amplifier will oscillate. Through a suitable voltage divider, arrange to sample about 1 volt of 60-cycle a.c. from the 6.3 v. heater supply. With one side grounded, put this test voltage on the plate pin of V_9 or on the secondary center tap of T_1, whichever is more accessible. Simply adjust R_1 for minimum output of the limiting amplifier. After completing this adjustment, remove the test voltage. This adjustment may require touching up from time to time as the tubes age.

Finally, as discussed previously, the speech waveform polarity should be observed throughout the system so that (1) the peaked side of the wave goes through the limiter on the uncontrolled side of the amplifier, *i.e.*, the part of the wave having the shallow side most consistently should be the one that feeds through the half-wave control rectifier. This is done simply by selecting the correct choice of polarity of the microphone leads. (2) The peaked side of the wave after compression should be polarized so that it modulates the transmitter in the *upward* direction. This is done by revers-

ing the connections to one winding of the modulation transformer, if necessary. These polarities can easily be seen in a scope presentation by observing the audio waveform while sounding a vowel such as "Oh" or "Ah," which are excellent test units for checking the limiting amplifier.

In use, the output gain control sets the absolute modulation percentage of the transmitter. An input volume control in the microphone preamplifier stages of the speech system will set the input level to the compressor and thus determine the amount of compression that takes place. If the microphone preamplifier is arranged to suppress the low frequencies and emphasize the speech frequencies, it will be possible to take advantage of as much as 20 db of indicated compression without any ill effects. With flat amplification it will be necessary, or at least advisable, to limit the indicated compression to only 10 db.

This circuit will compress up to better than 30 db without distortion and the output rise is less than 1 db at 30 db of compression, or a control ratio of better than 30 to 1 for any level above the threshold point.

EDITOR'S NOTE: *You will note that in the schematic diagram of the power supply, Fig. 6, the 6.3 volt winding is floating and is not tied to ground. In the author's model, he had one side of the filament winding grounded. This, of course, does not follow sound engineering practice because under this condition the potential between cathode and heater of V_2 would be 305 volts. The maximum rated potential is supposedly 300 volts. Again, the potential difference between the cathode and heater of V_2 is 150 volts while the maximum allowable rating in this case is approximately 90 volts. In both cases the author has not designed his unit within specified ratings. He has, however, operated his unit under the grounded condition for some 5 years and hasn't lost any tubes as yet. There is no reason to believe that anyone following his idea would run into any particular trouble.*

For good design practice, however, this should be corrected. There are several ways in which this condition can be overcome. One way would be to operate the heaters at a potential of 75 volts above ground. This would place all tubes within their ratings and would also have the added advantages of biasing the low-level heaters for hum reduction. The simplest way to achieve this condition is to return the heater winding center-tap to a point 75 or 80 volts above ground on the main bleeder. In doing this, connect a 100,000 ohm isolating resistor in series with the center-tap of the heater winding to the 75 or 80 volt point on the main bleeder.

If this suggestion is followed, it would make it necessary to obtain test a.c. voltage, mentioned under the adjustment procedure, from a separate source so that one side would be at ground potential. —30—

WHAT'S New in Radio

The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

CIRCUIT SOCKET

Methode Mfg. Corp., 2021 Churchill, Chicago, Illinois has announced the availability of a newly-designed laminated tube socket for printed circuit applications.

The sockets utilize twin wafers supporting contacts with vertical terminals which snap into individual holes in the circuit panel. This permits the printing of jumpers on the circuit panel to connect different pin positions.

The socket has particular advantages from the service and replacement standpoint, since solder connections between terminals and pads may be rapidly and individually wiped away with a pencil iron after which the socket is easily pulled from the board. Sockets are available in seven- and nine-pin types and can be used with or without tube shields.

SMALL WIREWOUND CONTROL

Clarostat Mfg. Co., Inc., Dover, N. H. has developed a small wirewound control which measures just 1⅛".

Designated as the Series 43c, this new version is distinguished from the previous Series 43 by an improved wiper arm that contacts the edge rather than the side of the resistance winding. This contact allows higher resolution, more intricate tapers, and closer tolerances in over-all resistance and linearity.

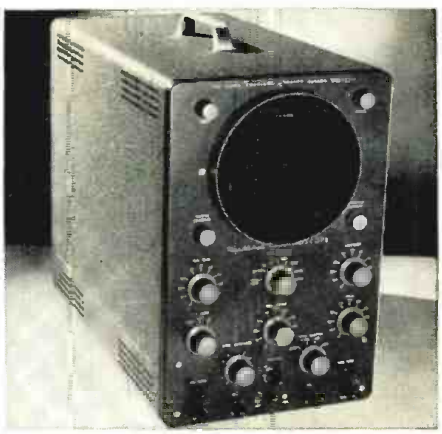
The new series is available in standard ohmages from 1 to 50,000 ohms with electrical tolerance of ± 5% and independent linearity to ± 2%. The units are rated at 2 watts and are available with taps and various tapers.

For further information, request Form No. 753805.

HEATH OSCILLOSCOPE

A new model oscilloscope, the Model O-10, has been announced by *Heath Company*, Benton Harbor, Michigan.

Designed especially for the professional service technician or engineer, the new instrument has features that make it suitable for color TV work. Vertical channel response is virtually



flat from 5 cps to 5 mc. It is down only 1½ db at 3.58 mc. (the color TV sync burst frequency).

The Model O-10 employs printed circuit boards for reduced kit construction time and stable circuit operation. It uses a full 5" cathode-ray tube and employs a newly designed linear sweep

generator circuit which will produce stable, linear sweeps up to 500,000 cps.

Full price information and technical specifications on this instrument are available on request.

"MULTIVOLTER POWER SUPPLY"

Authorized Manufacturing Company, 919 Wyckoff Avenue, Brooklyn 27, N. Y. has released a new addition to its line of service instrument tools, the Model #301 "Multivolter Power Supply."

Fitting in a pocket, tool box, or tube caddy, this unit provides a range of

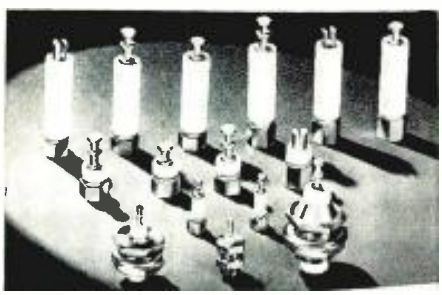
variable d.c. voltage from −135 through 0 to +135 volts as well as an a.c. range of 0 to 135 volts. An added feature provides one ampere of 6.3 filament voltage at separate terminals. A neon indicator provides indication of current output, extinguishing when 20 ma. is drawn.

The instrument is housed in a molded phenolic case which measures 3¾" x 6¼" x 2" with an anodized aluminum panel. It also comes with a *UL*-approved line cord.

NEW ERIE PRODUCTS

Erie Resistor Corporation. Erie, Pa. has announced that the complete line of its "Teflon" products is now available at distributors.

These "Chemelec Teflon" products include stand-off and feed-through in-



sulators, miniature tube sockets (seven- and nine-pin in "Teflon" and "Kel-F"), crystal sockets, fifteen- and eighteen-pin connectors, and five sizes of spaghetti in three colors.

A complete catalogue and price sheet on these products is available at electronic distributors stocking these products or by writing the distributor sales division of the company.

PISTON CAPACITOR

The Electronics Division of *JFD Manufacturing Company,* 6101 16th Ave., Brooklyn 4, N. Y. has developed a new variable trimmer piston capacitor, the Model VC-13G.

The expansion piston has a traverse

motion, free from mechanical backlash, giving smooth capacitance tracking over the complete range. There is rigid grip between the piston and inner wall of the dielectric tube. As a result, this capacitor is relatively free from the effect of vibration and shock. Positive wipe, due to constant spring tension of the moving parts, assures good r.f. contact and low noise ratio, according to the company.

Voltages in excess of 10,000 volts d.c. can be withstood because the unit has a long flashover path from the outer electrode to the mounting base. Provision can be made for anti-corona protection.

Free technical bulletins on this unit are available on request.

SELENIUM RECTIFIERS

Pyramid Electric Company, 1445 Hudson Blvd., North Bergen, N. J. has announced a new design in selenium rectifiers which features edge-mounting plates providing full air circulation between plates; light, constant contact pressure which eliminates center hot spots; rigid construction eliminating loose plates; smaller over-all size per rating; and simpler mounting.

The rectifiers, which are available in all current ratings, can be used in all types of electrical and electronic

equipment, including radio and television circuits. They can be used as replacements for all existing standard rectifiers.

Complete engineering data is available from the Rectifier Sales Engineering Department of the company.

POCKET-SIZE V.O.M.

Superior Instruments Company, 2435 White Plains Road, New York 67, N. Y. is now offering a new volt-ohm-milliammeter which has 71 per-cent more scale area than the usual pocket-sized instrument of this type.

The Model 770-A is built around a 850 microampere, D'Arsonval meter of 2 per-cent accuracy. It is housed in a 3⅛" x 5⅞" x 2¼" molded Bakelite case. It has six a.c. voltage ranges, six d.c. voltage ranges, two resistance ranges, three d.c. current ranges, and three decibel ranges.

The instrument comes complete with batteries, test leads, and operating instructions.

ELECTRONIC RELAY

Servo-Tek Products Co., 1086 Goffle Road, Hawthorne, N. J. is in production on a new "ultra-sensitive electronic relay" of simplified design.

Relay action is initiated by external contact as high as one-half megohm with current as low as 1/10,000 ampere. The unit mounts on a standard 4-inch electrical connector box.

High contact pressure on the silver contacts allows conservative rating of four amperes with a choice of either opening or closing a circuit or simultaneously opening one and closing an-

other. Power input is 115 volts, 25-60 cycles, single phase. Other voltages and frequencies are available on a custom basis.

V.T.V.M. KIT

Franklin Electronics, King Street, Franklin Park, Illinois is now offering its Model FV-1 vacuum-tube voltmeter kit direct to service technicians.

The instrument features a 4½" meter for easy reading, a carrying handle which completely recesses into the top of the case to allow stacking, and smooth etched rub-proof panel on which markings remain clearly legible throughout long service.

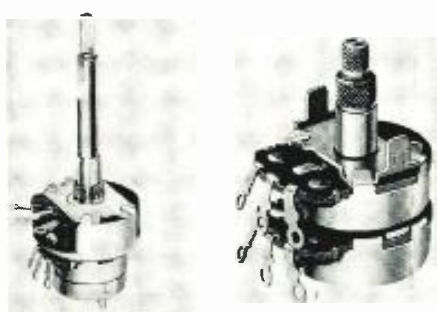
The kit includes tubes, assembly material, test leads, and detailed assembly manual.

VARIABLES FOR COLOR TV

A new line of variable resistors for all color TV applications is now available from *Chicago Telephone Supply Corporation,* Elkhart, Indiana.

The complete color TV line includes ¾" to 2½" diameter controls with wattages from 2/10 watt to 4 watts. Control types are carbon and wire-wound with and without an attached switch.

Mountings are conventional bushing, twist ear, and snap-in bracket for



printed circuits. Terminal styles are for conventional soldering, printed circuits, and wire wrap. An endless combination of tandems with both single and dual shaft is possible.

The company will supply data on the complete line upon request.

MULTI-POSITION COAX SWITCH

Barker & Williamson, Inc., 237 Fairfield Avenue, Upper Darby, Pa. is now offering a new, inexpensive, multi-position coaxial type switch which enables the operator to select antennas,

(*Continued on page* 139)

O. F. Jester

replaced with a

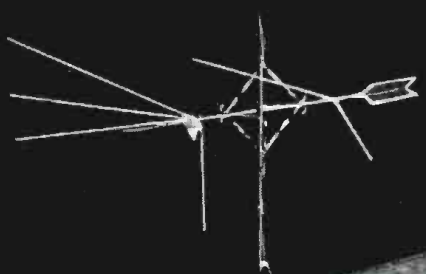
WARD TELE-VANE

Oden F. Jester, Distributor Sales Manager
Standard Coil Products Co., Inc.
Melrose Park, Illinois

Every home owner has pride in the appearance of his home—WARD Tele-Vane antennas add to the beauty of any home, add to the performance of any TV set.

Your WARD jobber has full information on how to make quicker sales and longer profit with locally promoted WARD Tele-Vanes—nationally advertised in LIFE, SATURDAY EVENING POST, BETTER HOMES and GARDENS, HOUSE BEAUTIFUL, HOUSE and GARDEN.

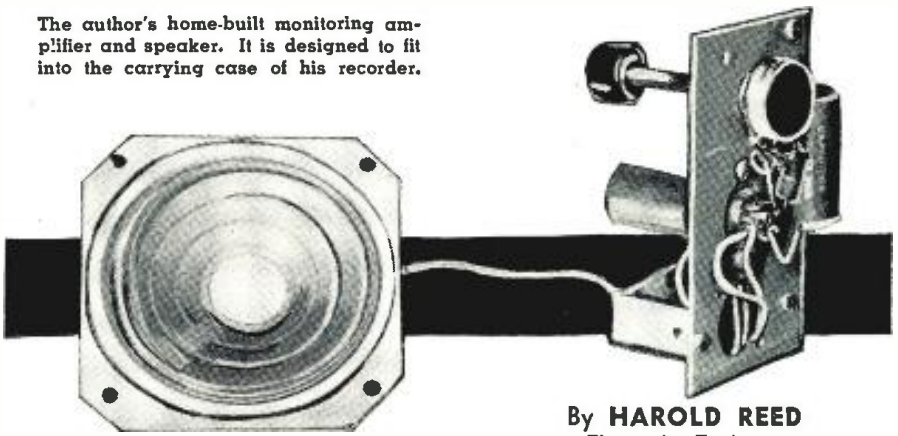
Also, conventional Ward antennas cost no more than copies of them.



WARD PRODUCTS CORPORATION, Cleveland 15, Ohio

A SINGLE-STAGE TAPE RECORDER MONITOR

The author's home-built monitoring amplifier and speaker. It is designed to fit into the carrying case of his recorder.



By HAROLD REED
Electronics Engineer
U.S. Recording Company

Details on a compact, 1-tube amplifier that is small enough to be tucked into the recorder's carrying case.

THERE are commercially available today, several good tape recorders which, although satisfactory in most other respects, have the annoying disadvantage of not being equipped with a monitoring amplifier and loudspeaker. The *Magnecord* "Voyager," PT6-VAH is an example of such equipment.

Manufacturers have several good reasons for not including these desirable items in their products. First, these recorders are built to meet a certain price level, therefore, all the advantages of costlier machines cannot be included. Secondly, these units are designed with compactness and portability in mind. Third, and this ties in with the first and second reasons, if the manufacturer included a monitor amplifier and loudspeaker he would want to meet certain specifications, similiar to those of the rest of his circuitry, particularly in the matter of low noise and distortion figures which would necessitate more than a single stage in order to obtain the necessary beneficial feedback requirements.

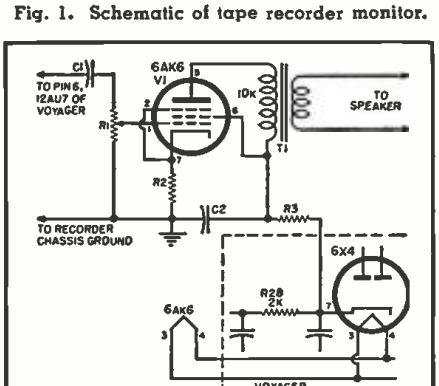
The individual electronics constructor, however, can build a monitor of the type described in this article and, keeping its limitations in mind, will find that its advantages greatly outweigh any disadvantages even though it may not be the highest of hi-fi. Its principal purpose, of course, in this case, is to eliminate the wearing of headphones when making a recording or playing back a tape for checking or editing.

This little unit was designed especially to be used with the *Magnecord* "Voyager" but, of course, could be adapted as well to other recorders. The photograph shows the experimental model constructed on a sheet of aluminum 3 by 5 inches, and the 4-inch loudspeaker used with it. The component parts can be built into a small "Minibox" and because no very low signal levels or high a.c. fields are involved the parts placement is non-critical.

The circuit diagram is given in Fig. 1. As can be seen in this schematic, a single 6AK6 pentode tube is used. The tube heaters in the "Voyager" are supplied through a selenium rectifier with 12 volts d.c., that is, all but the 6X4 high voltage rectifier tube. Heater supply for the 6AK6 which draws only 0.15 ampere was, therefore, taken off the 6X4 filament winding of the transformer. No hum pickup was encountered.

Plate and screen voltage for the

Fig. 1. Schematic of tape recorder monitor.



R1—200,000 ohm pot
R2—510 ohm, ½ w. res.
R3—6000 ohm, 1 w. res.
R2B—2000 ohm, 1 w. res.
C1—.02 μfd., 400 v. capacitor
C2—20 μfd., 250 v. elec. capacitor
T1—Output trans., 10,000 ohms to v.c.

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6AK6 was obtained directly from the 6X4 rectifier output prior to the filter section. Taking this voltage off at the input side of the rectifier filter will prevent the additional current drain of the 6AK6 from passing through the filter with the resulting greater voltage drop which would occur across the filter resistor. A separate filter section is provided for the 6AK6 by the resistor R_3 and capacitor C_2 although the filtering requirements in this case are not too great.

Signal voltage for the monitor is obtained at the plate of the 12AU7 output stage of the "Voyager" and coupled to the grid of the 6AK6 through a .02 μfd. capacitor and the 200,000 ohm potentiometer which serves as a volume control. This connection provides for loudspeaker monitoring during recording as well as playback operation. The output from the 6AK6 is coupled to a loudspeaker through T_1, a small plate-to-voice coil transformer.

Frequency response and distortion measurements were made on the "Voyager" before and after the monitor was connected. With the 6AK6 monitor in operation no deterioration in the recorder characteristics was observed.

With normal recording and playback levels the power output of the monitor is approximately 1 watt. Setting the monitor volume control to obtain ½ watt output gave ample loudspeaker output for average monitoring requirements. Although the only negative feedback available is obtained across the unbypassed cathode resistor, which contributes slightly more than 2 db, the distortion at ½ watt output is just 2%, while at 1 watt output it increases to 3% at 1000 cycles.

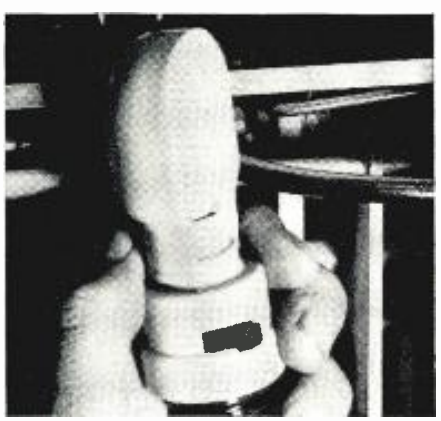
Ample space was found available in the "Voyager" carrying case for both this small amplifier and the 4-inch loudspeaker. -30-

SMALL TROUBLE LAMP

By HUGH LINEBACK
Oklahoma A & M College

A NEAT trouble lamp for lighting dark corners of equipment cabinets can be improvised by using a night-light, obtainable from the five-and-ten-cent store. Just plug the lamp into the end of an extension cord. -30-

Night-lights from the dime store make good trouble lamps for small cabinets or chassis.



What's New in Radio

(*Continued from page* 134)

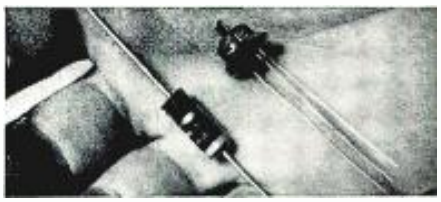
transmitters, exciters, receivers, and other r.f. generating devices using 52- or 75-ohm coaxial line.

The Model 550 is equipped with six SO239 type connectors which permits the immediate selection of any one of five 52- or 75-ohm lines. It will handle 1 kw. of modulated power with a maximum crosstalk of —45 db at 30 mc.

Housed in a 2¾" diameter aluminum case, the Model 550 is made for single hole mounting. Complete details are provided in Bulletin 550 which is available from the manufacturer.

NEW G-E TRANSISTOR

Development of a new, low-cost, fused-junction transistor has been announced by the Germanium Products



Division of *General Electric Company,* Syracuse, N. Y.

Designated as the 2N76, the new transistor was designed to cover a broad specification range so that designers and hobbyists interested in developing and experimenting with transistor circuits will have available a stable, relatively inexpensive component.

Like the other *p-n-p* fused junction types in production by the company, the new 2N76 is hermetically sealed. The transistor is developed for use in audio and ultrasonic frequency stages. It has a maximum frequency cut-off at 2.5 mc. with the design center at 1 mc.

FLYBACK AND YOKE CHECKER

Cornell-Dubilier Electric Corporation, South Plainfield, N. J. has developed a new flyback transformer and yoke checker especially for television service work.

This extremely sensitive unit can detect even a single short-circuited turn

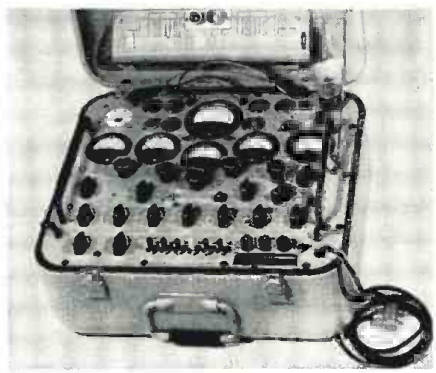
in the windings by indicating inductance change. Known as the Model BF-80, the new unit employs an oscillator circuit, a 6V6 tube, and a 4½" microammeter with separate indicator

scales for short tests, continuity tests, and yoke tests. Open-circuited conditions are also quickly detected in transformers, coils, and switches, or shorted elements in vacuum tubes. The instrument is portable and weighs only 8½ pounds complete.

CBS TUBE TESTER

The Special Contracts Division of *CBS-Columbia,* 170 53rd Street, Brooklyn, N. Y. has announced the availability of a mutual conductance and plate current electronic tube tester which has been designed especially for electronic manufacturers and laboratories.

The unit, Model VT T-1, is capable



of checking all tubes normally used in electronic work, including commercial and television types, subminiature, ruggedized, and hearing aid types. The tester has independent adjustments of plate, screen, filament, signal, and bias voltages which enables the tubes to be tested under operating conditions as determined by the circuit applications.

The VT T-1 is completely self-contained with no adapters or external meters required. It measures 17-11/16" x 15-½" x 6-13/16".

PUSH-BUTTON SWITCHES

Hetherington, Incorporated, Sharon Hill, Pa. has announced the availability of a line of small, rugged push-button switches which is suitable for a wide variety of electronic assemblies, control systems, appliances, and toys.

The new "B1000" series uses a unique precision snap-action mechanism whose fast action greatly reduces arcing and contact wear and provides for greater current-carrying capacity than the small size and low cost of these switches would indicate.

These switches are rated for resistive loads of 10 amperes or inductive loads of 3 amperes at 115 volts a.c. or d.c. Complete specifications on the switches in s.p.s.t. normally-open or normally-closed circuit arrangements are available on letterhead request to the manufacturer.

MINIATURE TUBE SOCKETS

A hermetically-sealed miniature socket which extends only 5/16" above the chassis and less than ⅜" below chassis, including solder-type terminals, has been announced by *Livingston Electronic Corporation,* Livingston, N. J.

Made in 7-pin miniature (Model

M-730) and 9-pin miniature (Model M-930) sizes, these sockets make it possible to seal components for high altitude or other uses and at the same time be able to replace tubes without

breaking the seal. Sealed chambers may be pressurized, evacuated, or filled with Silicone oil or inert gas as the sockets are guaranteed vacuum tight.

The company will supply complete specifications on request.

MINIATURE VARIABLES

McCoy Electronics Co., Mt. Holly Springs, Pa. is now offering a "Mini-Dual" variable capacitor which has been designed especially for subminiature receivers and transmitters.

The new unit has a capacitance range up to 385 $\mu\mu$fd. per section with at least a 10:1 ratio from maximum to minimum. Both rotors and both stators in the unit are isolated for greater flexibility of circuitry.

Dimensions, exclusive of shaft, are only 13/16" x 11/16" x 1-1/16". Shaft diameter is 3/16" or ¼", standard shaft length is ⅜" and the capacitor weighs ½ oz. —30—

International Short-Wave

(*Continued from page* 64)

news 2000. (Kippel, Colo.) CBUX, 6.160, Vancouver, B. C., noted with news 0100. (Cox, Dela.) Heard 1000 with weather report. (Mike Christie, Calif.) *Radio Canada* noted with German 1130-1145 over CKNC, 17.82, CKCS, 15.32; at 1500-1530 over CHOL, 11.72, CKLO, 9.63. (Schwartz, D. C.)

Canary Islands — EA8AB, 7.510A, Tenerife, noted at poor level 1520 with Spanish music, CWQRM. (Cox, Dela.)

Cape Verde Islands—CR4AA, 7.398, Praia, noted 1615 to closedown 1658. (Ferguson, N. C.; Mathieu, Mass.) Signs off with "A Portuguesa."

Ceylon — Commercial Service of *Radio Ceylon*, 9.520, noted 1114 tune-in to 1230 sign-off, good level in Manitoba. (Bulmur) Noted QSA4-5, QSB, in Sweden 1030. (Tellus Radio Club) Heard announcing 6.004 is now used instead of 6.006 in "morning" (local time) transmission. (Saylor, Va.) Heard on 17.820 at 0600. (Sanderson, Australia)

China—Radio Peking noted on 9.663A with *English* 0930-1000. (Stark, Texas, others) And parallel over 11.330. (Sutton, Ohio) Noted on 9.663A at 1745-1800 in oriental language, music; at 1800 played interval signal, had pips, and identified as "Radio Peking," followed by "Red" march. (Niblack, Ind.) *Radio Peking* opens Home Service 0355 on 9.560, parallel 9.08, 7.50, 6.23, 6.12, 6.155, 6.10, 6.015; at 0600 noted on 11.65, 11.33, 10.26, 11.83, 3.915 in parallel, with separate program on 9.04,

6.78 (latter may *not* be Peking but Outer Mongolia). (Balbi, Calif.)

Colombia—HJKH, 5.075, Sutatenza, noted 1840-1900 at strong level, all-Spanish; verified with QSL card. (Machajewski, N. Y.)

Costa Rica—TIFC, 9.647, San Jose, is good *after* 2200 to 2400 closedown; and parallel on 6.037. (Arthurs, Pa., others)

Cuba—Radio Salas, COBZ, noted on 17.810 at 1015 with classical music. (Morgan, Calif.)

Cyprus—ZJM7, 11.720, Limassol, noted with Arabic chanting at strong level, man identified with "Mahattat a Sharq-al-Adna" at 1145, and followed with news or talk in Arabic 1152-1156, then had more music. (Cox, Dela.) Heard in Australia on 6.790 at good strength to 1500 closedown. (Radio Australia)

Czechoslovakia—Prague, 7.256A, noted at good level in *English* to North America 1930-200. (Churchill, Va.; Lilly, Md.) Noted relaying Moscow 1800. (Welch, Mass.) Heard with *English* for Europe 1400-1430, starting with news, on 9.504. (Sutton, Ohio) And parallel over 7.256A. (Hardwick, N. Z.; Pearce, England)

Denmark—OZH4, 15.165, Copenhagen, noted 0940 in *English* to 1001 when went into another language session; program is *Tue., Thur., Sat.* (Ferguson, N. C.)

Dominican Republic—HI9T, 6.195A, *Broadcasting Tropical,* Puerto Plata, observed at good level but with lots of QRM 1815-1835. (Niblack, Ind.) H12T, 9.735A, noted 1900 with world news in Spanish. (Weaver, Va.) HI4T, 5.970, good 2100. (Backus, Va.)

El Salvador—YSS, 9.555, San Salvador, noted to 2310A closedown with all-Spanish sessions. (Foster, Ill.)

Fiji Islands—VRH4, 3.980, Suva, heard 0443 with concert, poor level. (Morgan, Calif.)

France—Paris heard opening on 6.200 at 0100 with fair to good level; 7.220 outlet noted around 0300 in French. (Balbi, Calif.)

French Cameroons—Radio Douala has settled down on 6.115, daily 1230-1500; *Sun.* also 0500-0600. (Mercier, France, *via WRH*)

French Equatorial Africa—Radio Brazzaville, 11.970, 9.440, noted with news 1545 and 1745 at good level. (Argus, Ohio; Marsh, Pa.; Parker, N. H., others) *Radio Chad* has been dicontinued. (*WRH*) *Radio Brazzaville's* 11.970 channel noted with news 0015-0030. (Faulk, Ala.)

French West Africa—At times, *Radio Dakar* has been noted on 4.898, parallel 4.950, around 1615, closing 1730A with "La Marseillaise;" at other times these outlets carry *separate* programs. (Cox, Dela.) A much improved signal is reported from the 11.896A transmitter since power was increased to 25 kw. Excellent around 1730. (Niblack, Ind., others) Noted opening 0200 in French on 11.896A, 9.560A, off 0330. (Balbi, Calif.)

French Morocco—Rabat, 6.006, heard 0200 in French. (Sutton, Ohio)

Germany — RIAS, 6006, Berlin, excellent with dance music 1735, announcements in German. Stuttgart, 6.030, fair 0120 with classical music, man announcer in German. (Cox, Dela.) Leipzig, 9.730A, heard opening 0200 in German. (Balbi, Calif.) AFN, 3.188, Frankfurt, noted 1800 with news. (Pearce, England) The *Overseas Service* from Cologne to North America 2030-2330 is definitely now on *three* channels—5.980 (best), 7.290, 9.735; news 2130A. (Niblack, Ind., others) Noted with news 11.795 at 0630, fair level. (Hardwick, N. Z.) And 1030 on 11.795, 9.640. (Morgan, Calif.)

Greece — *Radio Athens,* 9.607, fair level with woman in French 1230-1244A, then news in *English* to 1257; slight heterodyne noted from *Radio Free Europe* on 9.606A. (Cox, Dela.) Noted opening to Cyprus 0215A. (Pearce, England) Larissa, 6.745A, noted at fair level some days 2345-0200 sign-off with native music; at times has heavy QRM. (Saylor, Va.)

Guatemala—TGWA, 9.760, noted at strong level 1850 with music.

Haiti—*Radio Commerce,* 9.485, noted recently with religious program in *English* 0845. (Anderson, Texas) Is strong level in French from 0630A opening. (Kippel, Colo., others) Noted opening 1900 over 4VB, 6.091A, still good level 2230. (Arthurs, Pa.) *Radio Haiti* noted on *measured* 6.216 at 1803 sign-off. (Parsons, Pa.) On *Thursdays* noted ending *English* session ("Musical Caravan") at 2242A; announced in French and closed 2245. (Chamberlayne, Va.)

Hawaii—VOA relay, Honolulu, noted on *new* channel 11.890, good level 1300. (Balbi, Calif.)

Holland — *Radio Nederland,* 6.025, Hilversum, noted with *English* for North America 2130-2210. (Hartle, Pa.)

Honduras — HRN, *measured* 5.873, noted 1900-2130 with bad CWQRM and heterodyne. (Parsons, Pa.)

Hong-Kong—ZBW3, 9.525, Victoria, heard 0600 with weather report, BBC news relay, music. (Sanderson, Australia)

Hungary — *Radio Budapest,* 6.248, 9.833, noted with *English* for North America 1930-2000, 2300-2330. (Hatter, N. Y., others)

India—Calcutta, 7.210, noted 0720 at fair level, native vocal music, through ham QRM (Morgan, Calif.) Delhi noted on 11.850 opening 1830 to West Indies; should have news 1930. (Niblack, Ind.) Madras, 9.590, strong level 1202 with native music. (Cox, Dela.) Delhi noted on 21.510 at 0515 with Home Service, music. (Sanderson, Australia) Opens in *English* 0230 over 15.225, excellent level (Hardwick, N. Z.)

Indo-China — *Radio France - Asie,* 9.770A, Saigon, noted 0900 with news, fair level. (Balbi, Calif.) Heard on 7.230 with news 1830. (Morgan, Calif.) At 0500 on 15.420 with *English* program of news, music. "Voice of Vietnam," noted on 11.830A at 0600 with news in Vietnamese and music; on

15.018 at 0545 with French news and music. (Sanderson, Australia)

Iraq — HNG, *Radio Baghdad,* 11.702A, logged 1150 with native music; at 1159 man identified with "Huna Baghdad," and followed 1200-1215 with news in Arabic; faded out by 1230. (Cox, Dela.) Heard at 0015 with Arabic program of news and music. (Sanderson, Australia) Heard on 3.297 with *English* 1415-1500 closedown. (ISWL, Pearce, England)

Israel—Tel Aviv, 9.008, noted with "Voice of Zion" session in *English* 1615-1700 closedown (some days runs longer). (Machajewski, N. Y., others)

Italy — Rome, 11.810, noted with news 1240-1250. (Sutton, Ohio) Noted on 9.63 strong 0400 with news in French to 0420, then *English;* announced 6.010 as parallel in this transmission. (Balbi, Calif.) Noted to Britain-Ireland with news 1330 on 7.290. (Pearce, England) Uses 9.570A and 6.010A for *English* to North America now 1915A and 2130A. (Scheiner, N. J., others)

Ivory Coast — In verifying, *Radio Abidjan* listed 495 kc., 1 kw., and 4.945, 5 kw., 0145-0900, 1330-1630; however, has been heard with *Sun.* opening 0215. (Cox, Dela.) Is best in *eastern* U. S. around 1530-1630.

Jamaica — *Radio Jamaica,* 3.360, noted at fair level 1845. (Welch, Mass.) Heard on 4.950 at 0615 with "Wake Up, Jamaica!" session. (Chamberlayne, Va.) With news 0730. (Cox, Dela.)

Japan—Far East Network, AFRS. 11.750, Tokyo, heard with fairly good level 1630, news 1700. (Balbi, Calif.) Noted on 6.160 at 0600 with news, music. (Sanderson. Australia) *British Commonwealth Forces Station,* 6.105, Kure, tuned 0340 with religious service; ABC news relay from Australia 0400; in verifying, listed schedule of 1630-1000. (Pearce, England)

Kenya Colony—Nairobi, 4.885, noted from 1452 tune-in to 1459 when closed with "God Save the Queen." Poor level, only partly readable. (Cox, Dela.)

Kuwait—Radio Kuwait, noted 1415 when MSF, England, is off for five minutes. (ISWL, England)

Lebanon—Radio Beirut, 8.036A, noted closing 1636A. Also noted with news in Arabic read by man 0000-0015, then with native music; heavy CWQRM at times. (Cox, Dela.) Has *returned to old* 1000-1100 schedule for *English.* (Pearce, England)

Libya — Forces Broadcasting Service, North Africa (*new* call), 3.305, noted from around 1130 to closedown 1600; opens 2300 on 7.220. (Pearce, England) Location is Benghazi.

Liberia — ELBC, 6.025A, Monrovia, noted to closedown with Anthem 1846; QRM'd at times by Moscow and *Radio Nederland.* (Cox, Dela.) Uses *English.*

Malaya—BFEBS, 17.755, Singapore, logged with BBC news relay 0800 at poor level, some QSB. (Cox, Dela.) Noted on 7.120 at 1030-1045 with request recordings. (Mike Christie, Calif.) *Forces Broadcasting Service,* 5.010, noted 0820 at poor level, native musical program. (Morgan, Calif.) *Radio Malaya,* 6.025, Kuala Lumpur, noted 0900 with news by man, then music to 0930; fair signal in Ohio. (Sutton) Singapore heard on 4.820 with news 0900, good level in N. Z. (Hardwick)

Mauritius — Forest Side has been logged in Sweden around 1105 with weak level on 15.090. (Radio Sweden)

Mexico—XEFT, 9.545, Vera Cruz, noted 1900-1917 on a *Fri.* with *English*-Spanish lesson; may be other days, too; lesson prepared by BBC. (Niblack, Ind.)

Mozambique — CR7BF, 11.742AV, Lourenco Marques, noted 0015 with usual recorded program, at times solid level. (Niblack, Ind.) Noted opening 2300 with announcement for 6 a.m. (Ferguson, N. C.)

New Caledonia — Radio Noumea, 6.035, noted opening 0200 in French at good strength. (Van Vranken, Calif.)

Nigeria—Kaduna, 3.326, heard with native music 1440, weak, CWQRM. (Hardwick, N. Z.) Lagos, 4.800, is good level to 1700 when closes with "God Save the Queen." (Chamberlayne, Va., others) Is one of best signals from Africa now. (Cox, Dela.)

Norway — Radio Norway, 7.210, noted opening to North America 2000; closing 2058 when asked for reports to Radio Norway, Oslo, Norway. (Ferguson, N. C.)

Pakistan — Radio Pakistan, 15.135, Karachi, noted in 0745-0830 beam to Indonesia. (Ferguson, N. C.) Heard on 11.726A with news 2100. (Sanderson, Australia) Has *moved* to 6.235 from 9.484, parallel 7.010, for news 0945-1000. (Morgan, Calif., others)

Panama—Colon's HOLA, 9.505, noted on a *Sun.* 1630-1705 tune-out with religious program in *English;* heard another day 1805 with *English.* (Niblack, Ind.)

Peru—OAX4T, 6.082A, Lima, noted with news 2330A (Buehler, Ohio)

Philippines — DZH7, 9.730, Manila, noted at fair level with Mailbag session 1000-1030. (Daniel, Idaho) This may not be daily. Noted by Winch, Calif., in *English* 1158.

DZH2, 9.640, Manila, heard *after* 0200, fair signal; DZH9, 11.855, audible *after* 1800, weak signal, in parallel with DZH8, 15.300. (Balbi, Calif.) DZI6, 17.805, Manila, noted 2345 with organ music. (Sanderson, Australia)

Poland—Radio Warsaw, 6.025, noted in *English* 0030, good level; on 11.740 in *English* 0715, fair. (Hardwick, N. Z.) Heard on 9.555 at 0147 with *English.* (Morgan, Calif.)

Portugal—Lisbon noted on 4.880A at 1600 with identity in Portuguese and music; poor level, heavy QRM. (Cox, Dela.) Heard on 15.040A and 12.130 to 1200 closedown; noted opening 1230 on 11.996, 9.775; opening 1600 on 9.775, 11.915A (Pearce, England) Good over the 9.775A outlet 1520. (Parker, N. H.)

Roumania—Bucharest, 6.210A, noted closing with musical chimes 2030. (Buehler, Ohio) Heard on 9.254 with musical concert 1730-1750; identified

1800. (Sutton, Ohio) Heard on 5.980 with *English* 1430, weak level in N. Z. (Hardwick)

Sao Tome—CR5SC, 4.807, noted from 1530 to sign-off with "A Portuguesa" 1558A. (Cox, Dela.)

Sarawak—Radio Sarawak, Kuching, noted 0800 with news on 4.870. (Mike Christie, Calif.) Closes 05830A but *last announcement in English* is 0814A. (Morgan, Calif.)

South Korea—HLKA, 2.510, Seoul, noted 0836 with talk by man in Korean; is *improving in strength*. (Morgan, Calif.) Schedule on 2.510, 7.935 is 1530-1830, 2200-0000, 0400-1030, according to station officials; each program ends with "HLKA, Seoul, Korea." (Pearce, England)

Spain—"La Voz de Falange," Madrid, *measured* 7.378, tuned 1725 with program of Spanish music; signed off 1853 with march and "Viva Franco! Arriba Espana!" (Ferguson, N. C.) A station announcing as "Radio Salamanca" is noted opening 1500 on 6.390A. (ISWL, England)

Sweden—Radio Sweden, 9.535, good level with news 1100-1115. (Bulmur, Manitoba, others) Heard with news on 11.705 at 0700-0715. (Rosener, Ill.) Heard with *English* 1315-1330 on 9.620, then into Swedish. (Richardson, Va.) Good level on this channel 2100 in *English* for North America. (Himber, Calif., others)

Switzerland—Berne is good signal on HER3, 6.165, and HER2, 6.055 in the 2315-2400 beam to Western North America. (Arthurs, Pa.) Good over the 6.165 outlet in Eastern North American beam 2030-2215. (Backus, Va.) Berne noted on 11.865 at 1345-1415 to United Kingdom-Ireland in *English*, news 1345, fair level but with VOA QRM. (Daniel, Idaho) And on 9.665, fair level in B. C.

Syria—Damascus, 9.555, noted some days in Spanish to Latin America around 2000. Transmission runs 1900-2100. (Kinge, N. Y.) Has *English* yet 1630-1730 closedown. (Pearce, England)

Tahiti—Radio Tahiti, 7.025, Papeete, noted at fair level 0000-0130 sign-off in French. (Saylor, Va.)

Taiwan (Formosa) — BED7, *measured* 7.129, Taipeh, noted 0649 with band number, followed with oriental-

(*Continued on page* 146)

language broadcast, good signal in N.C.

BED36, 7.300, noted 0600 with National Hymn, news in Chinese, and then Western music; BEC24, 9.810V, heard 0645 with Chinese news and music; BED6, 11.920, logged 0235 with *English* session of news, music, parallel BED4, 11.736; BED26, 10.080V, checked 0430, good signal in Chinese news, music; BED32, 9.778A, heard 0500 with Western music, and then news in Chinese. (Sanderson, Australia)

Tangier — A *new* "Swedish" radio station is planned in Tangier, to open in early February; will be called "The Voice of Days" or "Pingst-Radion." (Olsson, Sweden, others) WTAN, 7.175, noted in *English* 1730; wants reports to "Voice of Tangier," British P.O. Box 219, Tangier, Morocco, North Africa. (Pearce, England)

Thailand — Bangkok's HSK9 still *measured* 11.670 despite "Down Under" sources listing it widely as on 11.690. (Ferguson, N. C.) Heard at 2330 with news and music in beam for USA. (Sanderson, Australia) After months of unsuccessful checking, finally caught this transmission around 2325, weak and with QRM. Noted opening 0430 to Thai Forces in Korea; with news 0530. (Morgan, Calif.)

Uruguay — CXA13, 6.155, *Radio Carve,* Montevideo, noted at excellent level at 1815 check. (Niblack, Ind.)

USA — WRUL excellent 1838 on 6.140, 9.585, 11.780, good on 9.700. (Chamberlayne, Va.)

USI (Indonesia)—YDF, 6.045, Djakarta, noted weak to fair with choral music 0738 in Home Service. (Cox, Dela.) YDF2, 11.770, Djakarta, noted in *English* 1400-1500 at excellent level; announces YDF6, 9.710, as parallel, but is actually then using YDF6 on 9.585 (good signal). (Hardwick, N. Z.) Djakarta is again heard on 7.250 opening 0430 in Home Service. (Balbi, Calif.) YDQ, 9.553A, Makassar, Celebes, noted 0748 with native choral music; clock chimes 0800; *signal improving.* (Cox, Dela.)

USSR—Radio Moscow noted now to North America in *English* 1800A-0100A on such channels as 6.07, 6.24, 7.13, 7.15, 7.16, 7.17, 7.20, 7.23, 7.24, 7.25, 7.27, 7.29, 7.35, 9.57, 9.66, 9.70, 9.83, 15.11; some of these are obviously satellite relays by countries within the Soviet orbit. (Machajewski, N. Y.)

Moscow, 7.230A, noted at strong level 1800-2100. (Scott, Ga.) Alma-Ata, 9.340, noted in Sweden 1000. (Skoog) Kiev, 6.020, strong level in native language by woman 0210 tune-in. (Cox, Dela.)

Vatican — HYJ, 9.646, noted with news 1000-1015, then news in Polish to 1030. (Mike Christie, Calif., others) Should be parallel over 7.280, 11.685; the 1315-1330 *English* period is now scheduled for 7.280, 9.646, 11.685, 15.120; has *English* also *Tue.* at 1100-1115 on 11.685, 21.740. (Radio Sweden)

Venezuela—YVME, 4.800A, Maracaibo, is fair level in Spanish 1900. (Rosener, Ill.) YVLK, 4.970, Caracas, *Radio Rumbos,* noted 1800-1900 with "Supper Club" in *English;* seems to have Mailbag *Thur.;* good volume in Pa. (Jones, others)

Yugoslavia — Radio Belgrade has news 1330 on 6.100, 7.200; at 1715 on 6.100. (Pearce, England, others)

* * *

Press Time Flashes

4VEH, Haiti, has been noted on *measured* 6.242 *testing* 1750-1759 when announced in *English* and asked for reports. (Ferguson, N. C.) An outlet heard on 6.780 from around 0230 with Asiatic-type programs may be Outer Mongolia; parallels Peking *only* when latter carries home news sessions. The Japanese commercial broadcasters, JOZ, 3.925, and JOZ2, 6.055, are noted *irregularly* with *English* lesson 0300-0330. (Balbi, Calif.) The Technical Staff of *Radio Nederland* has published a *new* booklet, "Improvement of Short-Wave Reception," available from Radio Nederland, Postbus 137, Hilversum, Holland. (ISWC, London)

The World Friendship Society of Radio Amateurs has just issued *new* membership certificates for both junior and senior members. This club desires more members. House organ is called "Bee-Kay." Full particulars are available from Bob Kenney, Hon. Secretary, WFSRA, c/o Mrs. S. Cain, R.R. 1, Kleinburg, Ontario, Canada.

A station noted on 11.753 at 2220 with recordings and occasional announcements in Spanish of "Radio Crystal de Guatemala," has not been fully identified; still on when tuned out 2259, good level. (Ferguson, N. C.) Latest *revised* schedule of *Radio New Zealand* is to Australia 1500-0100, ZL19, 11.830, 0115-closedown, ZL18, 9.520. To Pacific Islands 1200-0100, ZL3, 11.780, 0115-closedown, ZL7, 6.080. Closedown times are 0545 *weekdays,* 0620 *Sat.,* 0500 *Sun.* (Radio Australia)

Cologne, Germany, is carrying out *tests* to the Near East on 3.970 at 0930-1230. (ISWC, London) Latest schedule for *English* from *Radio Bucharest,* Roumania, is to North America 2200-2230, 2330-2400 on 6.210, 9.570; to Great Britain 1430-1500, 5.980, 6.210, 9.254, 9.570, and 1730-1800, 6.210, 9.570. (Hardwick, N. Z.)

Direct from station officials, Mathieu, Mass., learns that Radio Montserrat, Box 201, Plymouth, Montserrat, B.W.I., is a semi-official station, established Nov. 9, 1952; it provides (1) weekly Sunday broadcasts of a religious program and a "magazine"-type program, and (2) educational programs to school children and teachers each Wednesday during school session. It is non-commercial and is essentially a public-service venture, supervised by a Broadcasting Committee endorsed by the Government which contributes a small appropriation towards its operation. Transmitter power (unmodulated carrier power at output) is 40 watts; operates on 3.255 with satisfactory regular coverage of 50 miles, using center-fed doublet, *Sun.* 1130-1200, 1500-1530, and *Wed.* 1315-1330, 1400-1430.

Latest *announced* schedule for *Eng-*

lish from *Radio Peking* is 2200-2230, 9.665, 11.330, 11.650, 11.960, 15.060, 15.105; 0400-0430, 9.665, 11.330, 11.650, 15.060, 15.105; 0930, 9.080, 9.665, 11.330, 11.650, 15.060; some of these channels *vary in frequency*. (Morgan, Calif.) AIR, Delhi, India, is now using 9.840, 11.640 for *English* to Asia 0830-0945. (Morgan) The 9.840 channel is good level in West Virginia but with moderate heterodyne. (Boord)

WTAN, Tangier, is scheduled 0800-0830, *Sun.* 0800-0900 on 6.025; *English, Mon., Wed., Fri.* 1530-1600; French, *Sat.* 1545-1600; Czech, *Thur.* 1530-1600; Portuguese, *Tue.* 0805-0830. *Sat.* 1530-1545; German, *Tue.*, 1530-1600; Spanish 0800-0830. *Wants reports on new English session* which is daily 1700-1730 over 7.175; all "morning" programs are over 6.025 and all "afternoon" sessions are on 7.175. (Pearce, England)

A *new* station in the Canary Islands, "Radio Atlantico," has been *testing* on frequencies varying 9.427, 9.485, 9.490, around 1700-1900 closedown; another session is audible around 0900-1000; *asks for reports* to Radio Atlantico, Buenos Aires 26, Las Palmas, Gran Canaria, Isles Canarias. (Mercier, France, *via* ISWC, London; others)

* * *

Acknowledgment

Thanks for the FB reports, follows! Keep them coming to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, W. Va., USA. . . . K.R.B.

Switching

(*Continued from page* 69)

been worked out pretty carefully for the frequencies used (33 and 45 kc.). If changes are made, some experimentation may be necessary to secure best oscillator operation. Plate and screen together should draw about 36 ma., which represents just over 5 watts input. If for any reason it is desired to cut transmitter power, this is best accomplished by increasing the value of the grid resistor.

Turning to the receiver, the only problem encountered, aside from the choice of a satisfactory resonant-circuit inductor, is the fact that the relay must operate on half-cycle rectified a.c. pulses. Of course a d.c. relay can be used if filtering can be provided for it. Even an a.c. relay will chatter on make and break without the aid of a capacitor to smooth things out a bit. But beware of just slapping a capacitor across the relay winding. If you do that, as soon as the gas triode fires, the charging current for the capacitor will overwhelm it. In order to limit the charging current to a safe maximum, R_3 (see Fig. 1) must be included. Almost any plate-circuit-style relay will work in the circuit, as long as it has at least 1200 ohms resistance. If it has less than this, but is sensitive enough, you can still use it by moving the connection of one winding terminal, the upper one in the diagram, to a tap on R_3 far enough down to keep a safe 1200 ohms between line and tube. The lower the current on the 0A4G, the longer it lasts.

With these solutions to the problems mentioned, the results are all anyone could ask. Around 30 volts peak of r.f. must be applied across the control elements of the receiver gas triode in order to secure reliable operation. This seems like a pretty hefty signal to be received with no amplification, but the setup described here is capable of producing a signal ten times that large! The result is that there is ample margin of power for periods of peak line loading and for operation over long distances. There seems to be no practical limit to the distance over which control is possible, provided only that the transmitter and receiver are hooked up to the same side or "phase" of the same power company transformer. Sometimes operation can be secured across phases or even across transformers *via* the high line, but this cannot be relied upon.

There is nothing critical about actual construction of either transmitter or receivers. If you favor a portable control unit, you may like the cabinet construction of Fig. 4. Here ventilation is secured through the panel itself. Standard ⅛ in. perforated hardboard is used for the purpose. More hardboard is used for the bottom of the box, with all mounting-screw heads countersunk on the bottom side and a

piece of felt cemented over all. It is not necessary to mount the pilot light on the panel. The bulb is colored and shines brightly through the panel perforations from its more convenient mounting on the chassis-board. Things are roomy and uncluttered with the interior dimensions of 3⅛ x 5½ x 5½ inches. The cabinets shown in the photographs were built for the purpose some time ago. A small cabinet has since appeared on the market that, by coincidence, has a perforated panel and almost the same inside dimensions. It is the *Acousti-Craft* model 705B, really intended to house a small speaker.

For safety's sake, both control unit and remote units should be housed, like an a.c.-d.c. set, so that the user can touch no metal. In the case of the units described here, we add "Except *UL* approved toggle switches, which in turn touch no metal." You can mount the fuses wherever you want to. Personally, I like them in the plug. Since so many fires are started from damaged and frayed cords, one might as well protect the cords, too, while he's at it.

Remote units are shown in Fig. 1. Boxes were made by gluing wood veneer sides to rabbeted ½ in. thick bottoms. Parts are mounted on top piece cut same as bottom. Small metal boxes would work just as well; they could be covered with leatherette for safety. The coils are here mounted so that tuning slug can be adjusted from exterior with box closed. However, the best way to tune receiver circuit is by watching the glow in the tube. Tuning will normally be very broad. To weaken signal to permit sharper tuning adjustment, plug control and remote units into opposite "phases" of a three-wire power circuit. It may also be necessary to shunt or short R_2 in the remote unit in order to temporarily cut receiver sensitivity.

By the way, both transmitter and receiver coils should be operated with their slugs nearly all of the way in, in order to maintain maximum "*Q*." If it is necessary to trim tank circuits a little by juggling capacitors in order to effect this, it is worthwhile.

A portable carrier-control outfit can be a lot of fun. Take it with you on visits and trips. People are much more impressed by something being turned off and on than they are by the operation of a carrier-type intercom outfit. Radio and television have made them pretty blasé about mere communication. —30—

A SIMPLE BIAS SUPPLY

By ROBERT J. ROPES, W9PAP

THIS fully adjustable bias supply is intended to provide bias voltage for power amplifiers requiring up to 90 volts bias. This covers such tubes as the popular 807, 6146, etc.

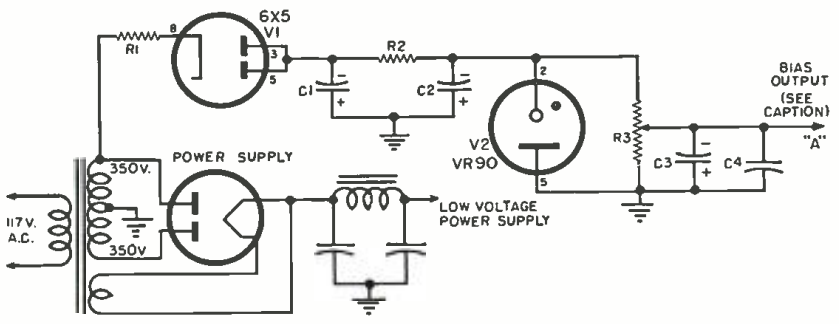
The circuit is self-explanatory, but a word of caution is in order regarding the filtering of the bias supply. Do not "skimp" on the filter here, since it is possible that the 60-cycle ripple frequency will grid-modulate the stage being biased.

A desirable feature of this supply is the ease with which it may be added to the driver supply at an additional load of only 15 ma. or so. The bias control may be set for any value of bias (up to the maximum output, of course), and thus the "static" current of the power amplifier may be left at some value which will definitely improve the regulation quality of most power supplies.

None of the values is critical; however care must be taken not to overload the power transformer. The series resistor between the 6X5 cathode and the plate transformer must be chosen to provide only enough current to ignite the VR tube, plus the 10 ma. bleeder current through the control.

Do not substitute a selenium rectifier for the 6X5 tube, as the inverse voltage will quickly ruin the selenium rectifier, and possibly the transformer winding will be damaged. —30—

Circuit diagram of the simple bias supply. Output bias is taken from point "A" on the diagram. If a lower maximum bias voltage is desired, use a VR75. Similarly, if a higher bias voltage is required, an 0B3 may be used. A VR150 can be used only if there is no danger of exceeding the transformer rating. The 5000 ohm resistor, R_1, between 6X5 cathodes and high voltage winding will have to be changed to 3000 ohms.



R_1, R_2—5000 ohm, 20 w. wirewound res.
R_3—10,000 ohm, 4 w. wirewound res. (with slider)
C_1, C_2, C_3—16 µfd., 450 v. elec. capacitor
C_4—.001 µfd., 400 v. capacitor
T_1—This need not be a special transformer. To add a bias supply, simply tap off from either side of the high-voltage secondary of the transformer used in existing low-voltage power supply. The 350 volts shown is not critical since final bias voltage can be adjusted by means of slider on R_3.
V_1—6X5 tube
V_2—VR90 tube

Radio Licensing

(*Continued from page* 52)

a separate antenna form is required. The FCC supplies this.

Therefore if you want to control a garage door or play with remote control of airplanes, etc., you apply for a simple Citizens Band license when you purchase your FCC-approved transmitter.

Commercial Licenses

It is within the commercial field that radio licenses do the most economic good for the operator. Positions as wireless operators in the Merchant Marine service now bring the operator officer status with good pay and a future, not to mention the chance to see the world. Radio operators in the broadcast service come under station engineer classification. It is possible to get a good job as broadcast engineer with no experience at all, as long as you possess a satisfactory FCC license.

In the order of simplicity these commercial licenses are:

Aircraft radiotelephone operator authorization: No written examination is required. This authorization may be obtained from Commission examining offices or from Commission authorized examiners at airports. It permits operation of radiotelephone in aircraft. You are required to know very elementary radio law, such as restrictions against profanity, false distress messages, and abuse of privilege and equipment. The examiner at the point will have such a pamphlet for study at the time you apply for authorization. He may charge you up to one dollar as his service fee.

Restricted radiotelephone operator permit: This is equivalent to the aircraft operator license, meant for use in taxicab fleets, etc. This permit is obtained by declaration rather than examination, and may be applied for in person or by mail. If requesting it by mail ask for form 756 from nearest FCC field office.

Temporary limited radiotelegraph second class operator license: This is for special cases where telegraph operation is required, but equipment adjustments are limited. No written examination is required. If the job calls for this license and applicant has held a prior license meeting certain conditions with specified prior service he may apply for this license. This may be at any FCC Field Office. While there he will be given a 16 wpm code test in code groups.

The commercial permits may be taken in sequence at your convenience. Each grade permit carries credit for its portions of the next higher grade, so that when applying for a higher grade only the additional elements of the examination need be taken. It is recommended that a study guide be obtained for thorough review before attempting any FCC exam. Then only

such elements as are required for the next higher license should be taken. This will assure you a minimum of study, with the chance of earning a certificate of accomplishment for at least some grade, rather than overdoing it, cramming for the hardest license at one time.

You may purchase Part 13 containing the "FCC Rules Governing Commercial Radio Operators" from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. for five cents. Don't send stamps! The FCC has prepared the "Study Guide and Reference Material for Commercial Radio Operator Examinations" showing the scope of questions used in commercial operator exams, but it doesn't give the answers. This may also be purchased from the Superintendent of Documents. It's far better to buy a commercial (not FCC) study guide. It will have the rules in addition to the commercial material, giving sample questions and correct answers.

Complete study guides are not cheap. If you consider them as an investment, possibly pooling your money with that of a friend or two you find it worthwhile to pay the $6.00 to $7.00 required for one of these up-to-date commercial guides. Get one printed within the last two years or it may be obsolete. Make certain the guide you select covers all the commercial radio licenses or you may find you'll have to buy another guide later.

There are no physical restrictions for operators other than minimum age of 21 years for radiotelegraph first class operator and minimum age of 18 years for aircraft radiotelegraph endorsement. In other words, the broadcast engineer who puts the station on the air Sunday morning, waking you with your radio-alarm with early morning music may be a 16-year-old high-school student working at the station part-time and weekends.

After you have purchased your study guide, concentrate on elements one and two only. These cover basic law and basic operating practice. Here is a clear-cut case of memory. Just memorize all the questions and their appropriate answers. No technical knowledge or previous training is required. When a friend can ask you the questions in elements one and two and get a reasonably correct answer from you on all the questions, proceed without delay to contact the nearest FCC Field Office for appointment to take the test.

When you arrive at the examining room you will be asked to prepare an application for Radiotelephone Third Class Operator Permit (or any other license you seek.) This can be performed in a few minutes right there. Then you will be given a sealed packet containing element one. When you sit down and open it you'll find a single sheet with ten questions. You will be required to write out the answers directly upon the question sheet. Write fully. The FCC supplies you with pen

and paper. This is the only element of the commercial exams requiring "essay" answers in full.

As soon as you finish, take your test paper to the examiner who will grade it. Up to now, you've spent an hour or less at the FCC examination room. If you've failed to pass (75% grade) you'll be cheerfully told to return after two months to try again. If you pass you'll be given element two. Go back to your desk and work.

This will take an hour or so. There will be 50 questions of the multiple choice type. Take your time. Select the answer from those given. Take only the one most correct. The partially-correct/partially-wrong answers are considered wrong. Remember to sign your name to each sheet. When you're through, take your exam sheet back to the examiner.

He will check your test in a few minutes. Wait for his answer. He'll tell you only if you've passed or failed. Generally he won't give you your exact grade. If you pass, you'll be told the permit will be sent to your home by mail. This takes a week or so.

Now go right back to the study guide and work on element three. This is harder than everything else you've studied so far. Really study. Get another radioman to help if you don't understand the theory involved. While it is possible to get by if you study and memorize the questions and answers, it is usually necessary to understand the reasoning behind the answers as well since it is unlikely that the questions will be worded exactly the same as shown in the study guide.

When you're ready, take a trip to the FCC examiner. Take your permit with you to turn in if they ask for it. Fill out the application for Radiotelephone Second Class Operator Permit. The examiner will give you element three and you're on your own.

It should take from one to three hours to answer the 100 questions. Fortunately, they are multiple choice. All you have to do is select the right answer from those given. Where you have to work out a problem, use the paper the examiner gives you. Turn in your scrap paper with the exam. If you pass, you're a licensed Second Class Radiotelephone Operator.

Go back home and study element four. This is the element that qualifies you to be chief engineer of a broadcast station so study hard. While the exam carries only 50 questions, and multiple choice at that, you'll have to work out arithmetic problems before you know which choice to make in several of the questions. When you pass you're a First Class Phone Operator.

Failure of any single element delays you only two months before you may take the test again, without penalty. Your certificate of any grade is good for five years, so you have plenty of time to take the advanced elements.

If you want to take any of the telegraph licenses you must be prepared

to take a code test first. When you've passed the 16 wpm test of code groups you take elements one, two, and five for the Radiotelegraph Third Class Operator Permit. (It's a little harder than the phone set-up.)

The next time you take only element six. That gives you the Radio-Telegraph Second Class Operator Permit. (You will be given credit for any element passed for any other current commercial permit. Thus, if you have the Radiotelephone Third Class Operator Permit you need only take the code test and element five for your Third Class Telegraph ticket.)

From Second to First Class Telegraph you take another code test, consisting of 20 code groups per minute plus 25 wpm plain language followed by element six, passing which you are awarded the coveted First Class ticket only if in addition you are:

At least 21 years of age and have had an aggregate of one year of satisfactory service as a radiotelegraph operator manipulating the key of a manually-operated radiotelegraph station on board ship or in a manually-operated coast station using c.w.

First or Second Class Telegraph Operators may take element seven as a Special Endorsement Aircraft Radiotelegraph if they desire. This covers 100 questions, multiple choice plus code test of 20 code groups per minute plus 25 wpm plain language. Applicant must also be at least 18 years old and must present a CAA Flight Officer's Certificate with other proof of aircraft telegraph experience.

First or Second Class Phone operators or Telegraph operators may take element eight as a Special Endorsement Ship Radar Techniques if they desire. This covers 50 multiple-choice questions.

FCC exams may be taken at any of the Field Offices listed in the table. In metropolitan centers like New York City the FCC offers exams daily without appointment. It's best to check first, however, since the office you want may have a definite exam schedule established.

In the amateur radio service the novice class is the simplest grade. A one-year non-renewable license is issued by mail to applicants passing a 5 wpm code test (as checked by your local volunteer examiner) and a simple examination on basic radio law. If you want an instruction pamphlet for amateur radio write: The American Radio Relay League, West Hartford, Conn. They will send you a list of their latest low-price manuals on the subject.

The technician class permits operation only above 220 mc. and is designed for amateurs interested in the technical and experimental aspects of radio. The novice class leads to this class when an additional (mailed) test on basic amateur practice and general regulations is passed.

If you have a currently valid com-

mercial radio license, visit the Civil Service Commission office nearest you (generally in federal buildings or post offices) for announcements of positions in radio operating. You may also write to the Civil Service Commission, Washington 25, D. C. For employment in private industry in the radio service write to the U. S. Employment Service, Washington 25, D. C. or to State employment offices. If you are a veteran see your local V.A. or write: Veterans Administration, Washington 25, D. C. -30-

TV Signal Tracer

(*Continued from page* 59)

fier input and connect the amplifier output into the tester through the pin jacks. Set switch S_1 so that the pin jacks connect to the horizontal plates, and leave switches S_2 and S_3 open. Touch the diode load or video amplifier output in the set under observation with the probe. The blanking pulses and video will appear on the vertical trace of the tester and will appear to be lying on their sides. This is because the amplifier output is being impressed on the horizontal plates and swept out vertically at 60 cycles per second. A slight adjustment of the vertical hold control in the rear of the tester will stop the blanking pulse or, if desired, cause two blanking pulses to be displayed. All wave shapes of the vertical sync circuit, vertical multivibrator, and vertical output can be observed with no further adjustment.

For observation of horizontal wave shapes, the amplifier output is switched to the vertical plates and switch S_3 is closed, grounding the vertical output grid. Switch S_1 is set to connect the horizontal saw-tooth to the deflection plates of the CRT. The output of the sync and horizontal circuit may now be observed. Pulses or wave shapes at 7875 cps may also be observed but now two wave shapes will appear on the trace, one superimposed on the other.

Construction Hints

If the set to be converted to a tester uses a voltage doubler circuit with a rectifier type of power supply, care must be taken in servicing a set which has the same type of power supply. Before connecting the probe ground clip, check for a.c. between the tester chassis and the set chassis with a v.o.m. or neon tester. If a.c. is present between the chassis simply reverse one of the line cord plugs.

The probe used by the author is a standard test prod with a 1000 $\mu\mu$fd. capacitor in series with about a four foot length of coax. This will be found satisfactory for any frequencies normally encountered.

By using a diode probe, the video and blanking pulses may be observed through the i.f. strip; however, since the actual picture may be observed, this feature is not needed. -30-

TIME SIGNALS AVAILABLE FROM CANADIAN SOURCES

RADIO amateur operators and others interested in obtaining accurate time signals will be interested in learning that such time signals are available from several Canadian sources, in addition to the time signals that are broadcast from the Washington Naval Observatory. Canada has four sources for these time signals: Dominion Observatory station CHU, Ottawa; the coast-to-coast Canadian network known as the Canadian Broadcasting Company (CBC); station CFH, Halifax; and the telegraph transmissions of the two railroads, *Canadian National* and *Canadian Pacific*. Details are given.

CHU Time Signals

The Dominion Observatory station CHU sends time seconds beats continuously with identifications similar to those used by the Washington Naval Observatory station, but after the hour dash, the letters "CHU Canada CHU" are sent twice in Morse Code during the first minute after the hour.

Modulation is 1000 cycles and beats are about .25-second duration. Frequencies used are 3330 kc. at a power of 0.3 kw., 7335 kc. at a power of 3.0 kw., and 14,670 kc. (14.67 mc.) at a power of 0.3 kw.

The beginnings of the beats mark the exact seconds and are reliable to a few hundredths of a second of true time. Intervals between beats are accurate to better than one-thousandth of a second. The beginning of each minute is the first beat following the long pause.

Time is controlled by quartz clocks corrected from Photographic Zenith Tube star observations every clear night. The 1000 cycle modulation is also from a crystal source.

The Canadian time signals are broadcast according to the 5-minute period coding established originally by the Naval Observatory at Washington, D. C. Identification of each minute of any 5-minute group is determined by the omission of seconds beats at the end of each minute:

1st minute—29, 51, 56-59
2nd minute—29, 52, 56-59
3rd minute—29, 53, 56-59
4th minute—29, 54, 56-59
5th minute—29, 51-59.

Alternatively, this may be shown as in the table below, remembering that the 29th second is omitted from every minute.

It can be seen that when the 51st second is omitted and 4 more beats are sent, it indicates that there will be 4 more minutes to a 5-minute interval. At the end of the 2nd minute, 52 is omitted and 3 more beats are sent, indicating that there are 3 more minutes to the 5-minute interval, etc. The end of the 5th minute has the long gap from the 51st to the 59th beats. During the first minute of each hour, the call "CHU Canada CHU" is sent in Morse Code twice in place of the seconds.

CBC Broadcast Signals

At present a network of over sixty broadcast stations, located across Canada from coast to coast, transmits time signals at 1300 hours Eastern time. This time refers to standard or daylight saving, whichever prevails at Ottawa. Seconds beats with a musical pitch of approximately 800 cycles per second commence at $12^h\ 59^m\ 20^s$ and continue to the hour.

CFH Halifax Broadcasts

CFH (115 kc. and several high frequency bands) is connected by direct wire with the Dominion Observatory for 5 minutes before 10 and 22 hours of EST each day, and transmits observatory time signals during these two intervals. The type of connection to CFH involves a time delay of about one-tenth of a second.

C.N. and C.P. Telegraphs

For two minutes each day, individually coded signals are transmitted, Canada-wide, by *Canadian National* telegraph at 1058 to 1100 hours, EST, and by *Canadian Pacific* telegraph at 1154 to 1156 hours EST. -30-

This table shows the time seconds beat plan used by station CHU, Dominion Observatory, Ottawa, Canada. Each dash represents about .25-second tone at 1000 cycles.

	Seconds Beats										
Minute	50	51	52	53	54	55	56	57	58	59	60
1st	—		—	—	—	—					—
2nd	—	—		—	—	—					—
3rd	—	—	—		—	—					—
4th	—	—	—	—		—					—
5th	—										—

Spot Radio News
(*Continued from page* 18)

nals from an aircraft communications transmitter, operating in the very-high band, was tested at the Kingman, Arizona airport. The tests were very successful, and it was therefore decided to make an exhaustive study of this technique for field-light control from aircraft, in the interest of providing such a service at airports which are unattended. The results of this survey were detailed recently and reviewed (supplemented by recommendations) in a report prepared by the Radio Technical Commission for Aeronautics in Washington.

According to RTC, the greatest potential application of the activation system appears to be for private aircraft and for the airports which they use. It is recognized, the authorities added, that in those areas where private aircraft operate extensively at night, the use of a 122.8-megacycle band (available to private aircraft) for communications could interfere with the use of the same frequency for activation. However, it was felt that the possibility of such interference could be minimized through the use of signaling codes for activating lights, and by limiting the aircraft distance and altitude from the desired airport before transmitting on this frequency.

Use of only one frequency (122.8 or 121.7 or 121.9) was desirable, the experts found, wherever the operational requirements of the users of the airport could be met. However, since air carrier aircraft are not authorized to use the 122.8 mc. band, it might be necessary to operate the activation system on this band, and either of the other two alternates to meet the operational requirements of the airports. Consequently, the RTC report said, the 121.7 and 121.9-megacycle bands should be made available to all aircraft and the 122.8-megacycle band should be set aside for private aircraft.

Analyzing the problems of interference, the report said that the activation signal should not be transmitted at greater distances from nor at higher altitudes above the airport than are required operationally. For most airport areas, a maximum distance of 10 miles and a maximum altitude of 2000 feet above the earth would suffice. Detailing system requirements and characteristics, the aircraft study said that the activation signal shall be a series of dashes of radio-frequency energy, produced by pressing and releasing the microphone button of the aircraft very-high transmitter. The radio-frequency dash duration and the space between dashes shall be ¼ to ½ second, and a given number of dashes shall constitute a code: $A = 4$ dashes; $B = 5$ dashes; $C = 6$ dashes; $D = 7$ dashes; and $E = 8$ dashes.

Commenting on the relative costs or economics of operation of the unattended plan, the RTC report said that

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*
Arkansas	Little Rock	KTVH	11	198-204	316
Texas	Lufkin	KTRE-TV	9	186-192	10.7

NEW CALL LETTER ASSIGNMENTS

STATE	CITY	CALL	CHANNEL	FREQUENCY
Ohio	Toledo	WTOH-TV	79	860-866
Michigan	Detroit	WBID-TV	62	758-764
Nebraska	Lincoln	KUON-TV	12	204-210
Texas	San Antonio	KENS-TV	5	76-82
Virginia	Petersburg	WPRG	8	180-186
Washington	Pasco	KPKR-TV	19	500-506
West Virginia	Bluefield	WHIS-TV	6	82-88

*ERP=(effective radiated power, kw.)

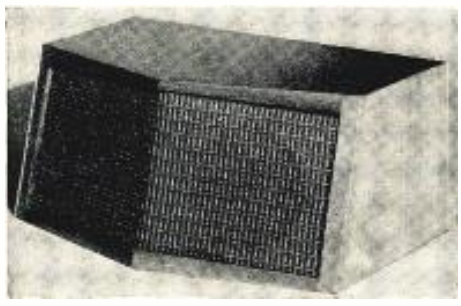
it has been shown that for some airports and with given traffic densities, there may be little difference between the cost of leaving the lights on all night long and the over-all cost of the light-control system. Because of the many variables, it was added, such as traffic density, availability and cost of control equipment and problems at airports having multiple runways, the

In the design of direct-coupled circuits, the establishment of the required d.c. operating potentials for tubes is a troublesome problem. One solution is a battery in series with the signal source. However, it has been found that the replacement or maintenance required of a battery, especially in cases where it must supply appreciable power, is a serious disadvantage. And a conven-

NEW EQUIPMENT FOR THE AUDIO TECHNICIAN

ELECTROSTATIC SPEAKERS

A.R.F. Products, Inc., 7627 Lake Street, River Forest, Illinois has introduced an electrostatic high-frequency loudspeaker in a separate package which is compatible with the equip-



ment with which it may be associated.

In order to make it fully adaptable to existing high-fidelity installations, the electrostatic speaker system is offered in six different arrangements. The simplest design includes a single electrostatic unit with a matching transformer and network components, for installation in existing loudspeaker cabinets or on a separate panel.

The most elaborate design consists of two electrostatic units mounted in a specially designed cabinet at angles which afford optimum distribution of the higher audio frequencies throughout the room. This cabinet also contains a matching transformer, network components, and a power supply to provide polarizing voltage. Other designs consist of various combinations of single and dual tweeter units with or without power supplies and with or without cabinets.

TAPE CUTTER-SPLICER

Robins Industries Corp., 82-09 251st Street, Bellerose 26, N. Y. has added a deluxe model to its line of "Gibson Girl" tape cutters-splicers.

The Model TS-4DLX not only miter cuts the recording tape and trims the

spliced joint with a unique indented "Gibson Girl" waist, but also carries a roll of splicing tape which is fed through to the point of application. Professional splices can now be made in five seconds and no other equipment is needed to make the splice.

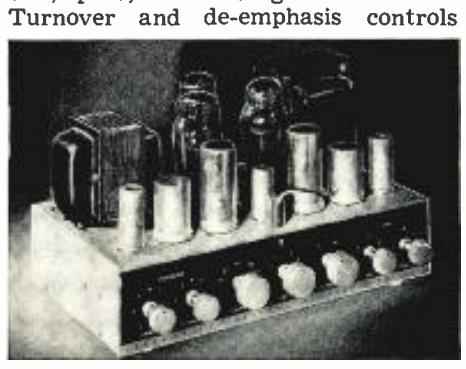
The splicer, designed for fast precise professional tape editing and repairing, may be removed from its plastic base and mounted directly on any tape recorder. The splicer works on the principle of the steel rule die and has a cutter cartridge which houses three long life blades. Movement of the unit's knob is all that is necessary to change from miter cut to the trim cut.

STROMBERG AMPLIFIER

A new amplifier has been added to the "Custom 400" line of high-fidelity sound equipment made by *Stromberg-Carlson Company,* Rochester 21, N. Y.

Designated as the Model AR-420, this new amplifier has a frequency response of 20 to 20,000 cps and provides a power output of 25 watts at less than 1 per-cent total harmonic distortion.

The unit features continuously variable record equalization controls which make possible the precise equalization of any record irrespective of make, size, speed, or recording characteristic. Turnover and de-emphasis controls



permit the selection of any turnover equalization point between 250 and 1500 cps and any degree of de-emphasis from 0 to 21 db.

A switchable rumble-suppression filter is also included. Tonal balance is provided by continuously variable bass and treble controls which give better than 15 db boost or reduction, measured at 50 and 10,000 cps.

TAPE REEL INDEXER

Halvick Industries, 189 Miller Ave., Mill Valley, California has introduced a novel unit for indexing the program material on tape reels.

Known as the "Atta-Glance Fidelity Index," the unit consists of cardboard discs which are placed over the reel. With dual-track recordings, a disc is placed on each reel. The position of the tape is marked at the edge of the slot before recording (the disc revolves with the reels during recording or playback) then without regard to time lapse or tape footage used, the recording is finished and that spot marked on the same slot in its final position of the tape. The subject matter is in-

scribed on the disc and bracketed to indicate the amount of tape encompassed by the subject.

Room is provided for a wide variety of notations and indications which can be inserted at the option of the user.

For full details on these discs, price information, etc., write the company direct.

NEW BOZAK ENCLOSURE

A new speaker enclosure, designed specifically for infinite-baffling of the company's B-207A coaxial speaker, has been announced by the *R. T. Bozak Company,* P.O. Box 966. Darien, Conn.

The E-300 cabinet has 5 cubic feet of completely-enclosed space and heavy acoustical damping, minimum wall and cavity resonance, and inherently-perfect transient response.

The cabinet measures 24" x 17" on the floor and is 30½" high. It weighs about 50 pounds without speakers. Finishes are mahogany, walnut, and birch with harmonizing wrap-around grille-cloth. The speaker panel has pre-cut holes for the B-207A and (closed with a removable panel) for the B-209.

Further data on this enclosure and the speakers with which it is designed to be used is available from the company.

LEADER AND TIMING TAPE

A leader and timing tape has been added to its line by *Reeves Soundcraft Corp.*

Spliced at both ends of a magnetic recording tape, it saves wear and tear in repeated threading. It is marked every seven and one-half inches, which permits accurate timing and splicing of timed intervals between selections.

The 150-foot roll comes in a handy dispenser pack which makes it convenient to pull out a suitable length and tear it off.

AMPLIFIER-PREAMPLIFIER

Newcomb, 6824 Lexington Avenue, Hollywood 38, California is now offering a new remote-controlled amplifier and preamplifier unit which has been designated as the "Classic 2500-R."

In addition to complete sound control, this amplifier offers the company's exclusive distortion control feature, "Audio-Balance." This control assures the user of minimum distortion for the life of the unit by giving him complete control over "unbalance distortion." Replacement of tubes frequently makes this type of distortion worse as new pairs are almost never identical nor do matched pairs necessarily remain matched.

The new unit includes a remote con-

trol unit which has been designed to fit any decor. It can be placed up to 100 feet away from all other equipment.

Technical specifications include: less

than .1 per-cent distortion up to 10 watts, less than .2 per-cent at 20 watts; 10 to 100,000 cps response within ± .1 db from 10 to 30,000 cps.

PILLOW SPEAKER

General Phones Corporation, 5711 Howe Street, Pittsburgh 32, Pa. is in production on a miniature speaker suitable for many different applications.

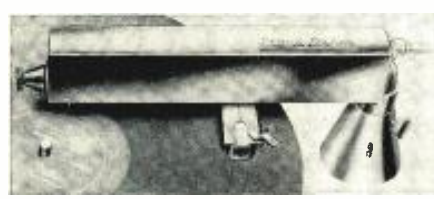
The unit is housed in a hermetically-sealed steel case, weighing one ounce, and uses the magnetic flux principle. The principle involves opposed *Alnico* magnets mounted on a fiber tone platform, which has a flat coil on its reverse side.

The speaker has no moving parts. It incorporates a very low impedance device to match any radio or television receiver without the use of capacitors or resistors.

"TRANS LINEAR" TONE ARM

Kral Products, 1704 Walnut Street, Philadelphia, Pa. has developed a new tone arm which plays back records in a straight line—the same way in which the records were originally cut.

The new "Trans Linear" tone arm is currently available in two models—one a 12" and the other 16" to provide complete coverage of all turntables on the market. The all-steel constructed arm with brass carriage can be easily installed on any turntable. No soldering is necessary to connect



the arm to the hi-fi system. A standard phono cord is used to plug the arm into the system. Height adjustment is accomplished by a handy thumb screw. The arm will accommodate most standard cartridges. An adjustable counterweight is furnished for use where necessary.

NEW TAPE DECK

Fenton Company, 15 Moore Street, New York 4, N. Y. is now offering the "Motek" audiophile tape deck which has separate capstan, take-off, and take-up motors yet remains in the moderate price class.

The unit's electrically interlocked

switch and brake system reduces the moving parts of the whole transport mechanism to the motor rotors, the flywheel-capstan axis assembly, and the tape pressure pad and pinch roller assembly.

Response with a suitable amplifier is better than 50 to 10,000 cps. Wow and flutter are less than .3 per-cent. Half track working on standard ¼" tape gives 32 minutes of playing time on each track at 7½ ips.

The deck is shipped with full instructions and circuit diagram for preamplifier and oscillator stages or the unit is available as a complete tape recorder and audio amplifier with separate power pack for remote installation.

STYLUS PRESSURE TESTER

Audak Company, 500 Fifth Avenue, New York 36, N. Y. has devised a new instrument which is designed to reveal quickly and simply whether stylus pressure is either too light or too heavy.

The "Micro-Poise" is designed to perform the sole function of telling whether stylus pressure is correct.

Too light pressure, as well as too heavy pressure, can harm disc grooves —the more so because a difference of only two or three grams one way or the other means as high as 50 per-cent off-correct in view of the feather-touch point pressure necessary with today's microgroove discs.

An interesting booklet on the "Micro-Poise" is available from the company on request.

COAXIAL-TUNED FM RADIO

Granco Products Inc., 36-17 20th Ave., Long Island City 5, N. Y. has recently introduced an FM receiver that is no bigger than the usual table model radio and is in the same price class.

The Model 610 FM radio, with self-contained antenna, is said to have excellent sensitivity, stability, tuning ease, low hum level, good tone quality and volume.

The receiver measures only 7½" x 4¾" x 4½" and weighs 5 pounds. It is available in ebony, blonde, and walnut plastic cabinets. The tuner covers the 88-108 mc. FM spectrum. The 300-ohm FM antenna is incorporated in the power cord so that no special installation is required. The set uses six tubes and operates on a.c. or d.c.

AUDIO ANALYZER KIT

Heath Company, Benton Harbor, Michigan has announced a new addition to its 1955 test equipment line.

The Model AA-1 audio analyzer

functions as three instruments in one: an a.c. vacuum-tube voltmeter, a wattmeter, and a complete intermodulation distortion analyzer.

Featuring built-in load resistors of 4, 8, 16, and 600 ohms and built-in low- and high-frequency oscillators,

this new kit retails for less than the cost of three separate instruments. This is made possible by the consolidation of circuit functions and the resultant elimination of duplicate components. One set of input and output connectors serves for all functions, and comprehensive audio testing is simplified through this combination of instruments.

Complete specifications and price information on the Model AA-1 are available from the company on request.

TEST TAPE SAMPLER

A handy reel of pre-recorded tape which enables the user to test his tape recorder and also enjoy some choice musical selections is now available from *The Dubbings Company,* 41-10 45th Street, Long Island City 4, N. Y.

Designated as the D-210 and called the "Plus-50 Music and Test Tape Sampler," the 3" reel provides two timing beeps accurately spaced 7 minutes apart for measuring tape speed and a 15 second 5000 cps tone for aligning the playback head. The 7½" recording is full track and consequently may be used on either full-track or half-track machines.

"TABLE-TOP" AMPLIFIER

The Radio Craftsmen, Inc., 4401 N. Ravenswood Ave., Chicago 40, Illinois has developed a complete "table-top" high-fidelity music control center which has been tradenamed the "Solitaire."

The new unit combines a 20-watt amplifier, a preamp-equalizer, and

dual filter systems in a cabinet measuring just 4" high by 11½" by 14½". It is housed in a leather-etched steel cabinet.

Features include six positions of record equalization; four inputs for records, radio tuners, television, and

tape; plus a cathode-follower output for tape recording. The exclusive dual filters eliminate turntable rumble and spurious high and low frequencies from the amplifier.

NEW RECORD CHANGER

The *Collaro* division of *Rockbar Corporation,* 215 E. 37th Street, New York 16, N. Y. has recently introduced a new three-speed, fully-automatic record changer, the Model RC-54.

The unit automatically intermixes all size records. 7, 10, and 12 inch records can be stacked in any order of play without any adjustment or presetting, provided they are of the same speed. The complete changing cycle takes only 6 seconds, irrespective of the speed at which the records are being played.

Only two knobs are required to control the unit, one knob sets the speed and the other is for "on," "off," and "reject." The changer measures 12" by 13½".

REPLACEMENT CARTRIDGE

The Turner Company, 900 17th Street, N.E., Cedar Rapids, Iowa has introduced a universal phonograph pickup replacement cartridge that can be used to replace 95 per-cent of all 78 rpm pickups now in use.

The cartridge is available in two models, AU and A. The Model AU is furnished with an externally mounted capacitor for low voltage (2 volts or lower output) replacement. The capacitor may be slipped off for high-voltage replacements. The Model A is the same cartridge as the AU but is furnished without the special low-voltage capacitor.

For complete information, write for Bulletin No. 962. —30—

For the first time in the history of the event, a Canadian amateur radio operator has won the W/VE contest. This international goodwill competition among hams in the U.S. and Canada is designed to promote increased radio communications between amateurs. Russ Wilson, VE6VK, of Calgary was this year's winner with a total of 37,725 points. The new cup, which was presented by Emerson Radio of Canada, was presented to the Montreal Amateur Radio Club, sponsors of the competition, by Rupert K. Grant, sales manager of Emerson and accepted by H. M. Ward, president of the Club. A miniature trophy will be presented to Russ Wilson. Alex Reid, Canadian general manager of the ARRL, represented that body at the ceremonies, while Carl Lockhart (right) of Emerson of Canada watched the proceedings with interest.

Radio Intermittents

(*Continued from page 44*)

row the field down to one or two units which is all that the troubleshooter needs for his final testing. He then can, for example, disconnect a capacitor for a running test in order to prove whether or not the capacitor is at fault.

Fuse Ratings

Proper rating of the fuses is the most important part of the method.

Ampere	Milliamperes
1/500	2
1/200	5
1/100	10
1/32	31+
1/16	66+
1/10	100
15/100	150
1/8	125
2/10	200
1/4	250
3/10	300
3/8	375
4/10	400
1/2	500
6/10	600
3/4	750
8/10	800
1	1000

(For values above 1 ampere simply add the fraction in milliamperes to 1000 times the number of amperes)

Table 1. Conversion of fractional ampere fuse sizes to the milliampere equivalents.

The rating should be as close to the normal current drain as available commercial fuse sizes will permit. For example, a 35L6 audio output tube will draw about 45 milliamperes at 110 volts, and fuse F_3 of Fig. 2 should be rated at 50 milliamperes or so. However, the nearest commercial size is 1/16 ampere or 62.5 ma., which could be used. A listing of the commercial fuse sizes in amperes and milliamperes appears in Table 1.

The many sizes of fuses permit the troubleshooter to use a fuse only slightly larger than the current drain of the circuit, which will insure that

Fig. 3. Two inexpensive fuses are shown being used to monitor a small a.c.-d.c. radio receiver for an intermittent. The fuse holders are mounted on a small piece of insulating material and chassis contact is avoided. The fuses are clipped into progressive stages with the set on.

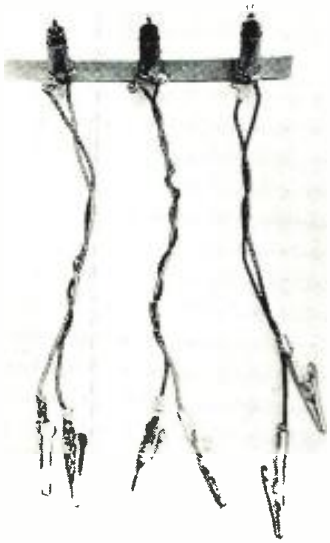


Fig. 4. Three panel lamp sockets with flexible leads and clips for testing for partial short circuits in a.c.-d.c. sets.

the fuse will blow if a heavy short circuit occurs.

A typical hookup showing the use of two fuseholders with a midget a.c.-d.c. set is given in Fig. 3. The fuse F_1 in this instance is a surge-limiting resistor which would act as a fuse if the current to the rectifier plate became excessive.

Partial Short Circuits

The partial short circuit presents another problem which is solved by the use of panel lamps as combination fuse-indicator devices. As the reader has probably experienced, a slight overload will quickly blow a panel or pilot lamp. A *Mazda* 44 requires 250 milliamperes (¼ amp.) to light it up to its full brilliancy and will blow rapidly with 400 milliamperes; it will glow a dull red with a current as low as 100 milliamperes. The *Mazda* 47 requires 150 milliamperes for full brilliancy, will blow at about 250 milliamperes, and will glow at about 60-65 milliamperes.

Panel lamps are very cheap and if one does blow, the cost is just about the same as a fuse. The glow of the lamp varies with the current passing through it. There is no exact proportional relationship; however, the relation is close enough. The amount of current for normal operation will cause a certain glow and more will make the lamp burn brighter—the eye can detect very readily small changes in brilliancy of such a lamp. In fact, the eye can do almost as good a job as a meter in this case.

The lamps are inserted into different circuits in the same manner as the fuses were in the cases previously described. Long flexible leads are necessary so that the panel lamps may be supported away from the set or apparatus under test, making it possible for the troubleshooter to observe them at a distance.

Fig. 4 shows three such lamps mounted on a piece of fiber or plastic for insulation. The tape around the

lamps (to insulate them from chassis contact) has been removed for photography. In use, the equipment is turned on and the lamps may be watched from a distance while other work is being done. If the circuit trouble disables the device, the lamps should be inspected to discover which is now glowing more brightly than prior to the development of the trouble. The circuit in which this lamp is connected should then be investigated further, using the methods described previously in this article.

The methods of detecting intermittents described here may also be applied to television sets and to other electrical or electronic devices; appropriate values for the fuses or lamps must, of course, be used for the circuits under examination. —30—

Improving Audio Quality

(*Continued from page 70*)

In some sets, one terminal of the speaker is grounded to the chassis, as is one side of the output transformer. These grounds should be removed.

Solder two suitable lengths of wire to each speaker terminal, running one wire to the circuit ground. Attach a 20- to 30-ohm resistor to the other wire and touch it to the cathode of the first audio tube, pin 2 of the 12AT6, with the radio on and playing. If this connection results in a reduction of volume, the feedback circuit is correctly installed. If a "howl" or whistle results the feedback circuit is reversed so you must reverse the two wires attached to the speaker. It was found that 22 ohms gave just about the right amount of feedback for the circuit of Fig. 1.

It is imperative that the .01-μfd. capacitor from the 50C5 output tube plate to "B+" be in good condition, otherwise high-frequency oscillation will result. It was found that .01 μfd. seemed to be the minimum size necessary to prevent oscillation. The high-to-low frequency balance of the circuit can be varied by varying the capacitor. In one set modified, this unit was increased to .05 μfd. for proper balance.

Fig. 2 illustrates the frequency response of the set diagrammed in Fig. 1, before and after the changes. The response curves were taken at a little over one-half watt output to the speaker, which is somewhat higher than normal listening level, but also a much more critical test for the circuit to meet, in view of the output transformer quality. It is interesting to note that there is a difference of 9 db at 60 cps and approximately the same improvement at the top end. Note also that the points at which the response is 3 db down before feedback are at 400 and 4000 cps; after feedback, the response at this power improves to 90 and 9000 cps.

Square waves were introduced into the circuit not only as a rough means of observing frequency response, but also as a check on listening quality in

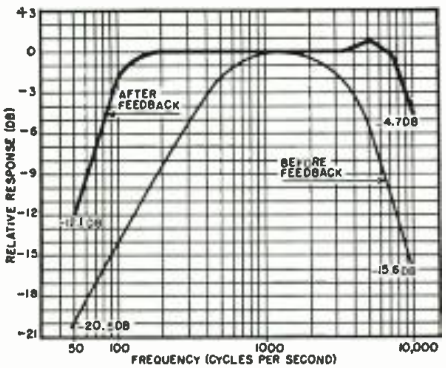
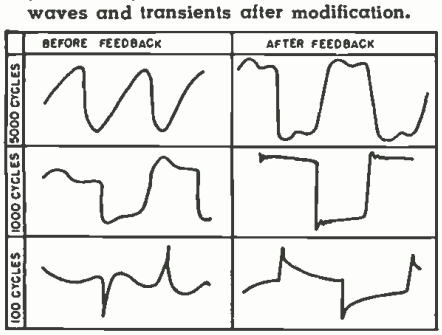


Fig. 2. The frequency response curves of the receiver in Fig. 1, before and after the feedback loop was added. The audio output of the radio was ½ watt.

terms of transient response. Frequencies of 100, 1000, and 5000 cps were chosen for illustration. The results of these tests are recorded in Fig. 3. It will be noticed that there is not only a great improvement in the general form of the wave at both 100 and 5000 cps, but also that the feedback has now produced some ringing which can be attributed to circuit capacities. This ringing cannot be considered a serious drawback for this circuit, and in most cases cannot be detected by the ear. An indication of this ringing can be seen from the slight peak in output on the frequency response curve in Fig. 2. The inductive load of the voice coil also tends to produce this effect.

An additional modification which may be tried is to slot and dampen the speaker cone. The method of slotting a cone is not new, and it is found that the resonant frequency can be lowered substantially by the change. It is only necessary to make cuts along the outer roll of the cone, perpendicular to the circumference, and spaced every ¾ of an inch along the circumference. Cut only the suspension roll. The cone, along the width of these cuts in the roll, is then painted with three coats or so of rubber cement to apply some damping to its movement. This treatment, when applied to the 5-inch speaker of the set diagrammed in Fig. 1, lowered its resonant frequency response from 200 to 145 cps, a sufficient amount to warrant the change. If the speaker size can be increased or the baffle size increased or improved even with the existing speaker, considerable improvement will be noticed of course. -30-

Fig. 3. These curves indicate the improved response of the radio to square waves and transients after modification.



RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

A LARGE NUMBER of letters from readers to the editors of this department come from technicians who are planning to start their own full-time service businesses. The most commonly asked questions in these requests for information are: (1) What are the charges that service businesses make for various types of TV and radio repairs; (2) Have service operations on TV sets been standardized (along the line of automobile repairs) to provide a uniform pattern for itemizing the various services that might be required in repairing a TV set; (3) Is it better to start a service shop on a part-time basis or go into it immediately as a full-time activity; (4) Is a business location preferable to operating a service business from your home; and (5) What are the minimum investment requirements for stock and test equipment for a new full-time service business.

It has been interesting to observe from these letters that technicians who are planning to start their own service businesses never ask a question about the most important and fundamental factor that underlies the success or failure of any business. That factor is the maintenance of a uniform volume of business that will provide enough profit to pay all costs of operating the business and give the owner a better income than he could get by working for someone else plus a fair return on his investment. Any business, regardless of whether it is selling goods or services, has a major problem to keep its volume of business above the "break-even" point. This factor should be one of deep concern to every man who starts a new business.

Recently an executive of a large appliance manufacturing concern made the remark that "Big business is getting bigger and little business is getting smaller." During the past two years the mortality rate among small businesses, particularly the so-called one-man type engaged in all types of activity, has increased steadily. A study of the factors involved in these disclosures indicates that it is a normal development brought about by current economic conditions together with a steady shift in the buying habits of the public.

While space does not permit a broad discussion of the forces at work that have brought about these pressures, the elements that affect one- and two-man electronic service shops can be identified and explained. The increasingly complex problems involved in selling either products or services to the general public and the high costs of operating—and making a living—place a heavy burden on the shoulders of the individual who is trying to carry the entire weight of the business.

There are many very small service shops, of course, that have been operating in the same location since the radio service days of the nineteen thirties that continue to do all right. However, these businesses were started during a period when it was possible to start a radio service business on a "shoe-string." The five-tube table model a.c.-d.c. sets that made up eighty per-cent of the service volume were easy to transport and owners thought nothing of dropping them off at a service shop for repairs. A versatile technician who knew how to maintain good customer relations would pick up income from servicing a wide variety of electronic devices like p. a. systems, auto radios, battery portables, etc. The business became known to thousands of set owners down through the years and when television came along these established shops were able to take on as much of the available video service as they felt capable of handling.

These established small service shops, however, are not a criterion of what technicians can do in today's market. The new shop today must make itself known to thousands of television set owners in a short period of time. It must have dependable transportation facilities, a substantial amount of test equipment, and a good inventory of replacement tubes, parts, and supplies. Further, and vitally important, it must operate on a system that will permit the owner-technician to spend a maximum amount of his time in productive work.

During the thirties, it was not uncommon for the average radio service dealer to spend most of the daytime hours promoting business and handling whatever commercial and industrial

work on sound equipment he had to do while the businesses were open. Then he would close his shop at six and spend four or five hours earning the bread-and-butter income of the business. These evening hours would be spent at the work bench repairing the a.c.-d.c. sets that had been brought to the shop for repairs.

Since eighty per-cent of the television service is performed in the homes, the operator of a new service business faces the very serious problem of getting enough calls for service every day to provide at least the minimum income necessary to meet his business and personal obligations. If *all* of the actual costs of operating are not earned by the volume of business handled, the service technician becomes so involved financially within a matter of six months or less that he finds it impossible to continue to operate.

Financing a New Service Business

Most small businesses are started on the false premise that if there is enough money or credit available to open a shop, put up a few signs, and get a telephone directory listing, enough business can be promoted during the first month to make the activity self-supporting. The money consuming factors that are involved in the operation of any business in today's economy are seldom appraised realistically by the people who optimistically start small business enterprises.

A TV service technician may have the required technical know-how, management ability, and basic experience, but he must have enough money at the outset if he is to be successful in starting his own service business. Of course, there are the exceptional individuals who do start on a "shoestring" and build successful businesses. But statistics of the United States Department of Commerce show that one out of every three business failures are due to lack of adequate capital.

A bank will not usually lend money to any businessman not already properly financed with equity capital. If the embryonic service business operator is unable to supply a certain amount of risk capital from his own savings, he will be sadly mistaken if he expects to borrow from a bank or hopes to get long-term credit from manufacturers, distributors, and jobbers.

Every business must observe certain fundamental principles if it is to survive in a competitive world. One of the most basic principles is that the amount of capital representing fixed assets such as testing equipment, car or truck, fixtures, working inventory, etc., and working capital needed permanently should be furnished by the proprietor of the business. It should be pointed out, too, that if the car or truck to be used in the business is being financed, the monthly payments will be an immediate burden on the business. The funds required for this essential equipment are the initial cap-

ital requirements. The available capital must be in excess of this initial capital because it may be several months before income exceeds outgo.

During the first several months after a service business is newly started the owner will need sufficient working capital to:

1. Pay his own living expenses
2. Buy tubes, parts, and supplies
3. Take advantage of discounts offered
4. Pay the landlord
5. Pay telephone bills and all other operating expenses
6. Provide a "cushion" to withstand a dull summer or a temporary slump in business

All too often a competent service technician will give up a good job to start a service business of his own without fully appraising the terrific expense burden he is assuming as an independent business operator. The following list represents the income-consuming items that make up the operating expenses of any electronic service business:

1. Auto expenses: operating, maintenance, and depreciation.
2. Insurance: auto liability, auto fire and theft, liability for damage to property in customers' homes, liability for various hazards in shop location, and fire and theft of stock and equipment.
3. Rent.
4. Depreciation: shop equipment, furniture, and fixtures.
5. Electricity, heat, and telephone.
6. Stationery, printing, and postage.
7. Advertising.
8. Local, state, and federal taxes.

These expenses will range from 18% to 50% of the gross income of the business depending upon the service volume accomplished, ratio of shop work to field service income, location of shop, etc. They are part of the machinery of a business and a heavy burden for one man to carry by himself. Since most of these operating expenses would not be increased appreciably for a three- or five-man service company, it adds up that the one-man shop is at a serious competitive disadvantage to the shops that have developed enough volume to support the activities of from three to five men.

Business Promotion

The basic advantage a multiple-manned service company has is that it frees the manager from most of the routine technical work and permits him to give concentrated attention to the problems of selling the company's facilities. Dealer contacts are vitally important. A high percentage of the retail establishments that sell radio and TV sets do not employ technical help. They rely on specializing service shops to handle in-warranty service and when experience teaches them that they are working with a technically competent service company, they make their out-of-warranty service referrals to that company.

Dealer service can be developed and maintained only through frequent contacts with non-servicing dealers. The one-man service shop operator, who is hard-pressed for time to accomplish income-producing work, finds it difficult to maintain these essential dealer contacts.

The conventional advertising programs of small shops consists of a listing in the classified section of the telephone directory and perhaps a small ad in a local or community newspaper. While there is nothing wrong with this type of promotion, the volume and character of business that is developed from these media is highly questionable. There are fringe service customers just as there are fringe service shops and technicians. The fringe service customer is the one who constantly shops to buy service at a price. They are hard people to satisfy and are the users who wear heavily on the nerves of the technicians who handle their service work.

The service companies that built mailing lists of their service customers from the in-warranty service they handled for dealers derive a high percentage of their C.O.D. business from their continual contact by mail with these set owners. As established service companies add to their services to handle AM radio, air conditioning, and other home appliances, they continually entrench themselves with the better type of customers. This makes it difficult for a new TV service business to break into the business satisfactorily handled by established service companies.

Perhaps the worst fallacy in the reasoning of most men who get into the electronic service business is that they can provide service at a lower cost than the larger, established service shops, and still pay all of their operating expenses and take out a good income for themselves. Of course, there are many foolish technicians who advertise service calls at a low charge and then make up the difference in padded parts charges. A man can get away with unscrupulous practices like that for a while but sooner or later his customers will catch up with his machinations. These practices do not provide a sound basis on which to build a permanent, growing business and the men who engage in them eventually quietly pass out of the service picture completely.

A careful study of the actual costs of operating a service business will show clearly that one man working alone will have to get more money for his time (a higher rate per call) than a five-man service company if he expects to take an income from the business comparable to that earned by the men in the larger and busier television service company.

It is obvious that the education of the set-owning public about what constitutes fair and adequate labor charges for competent technical service is primarily a responsibility of the men who operate service businesses. It is the independent service shop that stands to gain most by the general acceptance of the philosophy that capable service cannot be cheap service.

The standard operational and labor charges charts for television, radio, and phono service have been very helpful to service people in all sections of the country by giving them a pattern for determining adequate charges and one which could be explained to service customers. The service operations they set up reflect the pattern used by hundreds of service shops. The charges for the various operations are national averages to be used as a guide in checking the adequacy of charges in any locality where an electronic service shop is located. Such charts are available to readers of RADIO & TELEVISION NEWS for $1.00. —30—

UNIQUE B.F.O. ADDITION

By CLYDE ADAMS

AFTER several weeks of listening to short-wave signals on my little table model Emerson 729 to which hand-wound coils had been added, I decided on the addition of a b.f.o. in order to receive c.w. signals.

When the chassis of the little set was pulled from the cabinet I knew right then that it was impossible to even think of having the pleasure of receiving code on the set. There was barely enough room on the chassis for the 5-tubes without adding another tube, socket, and other required parts. The underneath of the chassis was as crowded as the top and nowhere could a coil be squeezed in.

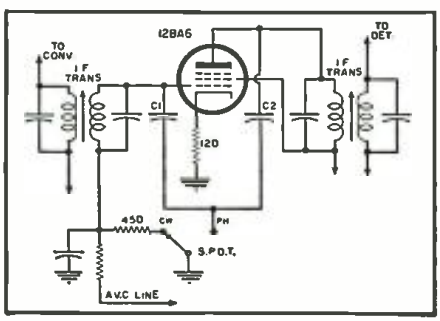
After several days of brooding my hopes soared when I ran across a schematic of a set, made by a well-known manufacturer, incorporating a novel b.f.o. arrangement whereby no tube, coil, or control is used. This circuit was tried on the Emerson and worked perfectly. Experimenters will be interested in this b.f.o. addition and the circuit shown in Fig. 1 is for your benefit.

Shown in the circuit is the i.f. stage of present-day midgets. Only a single 470-ohm resistor and s.p.d.t. switch are needed for c.w. signals. The capacitors C_1 and C_2 can either be 1 $\mu\mu$fd. ceramic units or two or three turns of wire wrapped around the leads to plate and grid of the 12BA6 i.f. tube.

When the switch is in the "c.w." position, the i.f. amplifier oscillates because of feedback from plate to grid through capacitors C_1 and C_2. The a.v.c. line is grounded through the cathode resistor to prevent the oscillations from increasing the a.v.c. voltage and reducing the gain of the set. In the "phone" position, C_1 and C_2 are grounded so that the set will operate normally. The switch on my set was mounted on the back of the set alongside the s.w. coils. The circuit works fine especially on the ham bands. Try it!

—30—

Fig. 1. The i.f. stage of a present-day midget set showing parts added for c.w. use.



Servicing Color TV

(*Continued from page* 51)

follows it. Hence, no 3.58-mc. oscillations would be generated, either. The complete color section would be totally isolated from the incoming signals.

Consider now the circuit shown in Fig. 6. The first chroma amplifier, which is the bandpass stage, receives its signals from the video cathode follower and serves only to forward the color sidebands to the *I* and *Q* demodulators. The burst amplifier obtains its signals separately from the video cathode follower. Thus, the burst amplifier would not ordinarily be affected by any failure in the bandpass stage. This means that the 3.58-mc. ringing circuit would be suitably triggered and 3.58-mc. oscillations would be developed and forwarded to the *I* and *Q* demodulators. Also, since the color killer circuit is associated with the 3.58-mc. limiter, it, too, would be activated, leading to the removal of its cut-off bias from the two color demodulator stages. All we need, then, to produce colored confetti on the screen are noise or other extraneous voltages either in the second chroma amplifier circuit or in the grid circuit of the demodulators. It is quite possible that under these conditions this will happen.

Thus, whether a defective bandpass amplifier leads to a colorless picture or one which has random color, depends upon the relationship between the color sync section and the chrominance section.

A defective color killer can also be the cause of no color in a picture. If the killer cut-off bias is on at all times, irrespective of whether or not color burst signals are being received, then no signals will pass through the chrominance section and none will reach the picture tube. It is also true that if the receiver employs a separate detector for the color portion of the signal, as the circuit of Fig. 7 does, any failure here would likewise result in no color. This same set also has a germanium detector for the Y signal and consequently, this signal would appear on the screen.

Thus far, we have covered the troubles that may cause a poor black-and-white picture to appear on a color TV receiver screen and the troubles that would cause no picture or an incorrect raster. This article covered also, some of the causes of an incorrect color picture. Despite the trouble, however, it is interesting to note that our servicing procedure is much like what we use for monochrome set servicing, i.e., we are using the picture tube as our primary trouble indicator.

Next month's article will conclude this series. *(To be continued)*

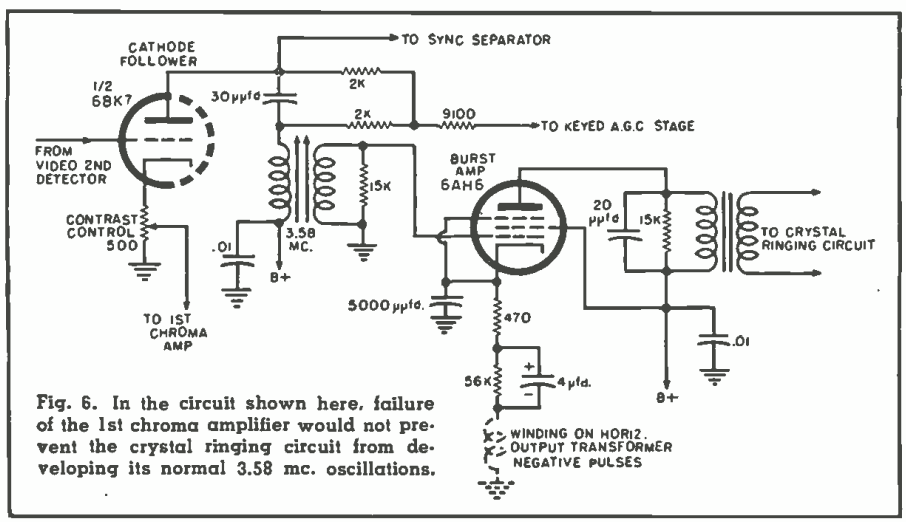
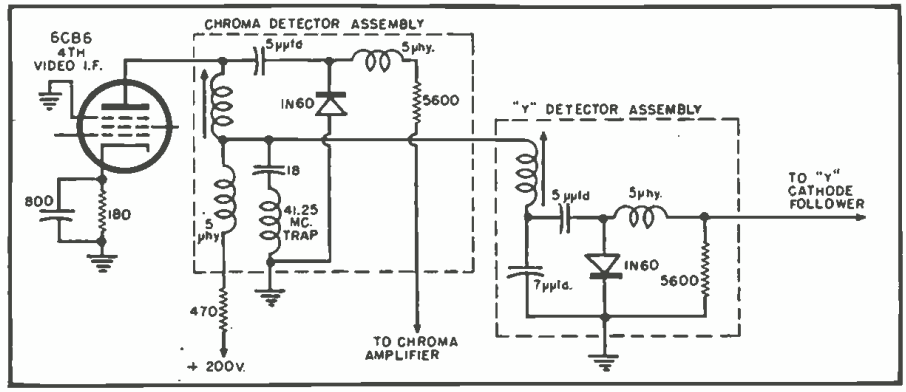


Fig. 6. In the circuit shown here, failure of the 1st chroma amplifier would not prevent the crystal ringing circuit from developing its normal 3.58 mc. oscillations.

Fig. 7. Any failure of the chroma germanium crystal in this circuit would remove color from the picture, but would not affect the monochrome presentation.



"Universal" Counter
(*Continued from page* 55)

prefers to solder the transistor directly into the circuit, he should exercise special care to avoid overheating this component. Do not cut the leads any shorter than necessary, and complete the soldering as quickly as possible.

Assembling the Accessories

The versatility of the "universal" counter depends not only on the counter circuit proper, but on the choice and use of various accessory "control" units. While the number of possible accessory control units is limited only by the imagination and requirements of the individual user, the group of four shown with the counter in Fig. 1 should give the reader some idea of the possibilities.

Reading from left-to-right, the accessories shown in Fig. 1 are as follows: (*a*) selenium photocell, (*b*) mercury switch, (*c*) "Microswitch," and (*d*) push-button switch.

The photocell is typical of a current generating type of accessory and is equipped with a phone plug to fit in the proper "control line" jack (J_1). The selenium cell used is of the type employed in exposure meters. It has been mounted in a small plastic box. The connections for the photocell are given in Fig. 5.

The other three accessories are typical of "simple switch" controls. Each has been equipped with a short flexible line and spade lugs, for easy connection to the screw-type "A" terminals (see Fig. 3).

Typical applications of these accessories will be discussed later.

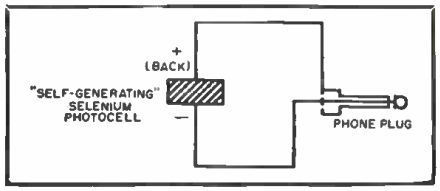
Adjustment and Operation

Once the wiring is completed and checked, the counter may be tested for proper operation. The first step, however, is to identify the various screw-terminals on the back panel. The connections used in the author's model are apparent when Figs. 2, 3, and 6 are compared.

Without plugging the line-cord into a wall socket, turn the instrument "on." Next, with R_2 set in its maximum resistance position, temporarily short out the "A" terminals (Fig. 3). Gradually adjust R_2 until the relay (RL_1) clicks as it is pulled in. Remove the short from the "A" terminals and the relay armature should drop out.

If the outlined action is not obtained as each step is carried out, it indicates either a defective part in the

Fig. 5. How the photocell, one of the accessories, can be connected to counter.



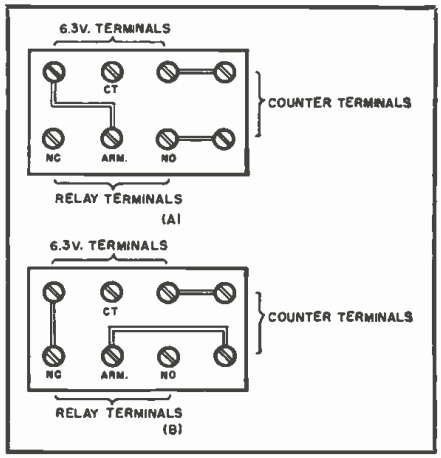


Fig. 6. Two ways of connecting the electromagnetic counter: (A) if relay is normally held open. (B) relay normally closed.

circuit or an error in wiring. Carefully recheck all connections and parts.

Once the relay circuit is operating properly, the rest of the counter may be checked. This will require connecting the electromagnetic counter, the 6-volt a.c. power source, and the relay circuit together properly. Use the relay contacts to switch the a.c. voltage so that it is applied to the electromagnetic counter whenever a counting operation is to take place.

Two connections are possible, and both are illustrated in Fig. 6. If the relay is normally to be held open, and to close for each count, the armature (Arm.) and "normally open" (NO) contacts are used. This connection is shown in Figs. 2 and 6A.

A typical example where this connection might be employed is where a s.p.s.t. push-button switch is connected across the "control line" ("A" terminals), with a count being registered each time the button is depressed and released.

On the other hand, if the relay is normally to be held closed, and to open for each count, the armature (Arm.) and "normally closed" (NC) contacts are used. This connection is shown in Fig. 6B.

An example of the second case is where the photocell accessory is used to count the number of objects moving along an industrial assembly line. The photocell is plugged into the J_1 jack and set up on one side of the line. A good light source is arranged on the other side of the line so as to strike the photocell.

Under such conditions, the relay is pulled in and held in until a moving object interrupts the light beam, allowing the relay to drop out and register a count.

A minor circuit modification: The electromagnetic counter used is also available with a 115-volt coil. If the builder prefers to use the 115-volt unit, the transformer (T_1) may be omitted from the circuit. The pilot light may then either be left out or a 115-volt unit used instead.

Should the builder decide to use a 115-volt coil, a cover should be ar-

ranged for the back panel of the instrument to avoid accidental short circuits or electrical shock from the exposed terminals.

Applications

As mentioned previously, the possible applications of the "universal" counter are almost unlimited. However, reviewing a few typical applications should give the reader a sufficient understanding of the potentialities of the unit so that he will have no difficulty in devising other applications of his own.

The photocell accessory might be used for counting the number of objects passing a given point on a production line, or the number of persons entering or leaving a specific area or room. The mercury switch could be used for counting the number of times the lid on a tool box or supply cabinet is opened and closed. The "Microswitch" might be used in a similar application, or could also be used for recording the number of times a door is opened or shut.

The push-button switch could be used advantageously at inventory time. Held in the hand, it might be used for quickly recording the number of objects on a merchant's shelves. For each count, the user simply depresses and releases the button.

In addition to its uses just as a counter, the completed instrument has other possible applications. For example, the relay and amplifier circuit, used alone, could well serve for remote or automatic control of solenoids, motors, lights, or similar equipment. Any of the accessories may be used as the basic control device in such an application. —30—

A SERVICE HINT

By JOHN B. LEDBETTER

HERE is a tip on the Motorola TS-95 when the brightness is normal but the sound is weak and there is no video except noise streaks across the screen.

Check for an open 2.2 μhy. cathode choke in the 12AT7 converter stage. The d.c. resistance should read 1.8 ohms on an accurate v.t.v.m. In most cases a replacement choke is difficult to obtain but a satisfactory choke can be constructed if a little care is used.

Select a length of #22 d.s.c. or enameled wire which measures approximately 2 ohms and scramble-wind this length on a ½-watt carbon resistor (4.9 megohms or higher as this value is sufficient to prevent interaction and the ½-watt size makes a good coil form).

Since the coil value is rather critical on the high channels it may be necessary to add or remove several turns to obtain proper response on channels 7, 9, 11, and 13. For example, if channel 13 is satisfactory but channel 7 is poor, the number of turns should be increased. If channels 11 and 13 are not received or if 13, 11, and 9 are received one channel lower than normal, decrease the number of turns.

Use only high-frequency dope to cement the winding or the whole process may have to be repeated. —30—

Within the Industry

(*Continued from page 28*)

opened a factory and warehouse at 15204 Oxnard St., Van Nuys, California . . . **TRAV-LER RADIO CORPORATION** has opened a factory distributing branch in San Francisco at 1251 Folsom Street . . . **INSULINE CORPORATION OF AMERICA** dedicated a new plant at 186 Granite St., Manchester, N. H. recently . . . **CBC ELECTRONICS CO., INC.** has moved to new quarters at 2601 N. Howard St., Philadelphia. The new plant has approximately six times the area of the firm's old facilities . . . **MAGNETIC RESEARCH CORPORATION** of El Segundo, California has moved to a larger location at 200 Center Street . . . Construction of a new plant building, comprising 27,000 square feet, on its present site, has been announced by **PYRAMID ELECTRIC COMPANY** of North Bergen, N. J. . . . **RAYTHEON MANUFACTURING COMPANY** has started construction on an electronics laboratory for engineering and research in Wayland, Mass., 20 miles from Boston. The building will have approximately 150,000 square feet of floor area . . . **KAY LAB** has started construction of a 150 x 200 foot building eight miles from the San Diego business district. The plant and site will include parking facilities for 300 cars . . . The purchase of 60,000 square feet of car radio tuner manufacturing facilities from **LEE J. DRENNAN, INC.** of Arcade, N. Y. has been announced by **MOTOROLA INC.**

* * *

ROBERT G. MARCHISIO has been appointed to the post of vice-president of *CBS-Hytron* and will have general authority in all phases of the company's operations.

He joined the company in 1951 as assistant to President Charles F. Stromeyer, who was then a vice-president. He previously had worked at *Sylvania Electric Products Inc.,* first as assistant chief engineer for proximity fuses, and later as chief engineer of the fixture division at Ipswich.

Mr. Marchisio is a graduate of MIT in electrical engineering.

* * *

GUDEMAN COMPANY, Chicago manufacturer of electronic components, has purchased **DILECTRON, INC.,** 2661 S. Myrtle St., Monrovia, California, manufacturer of ceramic capacitors. The new acquisition gives the parent firm its fifth plant and will be operated as a division of the company . . . **CLAROSTAT MFG. CO., INC.** has completed arrangements for the purchase of **CAMPBELL INDUSTRIES INC.,** Chattanooga, Tenn. manufacturer of highly specialized resistance products . . . All of the outstanding capital stock of **DOELCAM CORPORATION** of Boston has been purchased by **MINNEAPOLIS-HONEYWELL REGULATOR COMPANY**

who will operate it as a division of the parent firm. The new division has a main plant in Boston and another plant and engineering laboratories in Newton, Mass. . . . **AEROVOX CORPORATION** of New Bedford, Mass. has acquired all of the outstanding stock of **HENRY L. CROWLEY & COMPANY, INC.** of West Orange. N. J., manufacturers of powdered-iron and steatite products . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has purchased the television picture tube manufacturing facilities of **NATIONAL UNION ELECTRIC CORPORATION** in Hatboro, Pa.

* * *

LOUIS M. PARK has been appointed to the executive position of co-ordinator of sales, advertising, and management of the television and radio operations of *Raytheon Manufacturing Company.*

Mr. Park was formerly executive assistant to the vice-president in charge of sales at *Admiral Corporation* for 10 years and for 17 years prior to that he was with *Stewart-Warner Corporation.*

In his new post with *Raytheon,* he will serve as executive assistant to D. O. Klein, assistant vice-president and manager of marketing.

* * *

JFD MANUFACTURING COMPANY, INC. is celebrating its 25th anniversary on February 18th.

A large fund has been appropriated for year-long advertising and promotion. As part of the anniversary celebration, there will be testimonial banquets. awards, contests. and supplementary advertising. All packaging during this year will carry the company's anniversary seal and there will be special sales opportunities for the firm's distributors and dealers. —30—

PHOTO CREDITS

Page	Credit
37	Philco Corporation
45, 47	Aero Products Company
49	Westinghouse Electric Corp.
50 (Fig. 3)	Radio Corporation of America
64	Belgian National Broadcasting Service
72, 73	Motorola Inc.
112	Sylvania Electric Products Inc.
163	Emerson Radio of Canada

ERRATA

In Fig. 5 of the article "Acoustic Measurements for the Audiophile" in the September issue (page 112), one of the rectifiers was drawn with the wrong polarity. One of the 1N34's should be connected with its "anode" toward the meter, the other with its "cathode" toward the meter.

* * *

In the parts list accompanying the article "A Tone-Compensating Preamp," October issue, the value of R_{15} is incorrectly given as 750,000 ohms rather than 75,000 ohms. The Clarostat part number for R_{15} is, however, correct.

* * *

Also in the October issue (page 55), terminals 2 and 4 of the 6E5 in the schematic accompanying the "Economy Model Grid Dipper" should be reversed.

INDEX OF Advertisers

FEBRUARY 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.]

Classified

Rate 50c per word. Minimum 10 words

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

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CRYSTALS: FT-243's—3500 to 8700 KC, .01% setting, $2.00 each. Hundley Crystal Co., 2951 North 36th, Kansas City 4, Kansas.

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.

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CODE Practice Electronic Oscillators, new. Guaranteed. Not a kit. $1.00 postpaid. Details free. Stout 2211 E. Broadway, Muskegon, Michigan.

TELEVISION, Working. $30 up. W4APT, 1420 South Randolph, Arlington 4, Virginia.

OSCILLOSCOPES: Triplett 3141. All New. $169.50. Faith Radio-TV, Montpelier, Ohio.

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TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. N. Gensler, W2LN1, 136F Liberty, N. Y. 6, N. Y.

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USED Television Receivers. No Junk. Seale Corporation, Plain Dealing, Louisiana.

WILL Buy All. Art-13/type T-47A $200.00. Art-13/type T-17 $150.00. BC-788C Altimeters $100. R5/ARN7 Radio Compass $125. 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.

WANTED: Type R19/TRC-1 Receivers. Box 543, Radio & Television News.

TOP Dollar Paid for Art-13's, dynamotors, parts racks and all other component parts. Write: Harjo Sales Co., 4109 Burbank Blvd., Burbank, Calif.

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URANIUM Scintillation and Geiger counters. Free Booklets Radiotel Clinic, 2320 Burbank Blvd., Burbank, Calif.

COLOR Television from standard TV using color wheel, simple converter. Details, Colordaptor, 3471 Ramona, Palo Alto, Calif.

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Trigger coil for HI & LO Volt Flash. $1.47

Write for "TAB" Flash Tube Data....50¢

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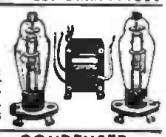

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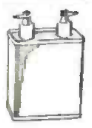

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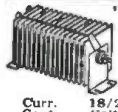

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6AMP	4.10	8.00	17.50	29.95
10AMP	5.55	11.50	25.00	41.50
12AMP	7.50	14.00	30.00	44.50
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Rectifiers to Convert 6-Volt Trickle & Reg. Battery Chgrs to New 12V & 6V Use BA14/1A—$1.35; BE14/2A—$2; BF14/3A—$3; BG14/4A—$3.50; BJ14/6A—$3.50; BK14/10A—$6

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T28V/12ACC	12Amp (1% Ripple)	$139
T28V24A†	0-28 VDC at 24Amp	$135
T28V/24ACC†	24Amp (1% Ripple)	$195
T28V50A†	0-28 VDC at 50Amp	$260
T28V/50ACC†	50Amp (1% Ripple)	$370
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B28V/24A	0-28 VDC at 24Amp	$110
B28V/24ACC	24Amp (1% Ripple)	$159
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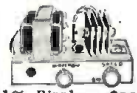

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MODEL 12C

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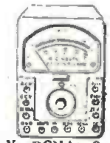
(plus 40c ship in U.S.A.)



Hi-accuracy precision imported VOM. 1000 Ohms per V. Reads AC & DC volts 0, 5, 25, 250, 1000 V. DCMA: 0, 1, 10, 100 MA. Ohms: 0 to 10, 100K. Size 1¼" D, 4⅝" L, 3¼" W. Test Leads. Model T5-52 Smallest precision built VOM. jeweled 3" D'Arsonval meter. 1000 Ohms per/V. Reads AC & DC volts 0, 10, 250, 500 V. DC MA: 0, 1, 250 MA. Ohms: 0-100K. Only 1⅛" D, 4" L, 3⅛" W. Test Leads. $6.89 ea. (plus 40c ship in U.S.A.)

GTD to SATISFY or your MONEY BACK!!

Special.....Model T5-52 & 12 @ $15

TRANSFORMER BUY

6.3 Volt 3¾ Amp

Continuous. 115 VAC input. Size 2-5/16" H. 2" L. 1⅛" W. mtg cntr 2⅜"; SPEC. Ea. 98c; lots of 12; 89c

SELSYNS-SYNCHROS

AY1 & AY5 Autosyn. 26V/400 cy.....$4.98

AY1 Autosyn,....2/$3.98

C69406-2/Type 11-2 Syn Rptr/115V/60Cy..2/$3a

C56701/Syn Rptr/115N/60Cy.....$21

C78249/Syn Dif/115V/60Cy....$7; 2/$12

2J1F1/Syn Gn/115/57.5V/400Cy.....$9; 2/$16

2J1G1/Syn Tr/57.5/57.5V/400Cy.$5; 2/$8

2J5HA1/Gen/115 105V/60Cy.....$57

6G Syn Gen/MK2/MOD IV/115V/60Cy $49

METER BARGAINS

0-1 MADC/3½ Rnd $3.95

0-5 MADC/3½ Rnd $3.70

0-100 MADC/3½..$3.50

0-1 MADC/3½ Sq $7.00

800 VDC/3½ Sq $8.95

1500 VDC/3½ Rnd $4.95

150 VAC/3½ Sq $4.95

5 MA/DC Tuning Meter AN...$1.39; 3 for $4.00

Weston 120 MA/RF/3" Rnd/301..$10.95

VARIABLE VOLTAGE XFMRS

SUPERIOR-GR-5TACO-UTC

D-132V 1.25A	$7.99
0-135V 3A	11.25
Cased 0-135V 7.5A	20.70
Uncased 0-135V 7.5A	16.20
Cased 0-270V 3A	23.40
Uncased 0-270V 3A	18.00
Cased 0-135V 15A	41.98
Cased 0-270V 9A	41.98

—Six or more 10% disc—

— HQS. FOR ALL TOOLS —

CUMMINS BALLRITE 44 ¼" ELEC. DRILL

Perm-Align gears. All Ball-bearings, Jacobs chuck. 1800 RPM/115 VAC Industrial Quality....$22.50

Speedway 200J ¼" drill w/ chuck. 2400RPM/115 VAC $14.25

Speedway 400J ½" drill w/ chuck. 2400 RPM/115 VAC $29.95

Speedway 200J Kit, Incls 200J ¼" drill & over 30 accessories. $25.50 Reg. List "TAB".....$18.95

Thor 5" Power Saw (90° cut 1-5/16" 45° cut 1¼").....$22.95

Cummins 6¾" Maxsaw (90° cut 2⅛" 45° cut dress 2x4).....$39.95

— "TAB" COMBO SPECIALS —

29 Pcs. drill set 1/16" to ½" with ¼" shank plus 200J ¼" elec. drill...$23.95

29 Pcs. drill set 1/16" to ½" plus 400J ½" elec. drill.....537.50

CHROME VANADIUM SPEED DRILLS

60 Pcs. set #1 to 60 C.V.....$5.95

29 Pcs. set 1/16" to ½" by 64ths ¼" shank. Wood case $9.95

5 Pcs. Wood Bit set ¼" shank.....$1.98

13 Pcs. set 1/16" to ¼" With Index $1.98

Hand Saw, Swedish Steel Cross Cut.....$3.98

¼" DRILL ATTACHMENTS

ROTO Sabre Saw $8.05 lots of 3; $8.95 ea

ROTO Hole Saw . . 3.37 lots of 3; 3.75 ea

ROTO Hacksaw . . 4.04 lots of 3; 4.50 ea

ROTO Hcksw. Sndr 6.74 lots of 3; 7.50 ea

ROTO Buzzsaw . . 9.67 lots of 3; 10.75 ea

REPAIR KITS

#873 UTILITY KIT: Incls (4) interchangeable screwdriver blades & handle, electrician's pliers, adj. wrench, long nose pliers snap around knife.....$3.59

#874 BUDDY KIT: Incls (5) interchangeable screwdriver blades & handle, 3 ft. steel tape rule, diagonal cutter & case.....$1.79

FAMOUS SOLDERING GUNS

TA 5-4 Soldering Gun 135W.....$7.89

TA 10 Soldering Gun 180W at tip....8.83

TA D-4 Dual Heat 100-150W.....9.65

TA D-5 Dual Heat 200-275W.....10.53

Lenk Soldering Gun—the Best.....7.45

TEST EQUIPMENT* PRICES SLASHED

EMC #208 Tube Tester $24.90 Reg. "TAB".....$21.95

EMC #106K VTVM Kit $23.90 Reg. "TAB".....$21.95

EMC #104 Multitester (20K PV)..$23.95

EMC #107 VTVM 4.90 Reg.....$42.95

EMC #206 Mutual Cond. Tube Tester $83.50 Reg. "TAB".....$67.50

HICKOK 600A Tube Tester, $164 Reg. $150

TRIPLETT 630 VOM, $38.71 Reg....$36

SIMPSON 260 VOM $38.17 Reg....$36

*Demonstrator Models

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

WRITE FOR COMPLETE LISTING

0A2	$0.88	4E27	22.49	6U4	.74	84/6Z4	.62	829B	12.48
0A3/VR75	1.04	4J22	129.51	6U8	.99	100TH	9.88	832	7.72
0B2	1.39	5D21	19.98	6V6	1.39	117Z3	19.48	832A	9.92
0B3/VR90	.96	5D21	14.98	6V6GT	.59	117L		833A	39.45
0C3/VR105	.92	5J29	11.92	6W4GT	.39	M7GT	1.98	834	5.95
0D3/VR150	.92	5R4GY	1.20	6X5GT	.54	117Z6GT	.96	836	5.95
1B3	.79	5R4GYW	1.75	6Y6G	.88	117Z6M	9.98	837	11.49
1B22	1.82	5U4G	.54	7A8	.68	FG166	48.49	849	29.45
1B23	8.87	5V4G	.98	7C7	.76	FG172	29.00	860	4.48
1B24	8.98	5Z3	.99	7F7	.76	250TH	18.97	861	22.48
1B26	2.24	6AG5	.71	7F8	1.24	250TL	17.75	865	1.49
1B27	11.98	6AG7	1.14	7H7	.72	304TH	12.49	866A	1.25
1B32/532A	2.48	6AH6	1.21	7N7	1.06	304TL	12.49	872A	3.29
1B35	9.15	6AJ5	1.24	7V7	.92	388A	1.48	CK1005	.68
1B37	14.87	6AK5	.87	7Y4	.68	WL417A	8.48	1613	.82
1B38	29.45	6AK6	.92	8D21	298.00	417A		1614	1.05
1B40	1.98	6AL5	.48	12A6	.48	5842	18.50	1619	.36
1B63	45.00	6AL7GT	.98	12AH7GT	1.45	GL434A	12.69	1625	.32
1D21/5N4	3.89	6AN5	3.27	12AL5	.54	446B	3.48	1632	.68
1L4	.48	6AQ5	.52	12AT6	.54	450TH	45.97	1633	.68
1L6	1.35	6AQ6	.81	12AT7	.89	450TL	52.00	1634	1.18
1LD5	.52	6AQ7GT	1.29	12AU6	.59	460/		1635	1.69
1LN5	.78	6AR6	3.27	12AU7	.59	HF200	15.95	1636	3.08
1R4	1.29	6AS7G	3.48	12AV6	.52	CK502AX	1.49	1642	.62
1R5	.59	6AT6	.54	12AV7	.98	CK503AX	1.49	1644	.92
1U4	.52	6AU5GT	1.10	12AW6	1.18	CK505AX	1.79	2050	1.48
1U5	.54	6AU6	.49	12AX7	.98	CK512AX	1.45	2050W	2.48
1X2A	.89	6AV5GT	.98	12AY7	1.69	CK531	5.72	8670	3.44
2A4G	1.18	6AV6	.48	12BA6	.59	CK532DX	1.89	CK5672	1.20
2C36	27.00	6AW6	1.09	12BA7	.94	WL532A	3.68	CK5678	1.28
2C39A	26.98	6B4G	1.18	12BD6	.59	CK533AX	1.29	CK5687	1.74
2C40	4.98	6BA6	.49	12BE6	.59	CK536AX	.99	CK5702	2.90
2C43	17.48	6BA7	1.09	12BF6	.85	CK538DX	.98	CK5703	1.29
2C44	1.15	6BC5	.63	12BH7	1.29	CK539DX	2.19	5713	120.00
2C51	3.88	6BC7	1.23	12SA7GT	.68	CK541DX	1.99	5719	2.99
2D21	1.18	6BD6	.83	12SC7	1.08	CK543DX	.99	5814	2.08
2E31	1.49	6BE6	.54	12SF7GT	.84	CK544DX	.99	5840	7.98
2E43	1.49	6BF5	.98	12SG7	.80	CK546DX	1.99	8012	2.58
2J31	27.00	6BG6G	1.58	12SH7	.63	CK571AX		8013A	3.92
2J33	27.00	6BH6	.63	12SJ7	.54	5886	2.49	8020A	2.98
2J37	12.70	6BJ6	.69	12SK7	.66	CK573AX/ 6029	3.49	9001	1.12
2J38	69.98	6BK7	1.58	12SL7GT	.62	WL676	34.98	9002	.82
2J39	6.98	6BL6	58.25	12SN7GT	.68	7034	1.49	9003	1.12
2J48	24.45	6BL7GT	1.19	12SQ7GT	.54	7054	1.72		
2J49	84.00	6BN7	2.69	12SR7	.66	705A	1.88	XTAL DIODES	
2J50	99.98	6BQ6GT	.99	FG17	3.90	707A	7.90	1N21	.30
2J51	238.98	6BQ7	1.65	24G/3C24	1.32	707B	14.88	1N21A	1.55
2J55	84.98	6BR6	.58	25B06GT	.98	715A	3.95	1N21B	2.10
2J56	149.52	6BR8	.52	25L6GT	.58	715B	7.94	1N22	1.22
2J62	49.45	6C4	.52	25Z5	.78	715C	17.98	1N23	1.35
2K22	23.48	6C8G	.59	25Z6GT	.58	717A	.88	1N23A	1.89
2K23	11.48	6C86	.59	FG27A	8.24	721A	24.48	1N23B	2.00
2K25	28.49	6D4	2.70	25Z6W	1.94	721A	3.92	1N25	4.98
2K25/ 723AB	23.88	6J4	6.66	35B5	.52	722A/287	1.94	1N26	8.75
2K28	27.48	6J5	.54	35L6	.67	723A/B	16.98	1N27	1.55
2K29	22.88	6J6	.58	35T	4.88	724B	3.95	1N34	.40
2K33	219.48	6L6	1.48	35Y4	.68	725A	9.98	1N35	1.65
2K39	134.99	6L6G	1.08	35Z5	.58	726A	14.48	1N38A	1.29
2K41	126.00	6L6GA	1.08	41	.72	726B	31.00	1N41	8.95
2K45	72.50	6L6GAY	1.98	42	.66	726C	44.00	1N42	16.95
2K48	99.48	6SA7GT	.66	45Z3	.88	801A	.42	1N45	1.49
2X2	.42	6SC7	.90	50A5	1.98	803	3.48	1N46	.69
3B22	2.48	6SF5	.78	50B5	.76	805	3.22	1N47	4.00
3B23	RK22 4.95	6SG7	.64	50C5	.54	807	1.25	1N48	.47
3B24	2.15	6SH7	.56	50L6GT	.54	808	2.62	1N51	.45
3B26	3.70	6SJ7	.51	FG67	.58	809	3.58	1N54	.78
3B28	7.90	6SK7GT	.56	HY69	14.68	810	10.88	1N54A	1.00
3C22	85.00	6SL7GT	.64	71A	4.98	811	3.95	1N58A	1.15
3C23	8.67	6SN7GT	.59	75	.74	812	2.70	1N60	.40
3C33	7.50	6SQ7GT	.62	80	.64	813	11.48	1N63/K63	2.49
3C45	9.98	6SR7	.62	83	.58	814	4.98	1N64	.69
3D21A	8.15	6S57	.88	83	1.38	815	5.98	1N69	.98
3E29	14.49	6SU7GTY	2.69	83	1.12	826	1.98	Other Types In Stock. Write.	
4D21	18.99	6T8	.96	83V	1.22	828	9.25		
						829	7.94		

NEW

Here are wire wound power resistors designed for today's servicing requirements. New, rectangular design is more compact. Famous IRC element is sealed in ceramic case for complete insulation and protection. Axial leads are easily soldered and speed replacement. Clear, permanent markings give full identification.

- **2 SIZES—PW-7 seven watts; PW-10 ten watts.**
- **COST LESS—new, low price for IRC Power Resistors.**
- **FULL POWER—Conservative ratings permit continuous operation at full power.**
- **NEW VALUES—in keeping with today's needs.**

WIRE WOUND POWER RESISTORS

in handy Resist-O-Card Assortments

IRC Resist-O-Cards are easier to buy, stock and use. Values are printed on each card—you always know what you have, and you always have what you need. Assortments are based on popular usage.

- **ASSORTMENT # 19—Twenty 7 watt resistors. Dealer Price $6.20**
- **ASSORTMENT # 20—Twenty 10 watt resistors. Dealer Price $6.60**
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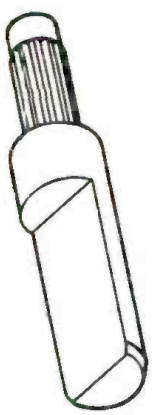
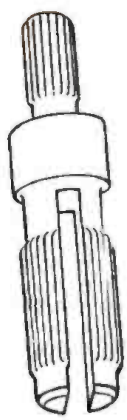
INTERNATIONAL RESISTANCE COMPANY

401 N. BROAD STREET, PHILADELPHIA 8, PA.

Wherever the Circuit Says ~~~

The simplest—and best—control replacements you can install





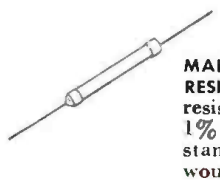
SAVE YOURSELF TIME with Mallory Midgetrols®—the carbon controls designed for *both* you and your customers. Features like the easily-cut tubular shaft that fits split-knurl or flatted knobs . . . line switches that you attach without disassembling the unit . . . will save valuable minutes of your shop work.

GIVE CUSTOMERS THE BEST with Midgetrols—the control that's engineered to equal or exceed the performance of original components. Their precise tapers, noise-free operation and excellent stability add up to the kind of performance that prevents call-backs . . . builds customer good-will.

ORDER YOUR STOCK TODAY Your nearby Mallory distributor is ready to supply you with a Control Kit that will equip you to replace controls in 90 per cent of the radio and TV sets in your area.

BE SURE TO USE . . .

MALLORY WIRE WOUND CONTROLS . . . a wide selection of resistance, wattages from 2 to 500, and variety of tapers . . . all designed for cool operation and long life.



MALLORY DEPOSITED CARBON RESISTORS . . . high stability resistors with tolerances of 1% or 10% . . . at cost substantially lower than wire wounds.

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