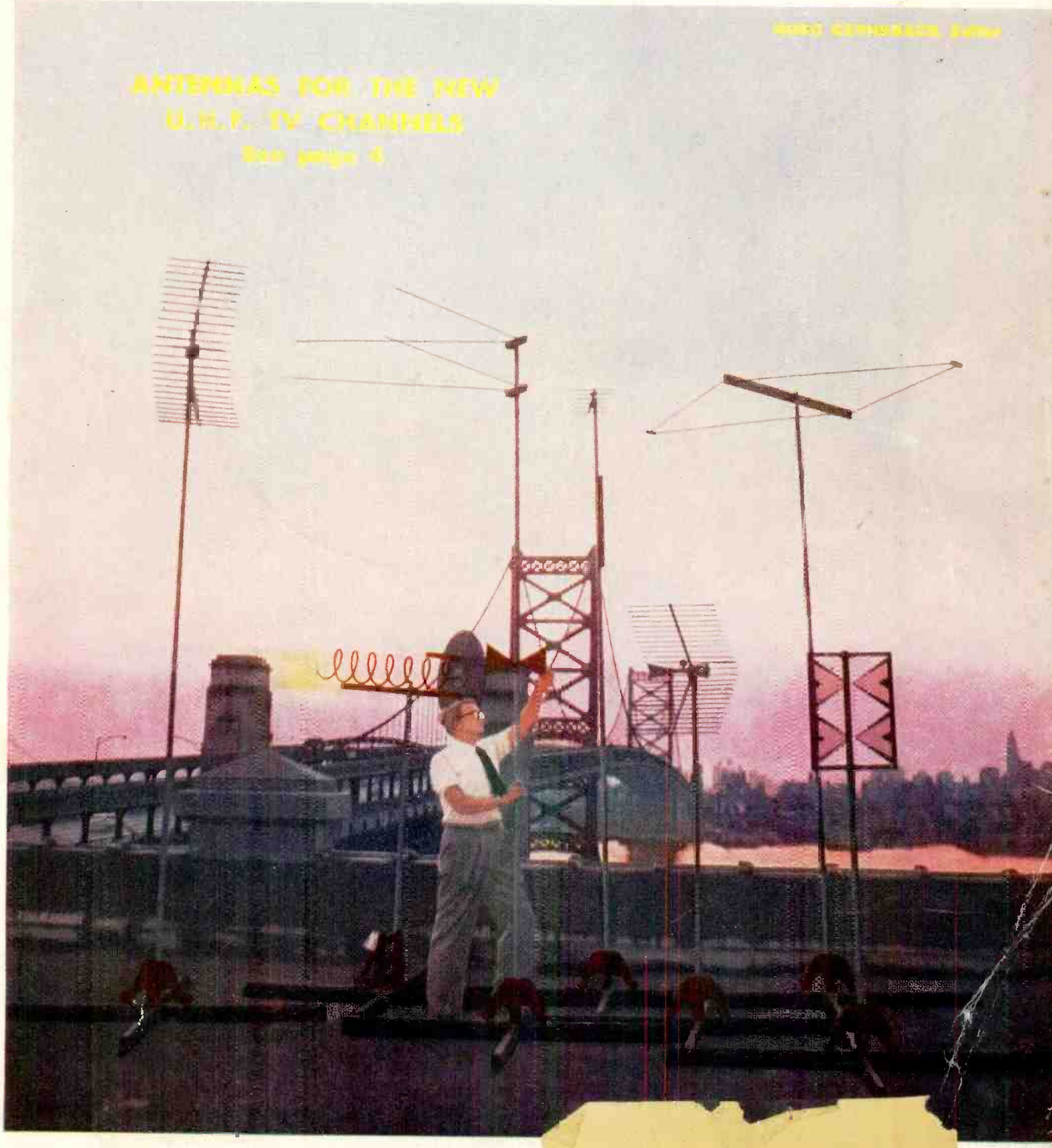
RADIO-ELECTRONICS

DECEMBER 1952

LATEST IN TELEVISION • SERVICING • AUDIO



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U. S. and CANADA

In this issue: **Audio Equalizer D**
Electronic Flame •

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Extra long-playing "Personal" type RCA radio batteries

These RCA long-life batteries have completely revolutionized the design and performance of "personal" type portable radios. They've opened up a brand-new replacement market for you that *never before existed.*

Think of it . . . the revolutionary, new RCA VS216, 67½-volt "B" Battery plays newly designed "personal" type portable radios *twice* as long as ordinary 67½-volt batteries. The new, companion RCA VS236 1½-volt "A" Battery (size G) provides up to *five times* the life of ordinary "A" batteries (size D).

New "personal" type portable radios designed to use one VS216 and two VS236 batteries can play up to *10 times longer without a battery change* than previous models using one 67½-volt "B" battery and one 1½-volt "A" battery of the ordinary type. This new battery complement offers savings in battery operating cost of as much as 25%!

Secret of the longer useful life of the new RCA VS216 "B" Battery is its use of "crown-type," alkaline dry cells. These cells use their active ingredients more effectively than do ordinary cells—resulting in greatly increased playing time.

The new RCA Victor Super "Personal" radio, model 2B400 series, has been designed to use the new RCA "balanced-life" battery complement. Tens of thousands of these as well as other makes of new "personal" type portables have been sold all over the country, creating a *ready-made* battery replacement business for *you.* It's alive, real and profitable today . . . ACT NOW. TMK ®

RCA

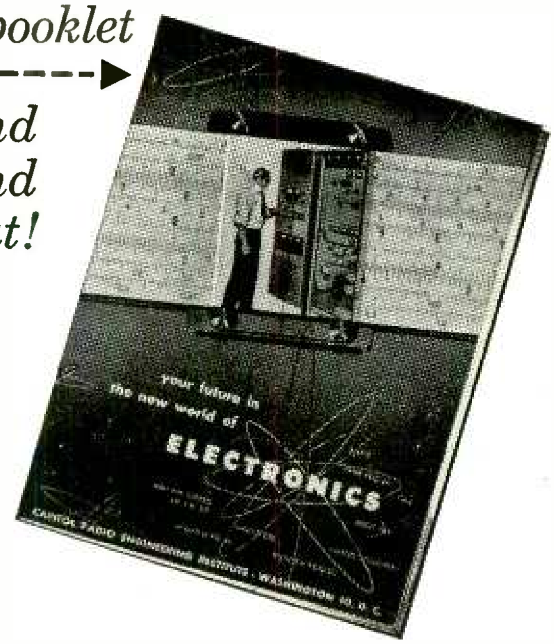
RADIO CORPORATION of AMERICA

RADIO BATTERIES **HARRISON, N. J.**

HOW YOU CAN *plan for success* IN TV-ELECTRONICS

Send today for this free CREI booklet

and find out!



You have a greater chance for success if you sincerely believe that success doesn't just *happen*. For every man who reaches the top on luck or looks, tens of thousands come up the planned way. The planned way means outlining your objectives, choosing the means of reaching your objectives, and having a burning ambition to succeed. You must plan your TV-Electronics career carefully, because these are fields where the rewards go to the man with technical knowledge.

When you read CREI's fact-packed booklet, called "Your Future in the New World of Electronics," you will get a complete picture of the electronics industry—where it is going—and how you can go forward with it.

This is a field expanding so rapidly that the most optimistic experts fall short in their predictions.

Consider the 2,980 radio stations and the 111 TV stations now operating plus the 2,073 more made possible by the FCC "unfreeze." Consider the 18,626,860 TV sets and over 100,000,000 radios now in operation. Consider the many positions to be filled by these and other developments. This year CREI is celebrating its 25th Anniversary. Since 1927 CREI has provided thousands of professional radiomen with technical educations. During World War II, CREI trained thousands more for the Armed Services. Leading firms now use CREI courses for group training in electronics at company expense; among them are United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Sears Roebuck & Co., Bendix Products Division All-American Cables and Radio, Inc., and RCA-Victor Division and Machlett Laboratories.

CREI courses are prepared by recognized experts, in a practical, easily-understood manner. You get up-to-date study materials; your work is under the personal supervision of a CREI Staff Instructor who *knows* and *teaches you* what industry needs. You choose your own hours of study *at home*. Upon completion you join the many CREI graduates who have found their diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold many top positions in America's leading firms.

CREI resident instruction (day or night) is offered in Washington, D. C. New classes start once a month.

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At your service is the CREI Placement Bureau which finds positions for students and graduates. Although CREI does not guarantee jobs, the bureau now has more requests for personnel than it can fill. Talk to men in the field and check up on CREI's high standing in electronics instruction. Determine for yourself right now that your earnings are going to rise with your knowledge—and that you will rise *with* this booming industry. All this CREI offers you, provided you sincerely want to learn. Fill out the coupon and mail it today. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future—is up to you.

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RADIO-ELECTRONICS

Formerly RADIO-CRAFT • Incorporating SHORT WAVE CRAFT • TELEVISION NEWS • RADIO & TELEVISION*

CONTENTS

DECEMBER 1952

MPA

ON THE COVER

Measurements and tests on new u.h.f. TV antennas on roof of one of the RCA buildings at Camden, N. J. Vertical bars at rear are part of Philadelphia bridge, not a new antenna.

Color original courtesy of RCA

MEMBER Audit Bureau of Circulations

Vol. XXIII, No. 15

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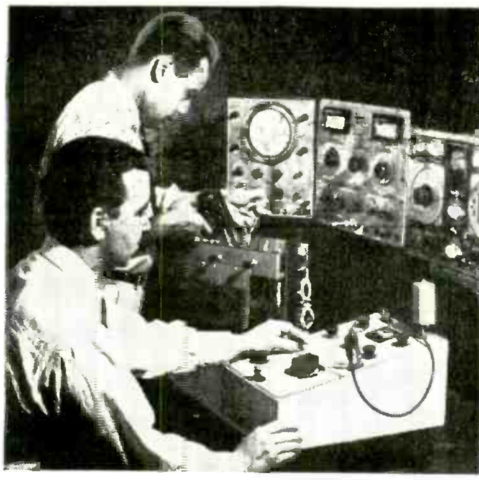

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At Portland, Oregon, where America's first UHF commercial station became air-borne on September 20, 1952, WALSCO UHF antennas were the *first* to be tested and approved...overwhelmingly *accepted* by the major jobbers in Portland, as well as countless dealers and service technicians. Only WALSCO was given such endorsement of its *Reflecto-Fan* and *Corner Reflector* antennas. Under the most strenuous field conditions, WALSCO was proven *best* by actual test. This is on-the-spot *proof* of matchless performance in America's first commercial UHF area.

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- I admire its remarkable 20 year record of helping men build brighter futures.
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- Never have I heard young men praise a school as enthusiastically as do the students and graduates of D.T.I. They are its best boosters.

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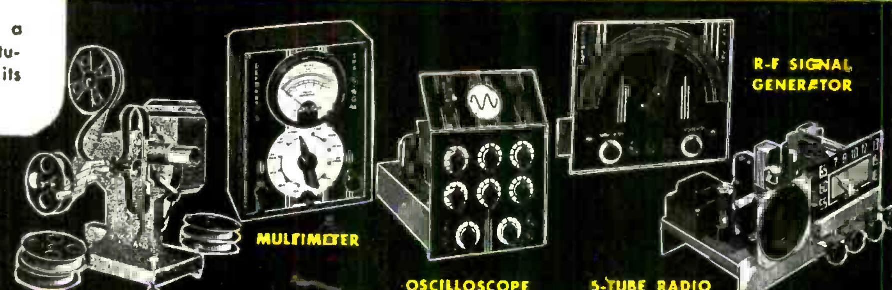
See for yourself how readily you may prepare at home, or in our modern Chicago laboratories, for a better job or business of your own in one of America's fastest-growing fields—TELEVISION-RADIO-ELECTRONICS.

If you train at home you get (1) the use of a 16-mm. movie projector and 16 reels of animated movies to help you learn important points faster . . . easier, (2) modern lessons and (3) sixteen shipments of electronic parts enabling you to get valuable practical experience from over 300 projects—including building and keeping the electronic equipment shown below. And upon completing training, you have the optional privilege of building and keeping a big 17-INCH TV set at moderate added cost. Get the full story. Mail coupon today!



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D. T. I.'s remarkable home training benefit of visual training MOVIES has been praised from the floor of the House of Representatives in Washington, D. C. and recorded in The Congressional Record.

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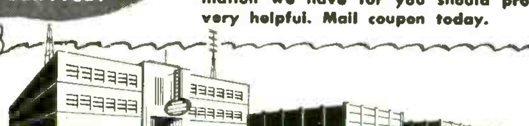

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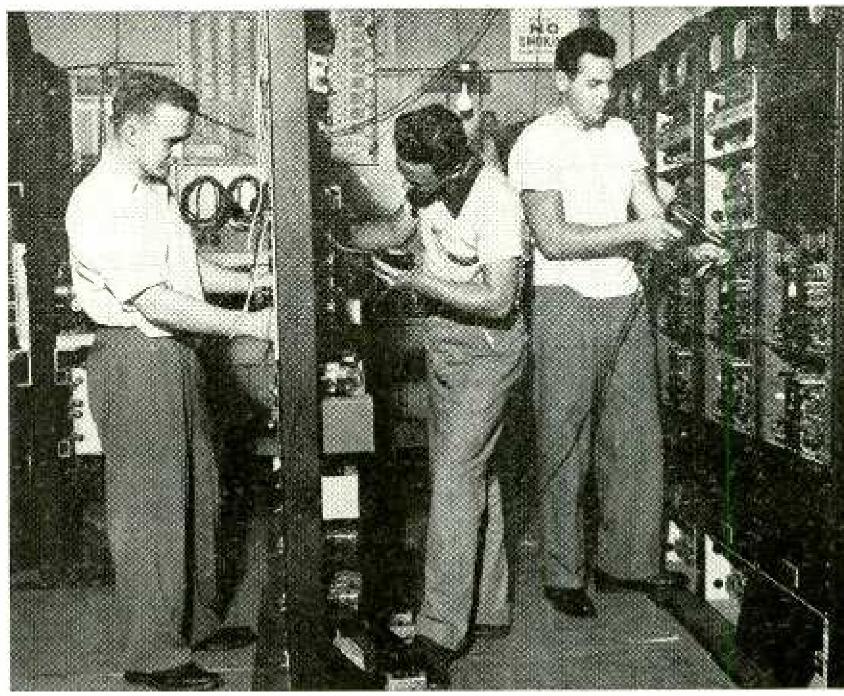
CADMIUM SULPHIDE CRYSTALS are the equal of germanium, selenium, and other semiconductors for rectifier and transistor applications, according to a paper delivered by G. Strull of Northwestern University at the recent National Electronics Conference in Chicago. J. G. Krisilas of American Phenolic Corp. presented data on the use of liquid dielectrics for coaxial cables and fittings. Tests cited by Mr. Krisilas show liquid-insulated cables have eight times the power-handling capacity and half the corona loss of solid-dielectric types.

U.S. AND CANADA radio amateur licenses are now valid in either country. The 1951 radio treaty, now in effect, also extends reciprocal operating privileges to civilian and military aircraft, and to public-utility and private mobile two-way radio installations.



Installing the multi-channel sound system for the first public showing of *Cinerama*.

"CINERAMA" MOTION-PICTURE projection system, now drawing capacity audiences in New York City, creates startling realism through the use of a 51-foot-wide semicircular screen, and a multi-channel "stereophonic" sound system. Three film projectors flash overlapping images which fill almost the full field of vision, giving the viewer a sense of actual participation in the scene; while five speaker systems spaced across the width of the panoramic screen, and fed by separate sound tracks, place the apparent source of sound directly at the position of the object. An extra sound track carries the combined effects of all the others as a protection against breakdown in any part of the complex sound system.

The photograph shows part of the multi-channel sound installation. Showings of *Cinerama* have been scheduled for other cities in the near future.

JAPAN BARS U.S. TAPE recorders in patent dispute. Tokyo Tsushin Kogyo (Tokyo Communications Industry) has obtained a court order halting the import, use, or sale of American tape recorders, claiming its Japanese patents—issued in 1940—antedate ours.

MERLIN H. AYLESWORTH, former president of NBC, died September 30 in New York City at the age of 66. An attorney and outstanding utilities executive, Mr. Aylesworth was named president of NBC at its founding in 1926, and was largely responsible for the development of commercially sponsored programs, nation-wide network broadcasting, and the establishment of Radio City in New York as a broadcast center. Following his retirement from NBC in 1936, Mr. Aylesworth became president and chairman of the board of RKO, and later joined the Scripps-Howard newspaper chain as publisher of the New York *World-Telegram*. During the recent war he served as executive consultant to the Office of Inter-American Affairs.

$200 MILLION YEARLY power bill is TV's boon to the public utilities industry, Dr. Charles B. Jolliffe, RCA vice-president, told a recent conference of utility executives. This represents only receiver consumption, said Dr. Jolliffe, and power companies will benefit still further from increased use of electricity and fuel as families spend more time at home, as well as from new transmitter and studio installations.

VENEZUELA'S FIRST TV station, now under construction in Caracas, the capital, is expected to go on the air in December. The government-operated station, using RCA equipment throughout, will offer cultural programs.

(Please turn to page 14)

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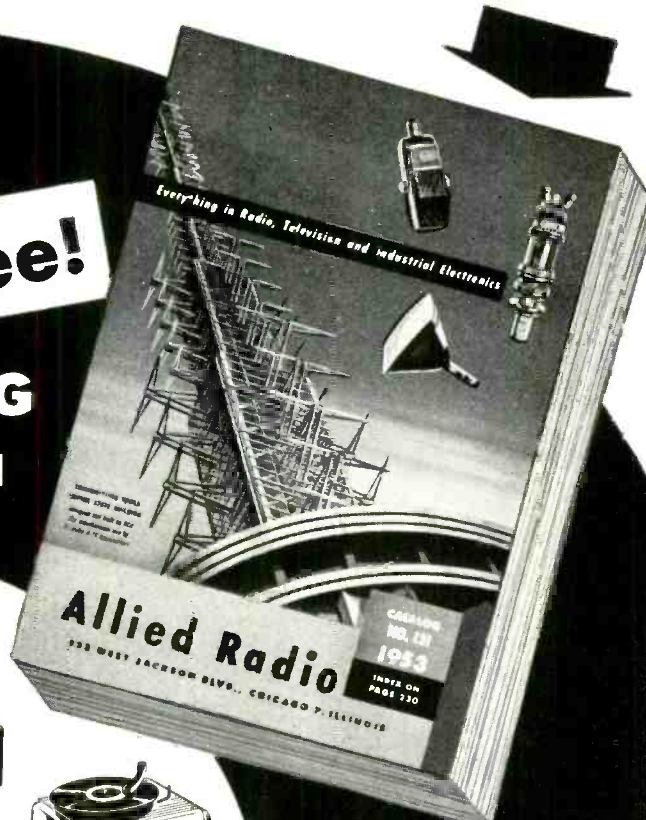

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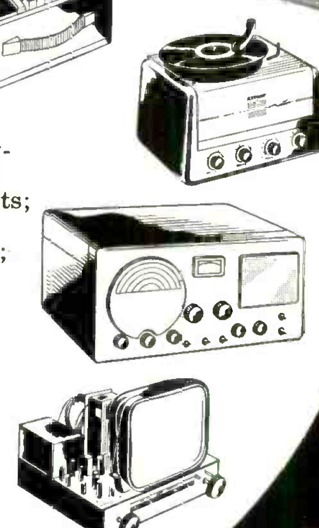

Here's the *one* authoritative, complete Buying Guide to *Everything in Electronics*—packed with the world's largest selections of quality equipment at lowest, money-saving prices. See the latest in TV, AM and FM receivers; High-Fidelity Custom Sound components; latest P.A. Systems and accessories; recorders; Amateur receivers, transmitters and station gear; specialized industrial electronic equipment; test instruments; builders' kits; huge listings of parts, tubes, tools, books—the world's *most complete stocks* of quality equipment.

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Redskin
MOLDED TUBULAR CAPACITOR

Chieftain
DRY ELECTROLYTIC CAPACITOR

for *sure* television capacitor replacements

When you replace television capacitors you want to *know* that your replacements won't cause "headaches" in unnecessary call-backs because of premature failure. You *can* be sure that these Sangamo TV replacements will live up to their reputation. Used as original equipment, they're "tops" for dependable replacements.

THE REDSKIN is a molded paper tubular, especially adapted to television. It's easy to work with—the leads are securely imbedded in a hard plastic case and have been especially designed to resist breakage. The REDSKIN is strong and it's dependable at 85° C, even under extreme humidity.

THE CHIEFTAIN is a dry electrolytic that fits anywhere! Tiny, but durable, it is ideal for application in tight spots beneath a chassis. Bare tinned-copper wire leads make it easy to mount. Maintains uniform capacity when subjected to high ripple currents at 85° C.

REMEMBER . . . these are only two of a complete line of mica, paper and electrolytic capacitors that will take care of practically any replacement requirement in the radio and television field.

SANGAMO ELECTRIC COMPANY
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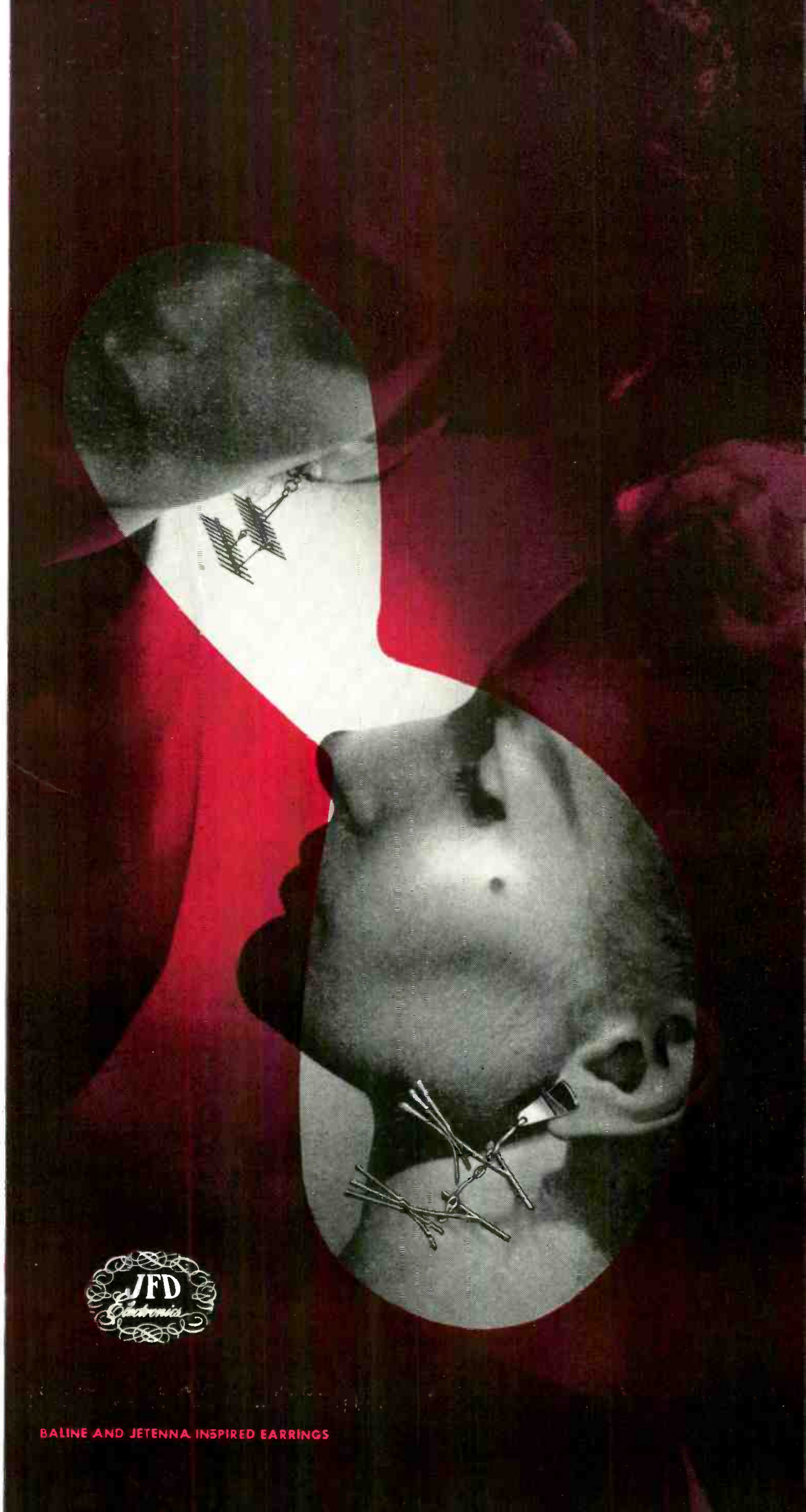
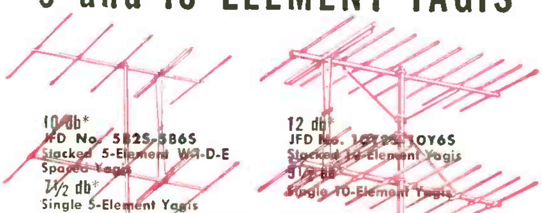
SC51-10A

for the ultimate in sight and sound



Baline**

5 and 10 ELEMENT YAGIS



10 db*
JFD No. 5B2S-5B6S
Stacked 5-Element W-I-D-E Spaced Yagis
7½ db*
Single 5-Element Yagis

12 db*
JFD No. 10Y2S-10Y6S
Stacked 10-Element Yagis
9½ db*
Single 10-Element Yagis

*Gain over a tuned folded dipole, tested and attested to by the Hazeltine Corporation, leading electronic research laboratory.

Single JFD 10-Element High-Band BALINE Yagis

Channels	Models	List Price
7-13	10Y7-10Y13	$13.85

Single JFD 10-Element Low-Band BALINE Yagis

Channels	Models	List Price
2	10Y2	$31.85
3	10Y3	
4	10Y4	$28.45
4 and 5	10Y45	$33.90
5	10Y5	$28.45
6	10Y6	$25.70

Stacked JFD 10-Element BALINE Yagis

Channels	Models	List Price
2	10Y2S	$63.70
3	10Y3S	
4	10Y4S	$56.90
4 and 5	10Y45S	$67.80
5	10Y5S	$56.90
6	10Y6S	$51.40
7-13	10Y7S-10Y13S	$27.70

Include JFD Baline Matching Transformers at No Extra Charge

Single JFD 5-Element High-Band BALINE Yagis

Channels	Models	List Price
7-13	5B7-5B13	$ 7.50
7 and 9	5B79	$10.75

Single JFD 5-Element Low-Band BALINE Yagis

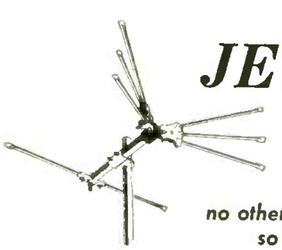
Channels	Models	List Price
2	5B2	$17.60
3	5B3	
4	5B4	$16.65
4 and 5	5B45	$22.05
5	5B5	$16.65
6	5B6	$15.85

Stacked JFD 5-Element BALINE Yagis

Channels	Models	List Price
2	5B2S	$35.20
3	5B3S	
4	5B4S	$33.30
4 and 5	5B45S	$44.10
5	5B5S	$33.30
6	5B6S	$31.70
7-13	5B7S-5B13S	$15.00
7 and 9	5B79S	$21.50

Include JFD Baline Matching Transformers at No Extra Charge

W-I-D-E S-P-A-C-E-D



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no other fan conical assembles so fast, performs so well!

Series with 1" seamless aluminum square crossarm and seamless aluminum elements reinforced with heat-treated aluminum dowels.

No. JeT160	Single Bay	Up to 8.8 db*	$12.50 List
No. JeT161	2 Bay	Up to 12.5 db*	$26.40 List
No. JeT164	4 Bay	Up to 15.5 db*	$56.80 List

Series with 1" seamless aluminum square crossarm and butt-seam aluminum elements with heat-treated aluminum dowels.

No. JeT660	Single Bay	Up to 8.8 db*	$ 9.75 List
No. JeT661	2 Bay	Up to 12.5 db*	$20.70 List
No. JeT664	4 Bay	Up to 15.5 db*	$45.40 List

*Performance tested and figures verified by the Hazeltine Corporation, Little Neck, N. Y., World Famous Research Laboratory.

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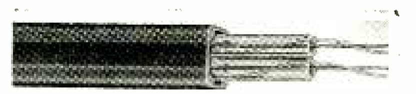
World's Largest Manufacturer of TV Antennas and Accessories

**REGISTERED TRADEMARK

BALINE AND JETENNA INSPIRED EARRINGS

THE QUARTER CENTURY Wireless Association, an organization of radio amateurs who have been licensed for 25 years or more, will hold its fifth anniversary dinner meeting at 7 p.m., Friday, December 5, at the historic Fraunce's Tavern, in New York City. The Association, founded only five years ago, now has over 550 members.

NEW LEAD-IN FOR U.H.F.-TV installations, developed jointly by RCA and Anaconda, has unique construction that gives it low losses and high resistance to weathering and abrasion. Each Copperweld conductor floats on a spiral polyethylene thread inside a sleeve of the same material. The sleeves



are supported and spaced only by point contact with each other and with bosses molded in the corners of the rectangular outer jacket. Known as ATV-270, the new line is ½ inch wide and ⅜ inch thick, has a characteristic impedance of 270 ohms, with losses of 3.6 db per 100 feet at 500 mc, and 5.1 db per 100 feet at 900 mc.

ELECTRONIC INSTRUMENTS for medical research and therapy, and developments in the use of various forms of atomic energy in medicine were to be discussed by leading scientists, engineers, and physicians at the fifth annual AIEE Conference on Electronic Instrumentation and Nucleonics in Medicine. The conference was to meet November 24 and 25, at the Hotel New Yorker in New York City.

RECTANGULAR TUBES now make up 99% of the total output of TV kinescopes, according to the report of the Radio-Television Manufacturers Association for August, 1952. Tubes 18 inches and larger made up 68% of the total, and practically all were 16 inches or larger.

MUSIC REPRODUCTION from the viewpoints of the musician, scientist, and home listener, is the subject of a series of monthly lecture-demonstrations being given at the Engineering Societies Building in New York City. The series started in November and will run till April. It is sponsored by the Basic Science Division of the AIEE.

A COMPUTER CONFERENCE sponsored jointly by the AIEE, IRE, and ACM (Association for Computing Machinery) will be held December 10, 11, and 12, at the Park Sheraton Hotel in New York City. Eighteen papers on computer input and output equipment will be presented during the three-day conference.

ELECTION RETURNS, aided by electronics, reached voters sooner this year than four years ago. Electronic computers, set up in the central studios of the larger radio networks, added and tabulated the vote at a rate exceeding that which has been possible in any previous election.

According to E. J. Quinby, director of research of the Monroe Calculating Machine Co., which supplied the computers used by NBC, the use of electronic computing equipment also makes reports on trends—calculated from all the significant factors—possible with a speed and completeness never before known. Heretofore intuition has been a large factor in such reports, as tabulation and study of even a fraction of the pertinent data would take much more than the available time.

ELECTRONIC SCALES, often used to measure weights of moving railroad cars, have been adapted to highways by engineers of the U. S. Bureau of Public Roads. Gross weight, speed, axle loads, and axle spacings are measured in a fraction of a second when a truck rolls across an inconspicuous platform in the road.

Strain gauges (wires of known resistance) change value when stretched or compressed by the weight of the vehicle. Changes are recorded instantly on the screen of a calibrated oscilloscope.

At present, a six-man party equipped with portable loadometers can weigh only about 200 trucks in eight hours, at a cost of about $125. Truckers often take roundabout routes to avoid being delayed at a weighing station.

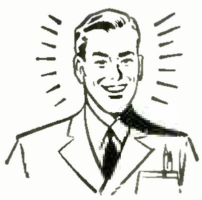
With the electronic scales, trucks can be weighed without causing traffic tie-ups, and overloaded trucks can be spotted quickly.

EDUCATIONAL TV on a national educational network is believed possible in 1953, according to George Probst, chairman of the Chicago Committee on Educational Television. A conference of educators from nineteen states was called to consider the plan of a committee that had been named by Mayor Joseph M. Darst, of St. Louis. The conference commended the FCC for tentatively setting aside 209 channels for educational use. Mayor Darst warned that unless some use is made soon of the channels they might be "forever lost to education."

Raymond H. Wittcoff, St. Louis manufacturer, chairman of the Mayor's Committee on Educational Television, and Mr. Probst were named co-chairmen of an eleven-member committee to formulate a working plan for the network before summer.

HI-FREQUENCY TRANSISTORS are now a practical possibility, according to the results of recent research. RCA has recently announced the development of experimental transistors that operate "at frequencies well up in the 10–200-mc band, and one of which reached a frequency as high as 225 mc." Thus they are suitable for TV and FM bands. B. N. Slade, transistor engineer for RCA, has discovered that frequency response depends on the spacing between the contact points and also on the resistivity of the germanium crystal. END

NOW MORE TV SET OWNERS ENJOY BETTER TELEVISION with B-T UNIT SYSTEMS



More and more SERVICE TECHNICIANS are using the B-T UNIT SYSTEM to plan and install Master TV Systems for VHF and UHF, for 1 Set or for 2000, and without outside engineering assistance. And today hundreds of thousands of set owners enjoy the benefits of Better Television

The **B-T UNIT SYSTEM** was designed expressly for the Service-Technician to help him meet the various problems which arise in his work. The B-T UNITS are intended for use wherever the Technician finds any one or all of the following requirements to exist: Amplifying Weak Signals . . . Handling Multi-directional Signals without a Rotator . . . Multi-set Distribution from a Single or Multiple Antenna Installation. (See Typical Applications)

The B-T UNIT SYSTEM is the result of exhaustive study projects conducted by Blonder-Tongue Laboratories, whose research facilities are entirely and continuously devoted to Better Television. All B-T UNITS are broad band, and require no channel tuning or band-switching.

B-T UNITS include:

MIXER AMPLIFIER MA-4
- Basic Chassis and Power Supply $52.50
- Individual Channel Plug-in Amplifier Strips $19.50
- UHF Conversion Strip To be announced

DISTRIBUTION AMPLIFIER DA-8
No Loss Distribution to 8 Sets $87.50

UL

DISTRIBUTION AMPLIFIER DA-2
No Loss Distribution to 2 Sets $39.50

COMMERCIAL ANTENSIFIER CA-1
All Channel Line Amplifier—27db Gain $77.50

UL

Prices shown are list

TYPICAL APPLICATIONS

FOR ↓ USE ➧	MA-4 plus Individual Channel Strips	CA-1 All Channel Line Amplifier	DA-8 Each Feeds 8 Sets	DA-2 Each Feeds 2 Sets
WEAK SIGNALS	✓ OR	✓		
MULTI-SET DISTRIBUTION			✓	✓
MULTI-ANTENNA INSTALLATIONS	✓			
COMMUNITY TV SYSTEMS	✓	✓	✓	✓

NOTE: These Units may be used alone or in any number of combinations. See Your Distributor, or Write to B-T Service Department for full specifications of B-T Units and Accessories.

Standard RTMA Warranties Apply

B-T LABS

BLONDER-TONGUE LABORATORIES, INC.
Westfield, New Jersey

YOU
make more money when you replace with
RAYTHEON PICTURE TUBES

RAYTHEON PICTURE TUBES GIVE YOU ALL THESE ADVANTAGES:

A brand new tube — Raytheon makes only new tubes of finest quality. Raytheon Picture Tubes have new glass, new guns, new screens.

Top quality — Raytheon Picture Tubes are the precision products of a multi-million dollar concern that has specialized in the design, development and manufacture of only top quality electron tubes for more than 26 years. During all this time RAYTHEON has *never* compromised with quality.

A thoroughly tested tube — *Raytheon Picture Tubes* and their components are given *101 rigid quality tests and checks* to insure electrical and mechanical perfection.

Right... for Sight!

An established brand name — Raytheon Picture Tubes don't need to be "sold" to your customers — thanks to Raytheon's national advertising and reputation for making only the finest quality tubes.

Service — *Raytheon Picture Tubes* are readily available through your Raytheon Tube Distributor.

A 1-year warranty — *Raytheon Picture Tubes* are guaranteed for 1 year from date of installation — a warranty backed by Raytheon — one of America's leading tube manufacturers.

THESE RAYTHEON PICTURE TUBE ADVANTAGES ADD UP TO:

Satisfied customers — Raytheon Picture Tubes will give your customers the finest picture, the finest performance possible. They'll build your reputation as a competent and thoroughly dependable Service Dealer — put you in line for repeat business and the business of your customers' friends.

More profit! — You'll save time on replacement jobs when you use *Raytheon Picture Tubes* because you work with complete confidence that their quality is uniform and will complement your skills. Saving time means more profit for you.

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

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

RAYTHEON MAKES ALL THESE

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

BAROMETER of the PARTS INDUSTRY

During October, 66 of the leading 400 manufacturers of radio-television-electronic parts and equipment made changes in their lines. Actually there was an increase in "change activity" as compared to September.

In price revisions by the number of manufacturers and products affected, the following summary illustrates the comparative trend for the months of September and October.

	No. of Manufacturers	
	September	October
Increased prices	6	13
Decreased prices	8	11

	No. of Products	
	September	October
Increased prices	454	68
Decreased prices	21	49

For a summary of the most active product categories, see the following table:

Product Group	Increased Prices		Decreased Prices		New Products		Discontinued Products	
	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products
Antennas & Access.	4	16*	5	32*	17	140*	5	48*
Capacitors	0	0	0	0	1	75**	0	0
Controls & Resistors	0	0	0	0	1	103	0	0
Sound & Audio Prod.	2	4*	0	0	14	78*	10	39*
Test Equipment	2	3**	0	0**	3	3*	3	7*
Transformers	0	0**	0	0	4	42**	2	8*
Tubes	5	45*	6	17*	9	76*	2	2**
Wire & Cable	0	0**	0	0**	2	52*	0	0**

* Increase over September
** Decrease from September

* Increase over September
** Decrease from September

Comment: The trend toward introducing new items continues as it has for the past five months. It is noticeable at this time that a greater number of manufacturers are involved than in the past. Tube and antenna manufacturers are showing more activity than in the past four months.

This data is prepared by the staff of United Catalog Publishers, Inc., 110 Lafayette Street, New York, publishers of RADIO'S MASTER, the Official Buying Guide of the Parts Industry.

Merchandising and Promotion

The Walter L. Schott Co., Los Angeles, is offering a new metal storage tray to service technicians who purchase Walsco "50-Line" packages through distributors. The tray holds up to 20 sliding-lid plastic containers which are labeled for the hardware items they hold.

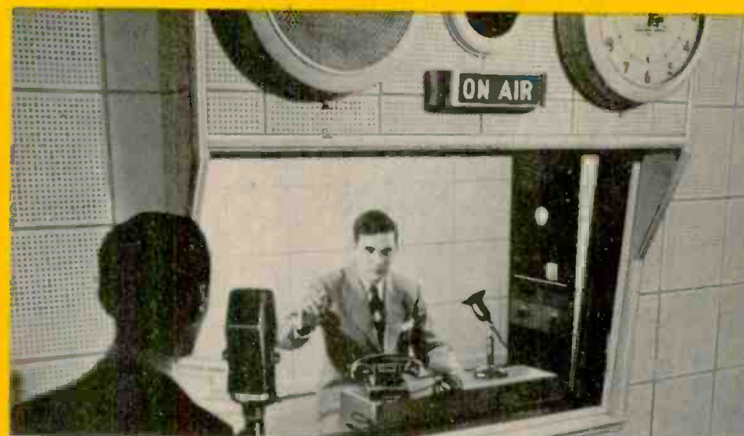
The General Electric Tube Department launched what it believes to be the first program of its kind in making cooperative billboard advertising available to TV service technicians through G-E tube distributors. Early reports indicate that the plan is meeting with marked success.

(*Please turn to page 22*)

(Above)—Walsco "50-Line" hardware assortment storage tray. (Below)—G-E's billboard sign aids local technicians.

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

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



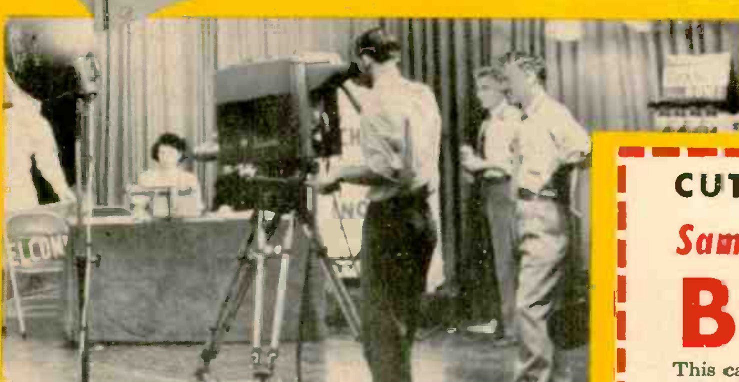
YOU LEARN SERVICING
by practicing with equipment I furnish

You build valuable Multitester (at left) as part of my Servicing Course. You use it to make many tests, get practical experience, make EXTRA money fixing neighbors' radios in spare time. Many of my students earn $5, $10 a week extra while learning. I send you many other kits too. You build a modern Radio. You build many circuits common to Radio and Television. All equipment is yours to keep. Read about and see other equipment in my free book. Mail card below.

YOU LEARN COMMUNICATIONS
by practicing with equipment I furnish

As part of my Communications Course I send you kits of parts to build the low power broadcasting transmitter shown at right and many other circuits common to Radio and Television. You use this equipment to get practical experience putting a station "on the air," performing procedures demanded of Broadcast Station operators. I train you for FCC Commercial Operator's License. Mail Card for Sample Lesson and 64-Page Book. FREE!

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



TELEVISION *is Today's Good Job Maker*

In 1951 over 15,000,000 homes had Television sets, more are being sold every day. 108 TV stations are already operating, over 1800 are now authorized and many hundreds are expected to be on the air in 1953. This means new jobs, more jobs and better pay for trained men. The time to act is NOW! Start learning Radio-Television servicing or communications. Want to get ahead? America's fast growing industry offers good pay, a bright future and security. Cut out and mail card now. J. E. Smith, President, National Radio Institute, Washington, D.C.

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.

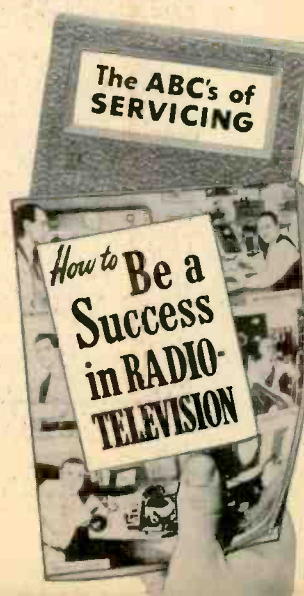
Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

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

ADDRESS...

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

A B C D E



SUPERIOR PERFORMANCE

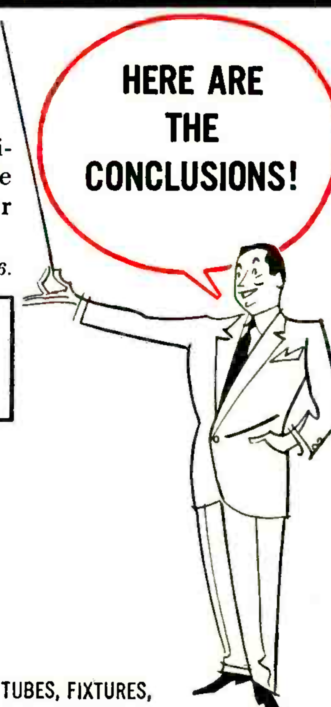
OF SYLVANIA PICTURE TUBES NOW PROVED BEYOND ALL DOUBT

LIFE TEST MAGNETIC TUBES
United States Testing Company
Hoboken, N. J.

Test No. 1-5526
Date 10-11-52
Engineer A.S.M.

Mfr.	Tubes Tested	Tubes Failed	Point Quality
A	8	3	76
B	8	4	79
C	8	6	62
D	8	4	74
E	8	4	67
F	8	5	42
G	8	4	52
H	8	5	30
SYLVANIA	8	0	93

Exhaustive tests by United States Testing Company prove Sylvania Picture Tubes out-last, out-perform all others tested!



● Hour after hour for over 1,400 consecutive hours, Sylvania Picture tubes were tested side by side with tubes of 8 other manufacturers. The chart at right tells the remarkable performance record. Note that only Sylvania Picture tubes showed no failures. Here's the conclusion of the U. S. Testing Company Report: "On the basis of an ultimate Life Test Evaluation of the eight tubes of each brand tested, it is our opinion, that the averaged overall qualities measured on the Sylvania Tubes were superior to the averages of the other brands tested."*

* *United States Testing Company, Inc., Test No. E-5526.*

We'll be glad to send you full details of this report. Send your request to Sylvania Electric Products Inc., Department R-2712, 1740 Broadway, New York 19, N. Y.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

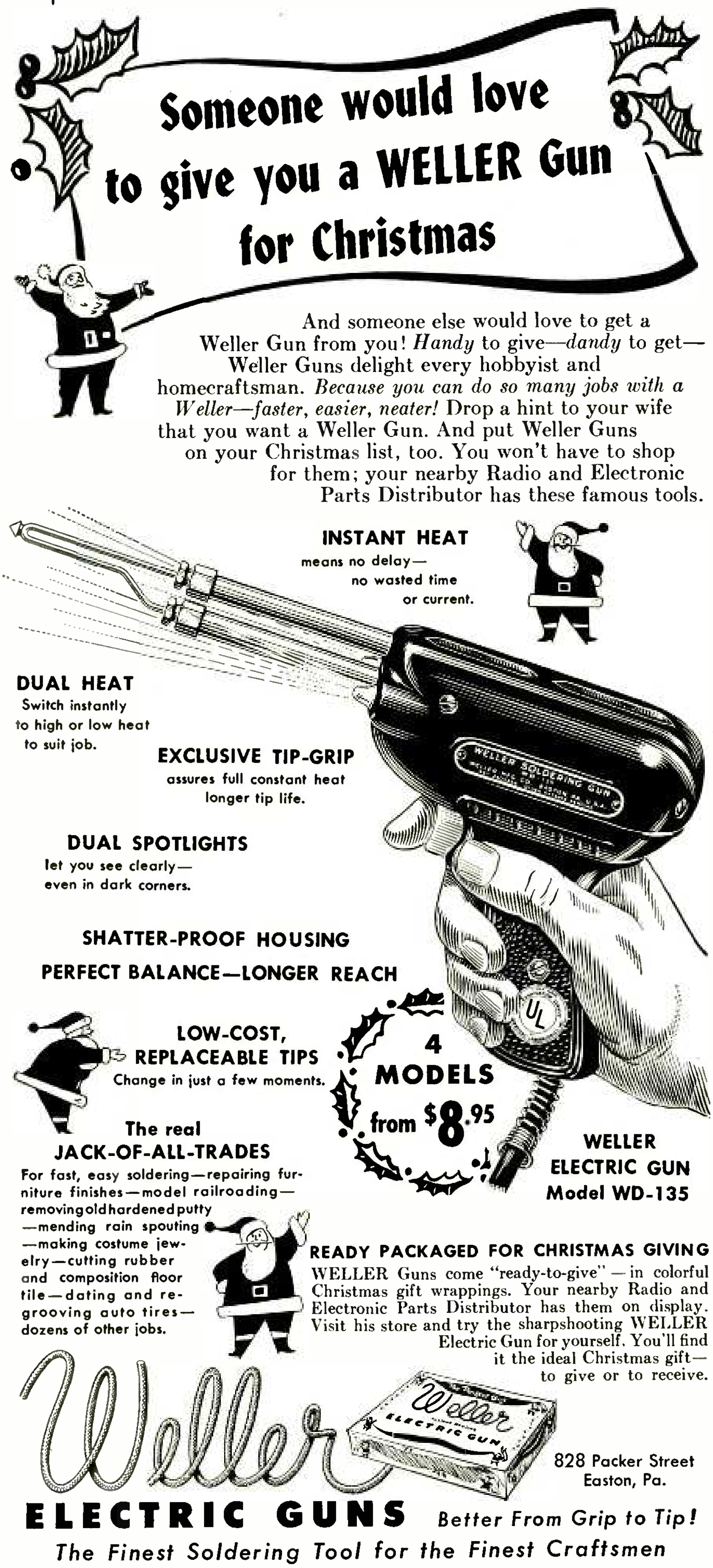
Weller Electric Corp., Easton, Pa., has launched a Christmas promotion at the distributor level aimed to capture extra Christmas gift sales. It suggests Weller electric soldering guns as "perfect gifts for servicemen, mechanics, hobbyists, and homecraftsmen." The guns are being shipped to distributors in colorful holiday wrappers.

Atlas Sound Corp., Brooklyn, N. Y., has developed a new display stand for point-of-sale exhibition and merchandising of its speakers at parts distributors.

Hickok Electrical Instrument Co., Cleveland, featured a handy point-of-sales display as part of its fall dealer-jobber promotion on its line of radio-TV probes and accessories.

Technical Appliance Corp., Sherburne, N. Y., has been canvassing service technicians and installers throughout the country in an effort to locate the oldest operating Taco TV antenna. One hundred dollars will be awarded to the service technician who locates the antenna, and a free new installation will be given to the customer who owns the Taco antenna. Complete details of the contest, which will end early in 1953, are available from Taco distributors.

Westinghouse Electric Corp., TV-Radio Division, conducted a series of more than one hundred TV service clinics throughout the nation early this fall. A demonstration on an actual chassis, valuable short cuts in trouble-shooting, and servicing tips were presented.



Merit Coil & Transformer Corp., Chicago, announced a new "Auto Radio Replacement Guide" which includes i.f.-r.f. coils and transformers.

Channel Master Corp., Ellenville, N. Y., completed a full-length sound and color movie on the subject of TV receiving antennas, titled, "The Antenna is the Payoff." Ed Thorgerson, sports commentator, is the narrator.

Ward Products Corp., Cleveland, published a new booklet, "Ward for You in '52," in presentation of its new *Signaline* TV antennas.

General Electric Tube Department announced the names of the three first-place winners of its recent business-building contest for radio and TV service technicians. The winners are: Russel J. Cummings, C&W Television Service, Inc., Cambridge, Mass.; Grant Maloy, The Harris Co., San Bernardino, Calif.; and D. J. Young, Young's Radio & Television, Chicago. Each of the top winners received a Dodge panel truck. One hundred other winners received their choice of matched golf clubs, jewelry, or a fishing kit.

New Plants and Expansions

Sylvania Electric Products dedicated its new Electronics Division headquarters at Woburn, Mass. The plant is described as the most modern of its type in the world. The company also announced that a new plant is under construction in Drummondville, Ontario, for the manufacture of electronic devices for Canadian defense purposes by its wholly owned Canadian subsidiary, Sylvania Electric, Ltd.

Javex, manufacturer of electronic devices, recently moved all its activities, formerly conducted in Garland, Texas, to a newly erected plant on a 25-acre site in Redlands, Calif. The company also announced the opening of a new Midwestern office in Chicago.

Plastic Capacitors, Inc., Chicago, was formed as a new firm in the electrical, electronics, and nuclear fields, with Stephen Meskan, formerly with Condenser Products Co., as president and general manager.

Business Briefs

. . . **The Audio Fair—West Coast**, scheduled for February 5 to 7 in Los Angeles, is being planned by Southern California sound equipment manufacturers, representatives, and distributors.

. . . **RCA Tube Department** renewal sales manager H. F. Bersche recently predicted a renewal market for tubes, parts, and test equipment which will reach a sales volume of one billion dollars by 1955, and more than two billion by 1960.

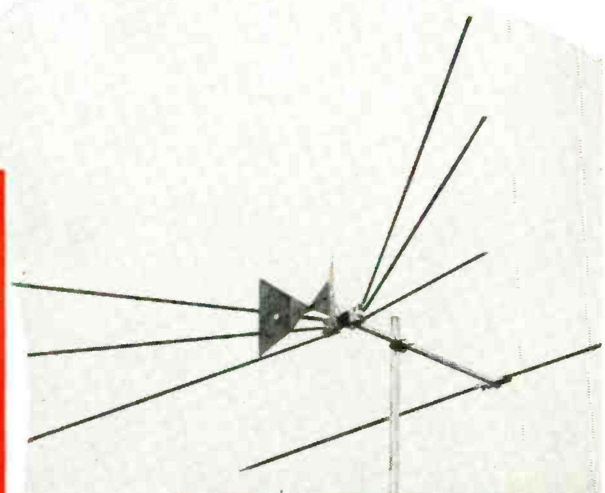
. . . **The RTMA** admitted seven new members to the Association: Daystrom Electric Corp., Poughkeepsie, N. Y.; Delco Radio Division, General Motors Corp., Kokomo, Ind.; Eldico of New York, Inc., Douglaston, N. Y.; Investors Diversified Services, Inc., Minneapolis; Johnson Electronics, Orlando, Fla.; Lyman Electronic Corp., Springfield, Mass.; and Rockbar Corp., New York City. END

Extra profits for service-men!

NOW you can add UHF to the thousands of VHF Super Fans presently installed in your area, with Channel Master's exclusive new Ultra-Dapter, Model No. 414. In 5 minutes you can convert any Super Fan into an all-channel VHF-UHF antenna. See your distributor for details.

VHF *and* UHF

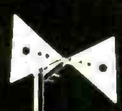
Now! Get all 82 channels with the *new*



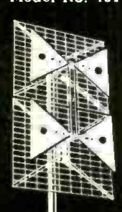
CHANNEL MASTER ULTRA FAN

model no. 413

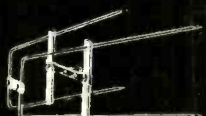
Write for literature on Channel Master's new complete line of UHF antennas including such models as these:



Ultra Bow
Model No. 401



Ultra Bow with screen reflector
Model No. 403



Ultra Vee
Model No. 404

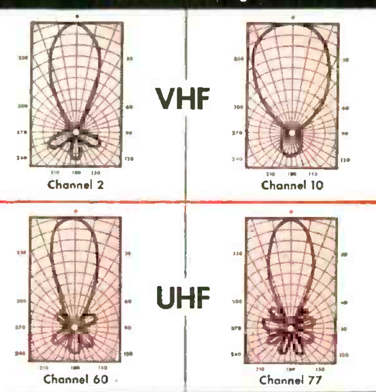
Today's most advanced ALL-VU* antenna.

*All VHF, All UHF

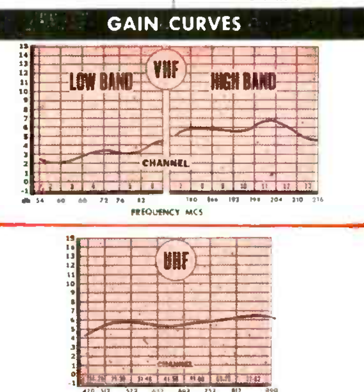
Featuring:

- **2 great antennas in 1 —** A genuine, high gain Super Fan on VHF, and an all-channel Triangular Dipole and reflector for peak UHF reception.
- **Electronic inter-action filter —** Automatically isolates VHF and UHF bands, eliminates inter-action. Ultra Fan operates with only a *single* transmission line to TV set.
- **"Free space" terminals —** Channel Master's *exclusive* UHF "free space" terminals prevent accumulation of dirt and moisture which gradually reduce picture quality in ordinary UHF installations.
- **Famous Channel Master engineering —** The Ultra Fan is an *integrated* VHF-UHF antenna that give uniformly high gain over *all* TV channels, from 2 through 83.

HORIZONTAL POLAR PATTERNS
(Relative Voltage)



GAIN CURVES

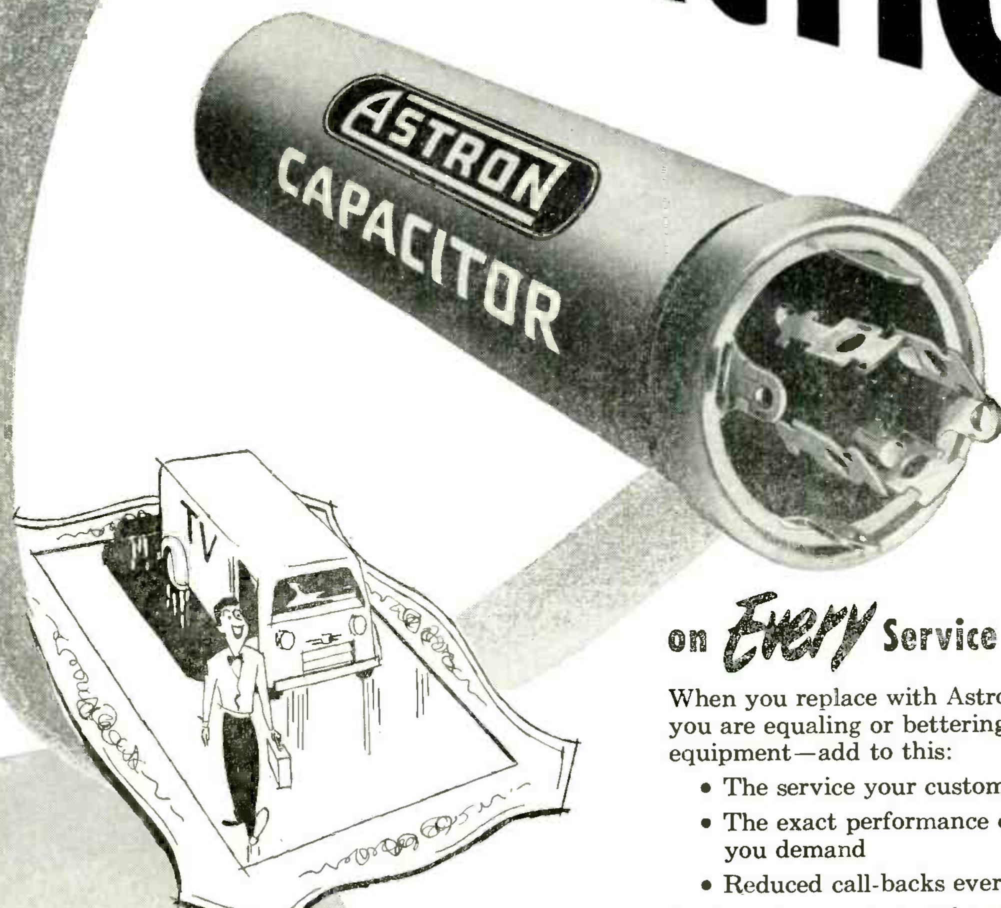


Can be stacked for additional gain.

MEMBER

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

ASTRON SERVES UP SATISFACTION



on *Every* Service Call

When you replace with Astron Capacitors you are equaling or bettering original equipment—add to this:

- The service your customer expects
- The exact performance characteristics you demand
- Reduced call-backs everyone demands

And you have a few of the reasons why Astron Capacitors help "serve up satisfaction" to your customers. Alert jobbers are stocking Astron Capacitors—make sure you talk to your supplier today—or write to us for the name of the Astron Distributor nearest you. Send for catalog AC-3.

ASTRON CORPORATION

ASTRON
CORPORATION
255 Grant Avenue • E. Newark, N.J.

DEPEND ON . . . INSIST ON . . . ***ASTRON***


EICO
TEST INSTRUMENTS
GUARDS CBS Columbia
HIGH STANDARDS OF
TELEVISION PRODUCTION QUALITY
In the CBS-Columbia design laboratories, Al Goldberg takes some important readings with the EICO Model 221 Vacuum Tube Voltmeter and Model 555 Multimeter, as Harry R. Ashley looks on.
Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Television production lines.
KITS-Wired Instruments
For Laboratory Precision at Lowest Cost—
the Leaders Look to EICO!
WHY does CBS-Columbia, Inc., one of America's great headline-makers in Television set production, use EICO Test Instruments on both its new Television production lines and in its design laboratories?
BECAUSE like Emerson, Tele-King, Teletone, Majestic, and many another famous TV manufacturer coast to coast, CBS-Columbia knows that
ONLY EICO TEST EQUIPMENT DELIVERS ALL 10 EICONOMICAL FEATURES
1. Laboratory Precision
2. Lowest Cost
3. Lifetime Dependability
4. Speedy Operation
5. Rugged Construction
6. Quality Components
7. Latest Engineering
8. Super-Simplified Assembly and Use Instructions
9. Laboratory-Styled Appearance
10. Exclusive EICO Make-Good Guarantee
Before You buy any higher-priced equipment, be sure You look at the EICO line—in Wired as well as Kit form! Each EICO product is jam-packed with unbelievable value. YOU be the judge—compare, see EICO instruments today — in stock at your local jobber — and SAVE 50%! Write NOW for FREE newest Catalog 12-C
FOLLOW THE LEADERS . . . INSIST ON EICO!
NEW 377K SINE & SQUARE WAVE AUDIO GEN. KIT $31.95. WIRED $49.95
320K SIG. GEN. KIT $19.95. WIRED $29.95
322K SIG. GEN. KIT $23.95. WIRED $34.95
425K 5" PUSH-PULL SCOPE KIT $44.95. WIRED $79.95
HIGH VOLTAGE PROBE $6.95
360K SWEEP GEN. KIT $34.95 WIRED $49.95
315K DELUXE SIG. GEN. KIT $39.95 WIRED $59.95
1171K RES. DECADE BOX KIT $19.95 WIRED $24.95
NEW 536K MULTIMETER KIT $12.90 WIRED $14.90. 1000 OHMS/VOLT
950K R-C BRIDGE & R-C-L COMP. KIT $19.95 WIRED $29.95
145K SIG. TRACER KIT $19.95 WIRED $28.95
221K VTVM KIT $25.95 WIRED $49.95
625K TUBE TESTER KIT $34.95 WIRED $49.95
CRA PIX TUBE ADAPTOR for Tube Tester $4.50
1040K BATTERY ELIM. KIT $25.95 WIRED $34.95
NEW 214K VTVM KIT $34.95. WIRED $54.95. 7½" METER
NEW 565K MULTIMETER KIT $24.95. WIRED $29.95. 20,000 OHMS/VOLT
AMERICA'S GREATEST INSTRUMENT VALUES BEAR THE NAME—
EICO Reg. U.S. Pat. Off.
ELECTRONIC INSTRUMENT CO., INC.
84 Withers Street, Brooklyn 11, N. Y.
Prices 5% higher on West Coast. Due to unstable conditions prices and specifications are subject to change without notice.
©1952

How to Enter the Electronic Industry

... Valuable Advice for Electronics Careers by the Government ...

By the U. S. Department of Labor

ELECTRONICS employers hire most of their workers through their own personnel offices. Qualified applicants desiring electronics employment should contact these offices. Many firms have arrangements with universities and technical or trade schools which provide trained workers. The State employment services will help place prospective electronics workers and furnish them with information on local employment conditions.

Individuals planning careers in electronics manufacturing should prepare themselves for their future jobs. The type and extent of preparation, of course, will depend upon the occupation selected. Executive and professional positions usually require a college degree in engineering or business administration.

Persons without previous experience who wish to enter subprofessional jobs or skilled occupations can obtain qualifying training or experience by attending trade or technical schools or by becoming apprentices in the desired trade. Prospective students should select a school with a good reputation because the quality of instruction is very important. Information on trade and technical schools can be obtained from State education departments, the United States Office of Education of the Federal Security Administration, Washington 25, D.C., and educational associations, such as the National Council of Technical Schools, 2601 16th Street N.W., Washington, D.C.

Persons planning to attend schools should also check with prospective employers as to the extent to which graduates are accepted as trained workers. Information on apprenticeships can be obtained by contacting employers or by writing the Bureau of Apprenticeship, United States Department of Labor, Washington 25, D.C.

Assembly and processing jobs require little preparation beyond elementary education and basic aptitudes, such as manual dexterity and an ability to follow simple instructions.

Higher executive and administrative positions are generally filled by promotion. Junior positions are usually filled by college graduates. Electronics products are highly technical. Therefore, engineering training is valuable in sales, production, and purchasing positions.

Engineering jobs are usually filled by graduates of recognized engineering schools and universities, but skilled workers and trade-school graduates are sometimes advanced into these positions. Many manufacturers prefer graduates of universities which grant degrees in radio engineering, and some prefer engineers with post-graduate training. Research and development positions generally require more academic training than production engineering positions. Only a few universities grant first degrees in radio or electronic engineering. Therefore, many electrical engineers or physicists with specialization in electronics are hired each year.

Persons planning engineering careers should complete an engineering course at a recognized engineering school or university. Information on universities, colleges, and technical schools offering engineering training can be obtained by writing the United States Office of Education, Federal Security Agency, Washington 25, D.C., or the Engineers Council for Professional Development, 25-33 West 39th Street, New York 18, N. Y.

For such skilled workers as machinists, tool-and-die makers, millwrights, electricians, or carpenters, apprenticeship is one of the best ways to enter the industry. These jobs are very similar to their counterparts in other industries, and previous experience in the trade is usually enough qualifying experience for immediate employment.

Electronic technicians need a knowledge of theoretical electronics before they can be considered skilled, and until they acquire it they can never advance very far in this occupation. This knowledge can be acquired in several ways. One can start out as a helper or apprentice and learn it on the job. Some of the best technicians are self-taught radio amateurs who acquired both the theoretical and practical aspects through home study and experimentation. This method requires ability, self-discipline, and initiative. Moreover, electronics is fast advancing beyond the home tinkering stage and is beginning to require equipment beyond the financial abilities of most amateurs.

One of the best ways to prepare for these jobs is by attending a good grade, technical, or vocational school where one can acquire basic theory and familiarity with testing and measuring equipment.

The armed services provide excellent electronics experience and training and have excellent service schools. Young men entering the Armed Forces who are interested in electronics work should try to attend one of these schools and seek assignment to a communications group. Technicians with military electronics training are usually familiar with the types of equipment produced by manufacturers who employ the greatest number of electronic technicians. For this reason, many employers prefer workers with military electronics experience. Electronics research and development have become so expensive that military has outstripped civilian electronics development, and technicians trained in manufacturing, operating, or repairing military equipment are often the only technicians available with this experience.

In addition to the basic theoretical knowledge and familiarity with test and measuring equipment, electronic technicians need specialized practical experience which is usually acquired by on-the-job training.

Even unskilled assembly jobs require some training and the ability to distinguish colors and shapes of parts and to follow simple instructions. Applicants for such jobs are often given aptitude and personality tests to determine their fitness for employment.

The great majority of electronics manufacturing jobs require only limited training. Some firms place new workers directly on the production lines where they receive on-the-job training from experienced workers and supervisors. Other firms have special training courses and practice production lines where they prepare workers for the main assembly line.

EDITOR'S NOTE

The above is slightly condensed from an article in an important brochure recently published by the U.S. Department of Labor, in cooperation with the Veteran's Administration. This is a 30-page booklet entitled, "Employment Outlook in Electronics Manufacturing." Some of the chapters are: "The Electronics Industry," "How Electronics Products are Made," "Electronics Workers," "Working Conditions and Earnings," "Employment Outlook," "Outlook in Individual Occupations," "How to Enter the Industry."

There are numerous illustrations, charts and statistics; rates of pay; average weekly hours in radio, television, and related products manufacturing; labor turnover rates in radio, television, etc. In addition there are numerous photographs, all of interest to those who wish to enter the industry.

There are also several appendices: "Electronics has many Applications," "Percentage Distribution of Workers in Electronics Manufacturing," "Percentage Distribution of Professional and Skilled Workers in Radio, Television, and Related Products Manufacturing by Occupation," as well as a great deal of other valuable information.

The editors of RADIO-ELECTRONICS thought so well of the brochure that it was decided to display this information in a prominent position, to make sure that all of our readers would be certain to see it.

To those who wish to obtain the brochure, it is known as Bulletin #1072 in the Occupational Outlook Series. It is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C. The price is 25c. This being a government publication, do not send stamps—only money order or check.

AUDIO EQUALIZER DESIGN

Basic circuits for restoring original sound characteristics in record-reproducing systems

By N. H. CROWHURST

AMPLIFIERS for reproducing various types of recordings—discs, tape, wire, or sound-on-film—require some form of equalization to compensate for the special frequency characteristics of each type. For example, in making disc recordings—still the most nearly universal type—the low frequencies are deliberately attenuated to prevent the recording stylus from cutting over between adjacent grooves on strong bass notes; the high frequencies are overemphasized to help them override the disc surface noise and the anticipated losses in the average reproducer.

Fig. 1 shows the general character of a disc recording curve. Practically all recording equalization curves are based on a *maximum rate of boost or drop* of 6 db per octave. (6 db is equivalent to a *voltage ratio* of 2 to 1. An octave is a *frequency ratio* of 2 to 1.) This is the steepest slope obtainable with simple single-section combinations of resistance and capacitance. Each manufacturer uses what he considers to be the right amount of bass reduction and high boost for the record speed, playing time, groove spacing, and disc material. (The chart on page 42 of March, 1952, RADIO-ELECTRONICS shows the *playback* equalization required for some of the most popular brands of disc recordings. These curves are just the *opposites* of the recording characteristics.)

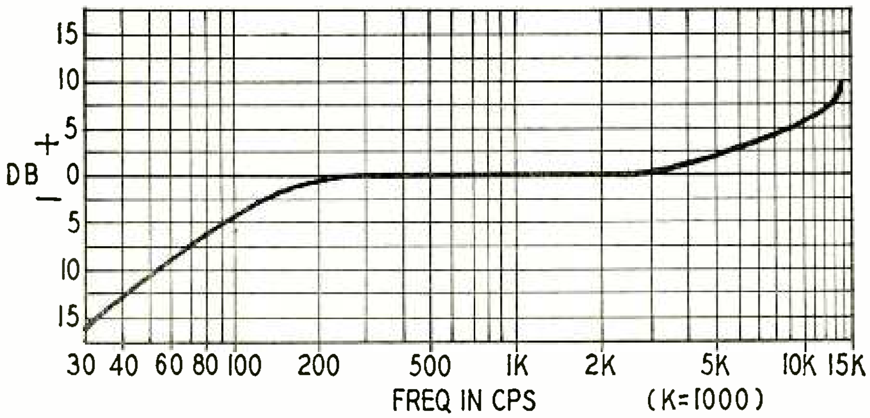


Fig. 1—Typical equalization curve used in making commercial disc recordings. Playback equalizer must have opposite characteristics for ideal reproduction.

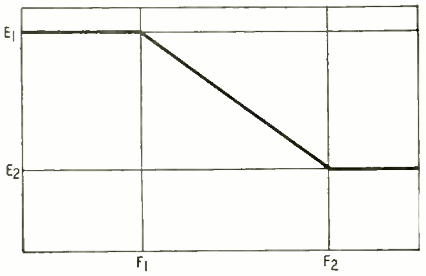


Fig. 2—Ideal equalizer characteristic.

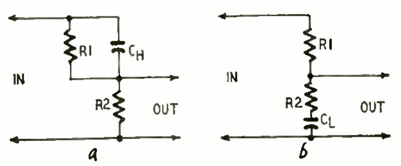


Fig. 3—Basic R-C equalizer circuits. (a) High-end boost. (b) Low-end boost.

Equalizer circuits look deceptively simple: a few resistors and a capacitor or two; but even when prescribed values are used they may fail to deliver the expected results. Many articles and books on the subject safeguard themselves against this possibility with a postscript to the effect that "The foregoing method will provide rough values. *Exact values* for any specific application will have to be determined by test." In other words, "This gives you a general idea; if you have all the necessary test equipment and enough patience, you *may* eventually get it right. If you haven't—well, just hope for the best."

Fortunately, this rather pessimistic approach to equalizer design is quite unnecessary if you understand and use the right methods. An equalizer has to provide a definite boost (or drop) in the response of a circuit between two specified frequencies. The *amount* of boost or drop may be expressed in decibels, or as a voltage ratio (db units are generally used in audio work). Since the two limit frequencies—called "turnover points"—are usually fairly far apart (at least in standard recording practice) an ideal equalizer would have the characteristics shown in Fig. 2. The response of the circuit (E_1) is perfectly flat up to the lower turnover point (F_1); then it drops *uniformly* to the desired level (E_2) at the high-end turnover frequency (F_2); then flattens out again.

Fig. 3 shows two basic resistance-capacitance equalizer circuits. The arrangement at *a* is for high-frequency boost; *b* is for low-frequency boost. (Inductors can be used instead of capacitors—with the opposite characteristics, of course—but capacitors are generally used because they are free from hum-pickup troubles, and are usually much less expensive than inductors. This article will deal only with capacitor type equalizers.)

Both circuits are essentially voltage dividers. In *a* the top resistive element (R1) is short-circuited at the highest frequencies by capacitor C_H. In *b* the lower resistor (R2) is open-circuited at low frequencies by the capacitor C_L.

Two mistakes are commonly made in dealing with these circuits:

1. It is assumed that they produce ideal steps with a slope of 6 db per octave (like Fig. 2), and that the turnover frequencies are exactly at the opposite ends of the step. The actual slopes are invariably less than 6 db, and the turnover points are never exactly at the ends.

2. The effects of the input and output impedances in the circuit where the equalizer is connected are neglected.

The most important actual characteristics of each circuit can be found by checking its response at three frequencies. Two of these are the turnover frequencies F_1 and F_2; the third (F_3) is the geometric midfrequency $F_3 = \sqrt{F_1 \times F_2}$. F_3 is useful because the actual response curve has its steepest slope at this point.

The insert in Fig. 4 is a generalized equalization curve showing the important factors. (Although this represents the performance of a high-frequency boost circuit—Fig. 3-a) it can be applied just as well to bass-boost equalizers (Fig. 3-b) by simply reversing the curve. The Fig. 4 chart shows how these factors are determined in designing a practical equalizer. Frequencies F_1 and F_2 are the "turnover" points of the curve.

The straight line A gives the relation between the over-all height of the step and the ratio R1/R2 or the ratio between the reference frequencies F_1 and F_2, which is simply (1+R1/R2). Curve B shows how much the response at the turnover frequencies F_1 and F_2 departs from the nearest level portion of the over-all response curve; for big steps this is very nearly 3 db. Curve C shows the difference in response between the turnover frequencies F_1 and F_2; curve D gives the *maximum slope* in db per octave (at the midfrequency F_3.)

Some typical solutions based on the use of this chart are shown in Fig. 5. In Fig. 5-a, for an over-all step height of 3 db, the turnover frequencies have a ratio 1.4/1 (half an octave). The maximum slope is about 1 db per octave, and there is only about 0.5 db difference in level between F_1 and F_2. There is a roll-off of 1.25 db between each of the turnover frequencies and the ultimate levels.

In Fig. 5-b F_1 and F_2 are separated by an octave, the maximum slope is 2 db per octave, and the difference in level between F_1 and F_2 is nearly 2 db. There is a 2-db rolloff at each end.

In Fig. 5-c F_1 and F_2 are separated by a decade, giving a 20-db over-all step, and a 14-db difference between F_1 and F_2. Even in this case the *maximum slope* is still less than 6 db per octave, and the *average* slope over the 10-to-1 frequency range is only 4.5 db per octave.

Terminal impedances

Now for the second source of error. If an equalizer designed according to the methods in the preceding section is connected between two existing amplifier stages, the results may not conform to expectations. The predicted response would be obtained *if* the equalizer input voltage was the same at all frequencies. Unfortunately, the input impedance changes with frequency, and so does the voltage. The grid-circuit impedance of the following stage also changes with frequency and affects the performance. These plate- and grid-circuit imped-

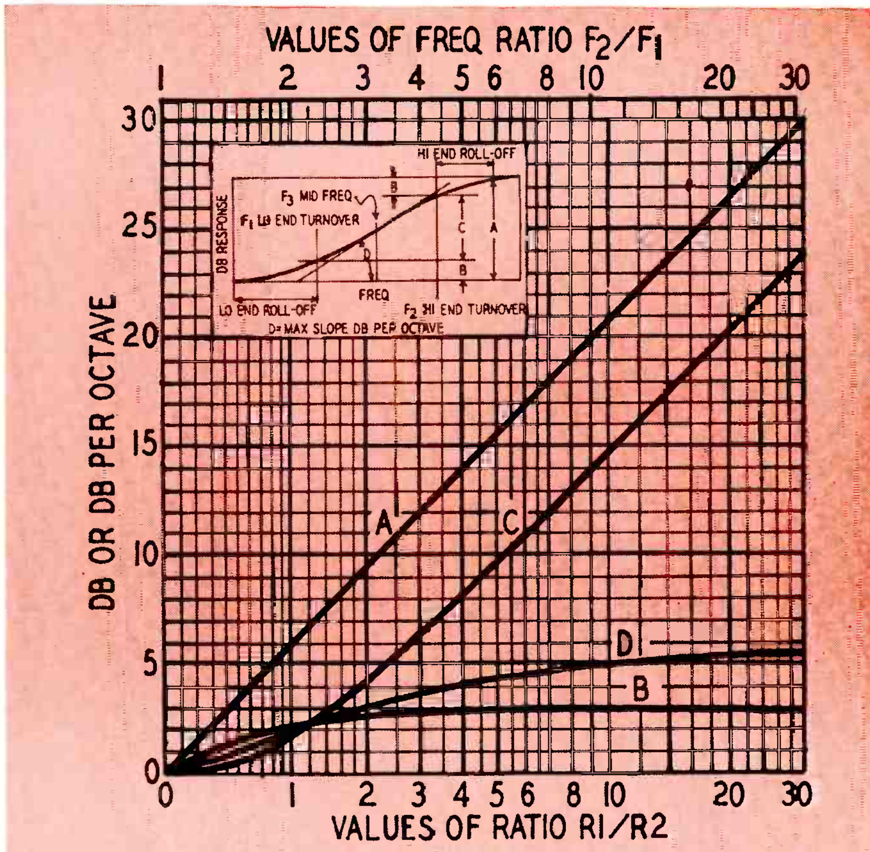


Fig. 4 (above right)—Generalized equalization curve (insert), and chart for finding essential characteristics with actual circuit combinations. "A" is the over-all height of the step; "B" is the height of the roll-off at each end of the step; "C" shows the net boost (or drop) between the turnover frequencies F_1 and F_2; and "D" gives the maximum slope at the midfrequency point F_3.

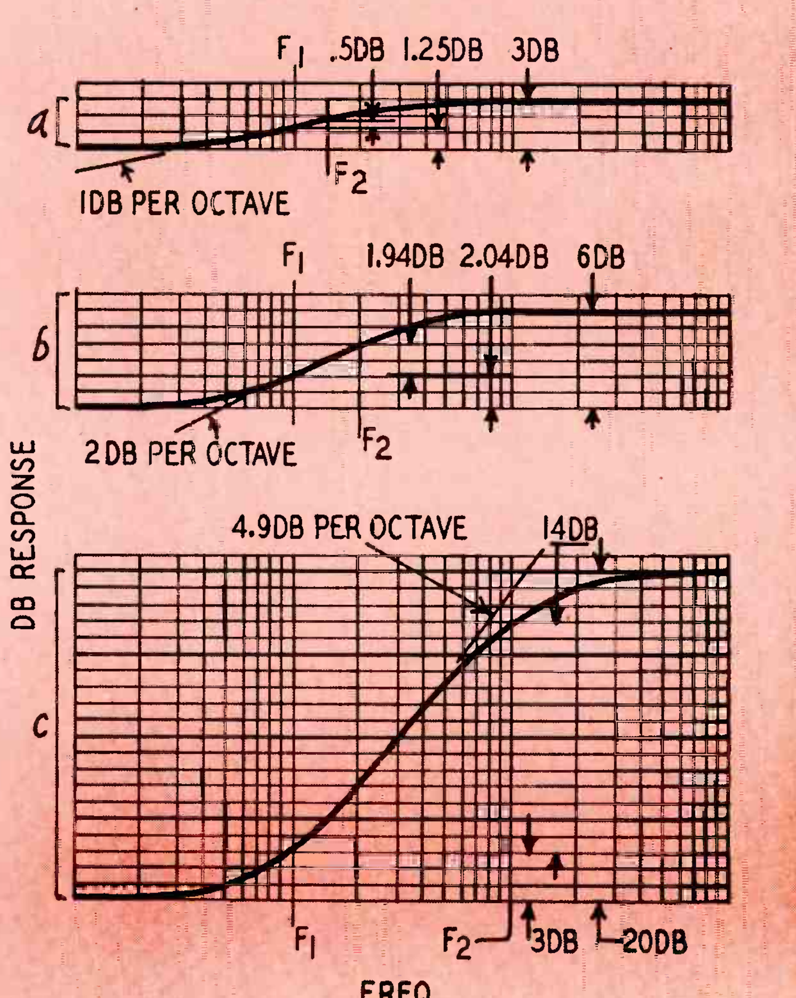


Fig. 5 (below right)—Typical curves derived from Fig. 4. See text for method.

ances must be included in the design calculations for the equalizer.

Fig. 6-a is the basic circuit of Fig. 3-a modified to include these source and output impedances. The low-end turnover frequency is found by making the reactance of C_H equal to R1. But the remaining resistance in the loop (R_T) is now R2 in series with the parallel combination of R_P (the plate resistance of V1) and the load resistance R_L (Fig. 6-b). As far as frequency discrimination is concerned, R_T is the equivalent of R2 in Fig. 3-a. The high-frequency turnover, F_2, is found by making the reactance of C_H equal to the parallel combination of R1 and R_T (Fig. 6-c). In practice it will only be necessary to find one of these frequencies. F_1 is the easiest to calculate, and Fig 4 gives all the other relationships.

As an example, suppose that R_P is 1.5 megohms, R_L is 330,000 ohms, and R2 is 470,000 ohms. A high-frequency-boost step of 15 db is required, starting at a low-frequency turnover of 2,000 cycles. R_P in parallel with R_L gives about 280,000 ohms net plate-circuit resistance; this added to 470,000 ohms (R2) gives 750,000 ohms for R_T. A 15-db boost calls for a ratio R1/R_T of 4.6 (curve A in Fig. 4), so that R1 works out to about 3.5 megohms. A standard value of 3.3 megohms would be close enough. The circuit will show a boost of 2.9 db (curve B in Fig. 4), when C_H has a reactance of 3.3 megohms at 2,000 cycles (25 μμf).

Now the grid-circuit impedance of V2 enters the picture. If the input capacitance (C_G), is 25 μμf, the total attenuation will be 6 db more than anticipated, because C_H and C_G form a 2-to-1 capacitive voltage divider at the highest frequencies. Using a smaller value for R2 will reduce the effect of C_G. With R2 equal to 100,000 ohms, R_T becomes 380,000 ohms. R1 then works out to 1.75 megohms (standard value 1.8 megohms). C_H would then be 50 μμf for a 2,000-cycle low-frequency turnover. With C_G equal to 25 μμf, the added loss is only 3.5 db.

Increasing the over-all height of the step will offset this loss still further. Using a figure of 20 db, the ratio R1/R_T will be 9. R1 works out to 9×380,000, or about 3.3 megohms, which again calls for C_H=25 μμf to lift at 2,000 cycles. The loss due to C_G will be 6 db, leaving a net step height of 20−6, or 14 db.

In any case it pays to reduce the V2 input capacitance to the smallest possible value. One method is to develop a large amount of inverse feedback in V2 by using an unbypassed cathode resistor, or by operating V2 as a cathode follower.

Bass-boost circuit

Now turning to the bass-boost equalizer following the basic circuit of Fig. 3-b. Input- and output-impedance factors are shown in Fig. 7. Here R2 is in series with C_L (Fig. 7-a) and the balance of the circuit is the series-parallel combination shown in Fig. 7-b.

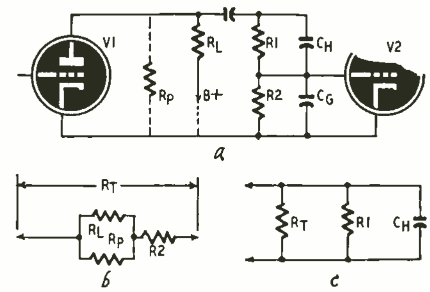


Fig. 6—(a) Complete h.f.-boost equalizer circuit showing additional elements affecting its characteristics. (b) Equivalent source impedance for finding l.f. turnover point. (c) Equivalent circuit for finding the h.f. turnover frequency.

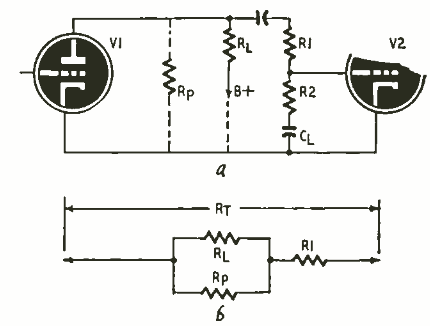


Fig. 7—(a) Low-frequency-boost equalizer. (b) Equivalent input impedance.

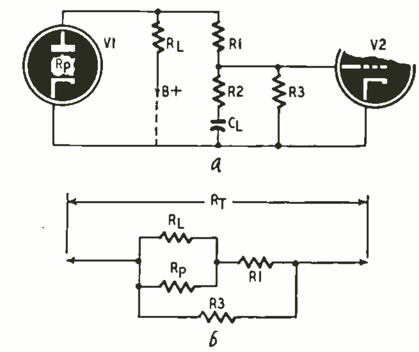


Fig. 8—Workable form of l.f.-boost equalizer, with d.c. return to ground.

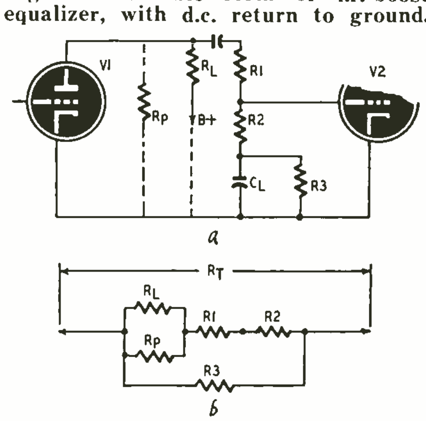


Fig. 9—Another form of low-frequency-boost equalizer. R3 may be a variable resistor for controlling the response.

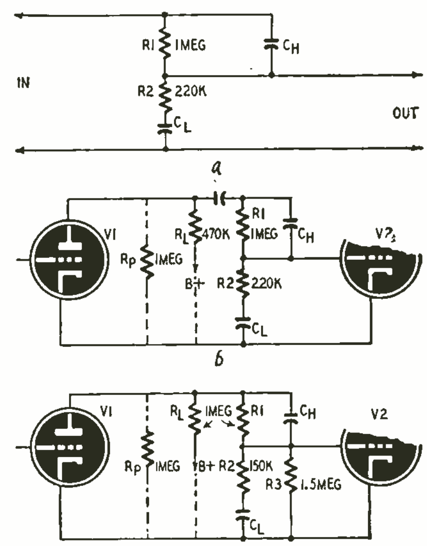


Fig. 10—Combination high-low-boost circuit. (a) Basic network. (b) Input and output circuits added. (c) Compensation for equal high- and low-frequency boost is provided by adding resistor R3.

This circuit would not work in practice because the V2 grid circuit has no d.c. return to ground. Two workable arrangements are shown in Figs. 8 and 9, and the equivalent basic derivation is given under each. In Fig. 8, R3 shunts all the other elements (R2 is effectively open-circuited by C_L). This is obviously the simplest circuit to use. Fig. 9 is better where adjustable boost is required.

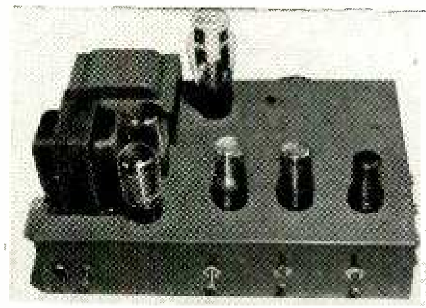
In this case the simplest reduction to the basic equivalent R_T is by using (R1 + R2) instead of just R1 (after which the value of R2 can be subtracted). If R3 is small compared to the other values, both R2 and (R1 + R2) are approximately equal to R3. R1 is nearly zero and there is no step, which is what happens when C_L is effectively short-circuited by R3.

Turning back to the question of the errors arising from failure to take circuit impedances into account, take the example shown in Fig. 10. This network is intended to boost both ends of the frequency range. The values of R1 and R2 in the basic circuit of Fig. 10-a should give a lift of about 14 db at each end. If this arrangement is merely inserted between two stages, as in Fig. 10-b (ignoring for the moment the need for a d.c. grid return), the plate-circuit impedance of V1 will reduce the h.f. boost and increase the bass boost, throwing the whole arrangement off balance. With the values shown, the plate-circuit resistance is about 330,000 ohms, R_T is 550,000 ohms, so the ratio R1/R2 is only about 2, giving less than 10 db top lift (ignoring possible effects due to input capacitance). For bass lift R1/R_T is about 6, giving nearly 16 db lift.

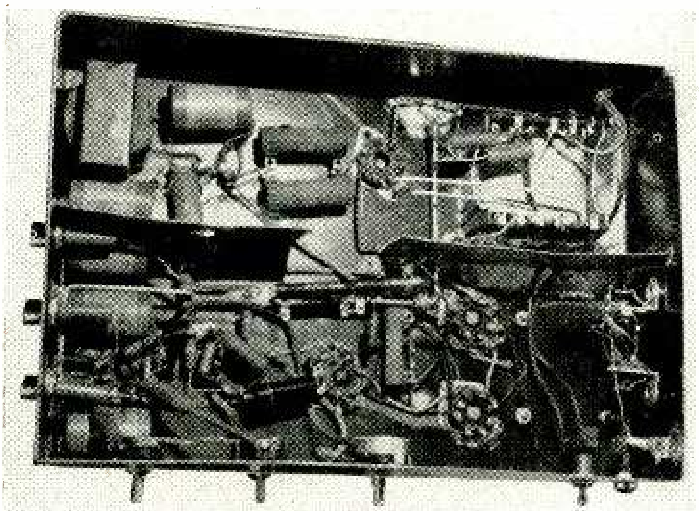
By careful choice of values in the circuit of Fig. 10-c, using the equivalents shown in Figs. 7 and 9, R3 will not affect the top lift materially, but its value can be adjusted to bring the bass boost to the required equal value. The values shown will give 14 db lift at each end. The reactances of capacitors C_H and C_L must be equal to R1 and R2 respectively at the high and low turnover frequencies. To avoid confusion the effect of grid input capacitance has been ignored; to include it, the procedure for designing the top lift will be as in the earlier example, after which the bass lift can be adjusted by R3 as just stated. END.

DIRECT-COUPLED AMPLIFIER

By W. J. HANTZ



Completed amplifier chassis. Straight-line circuit layout reduces feedback problems. Input connectors at right.



Under-chassis view of the amplifier. Shields between amplifier and power-supply sections cut down hum pickup in high-gain input circuits and output.

Circuits old and new are combined in this amplifier for high-quality performance

AUDIO men are always looking for the ultimate in high-fidelity amplifiers. If you are one of these you had better keep on looking because you won't find it here. However, if you want to build an audio amplifier with very low hum level, good low- and high-frequency response, and a balanced-direct-coupled phase inverter, then this one is your dish.

This amplifier was constructed as a low-cost auxiliary unit for announcing outdoor sports programs.

From the circuit of Fig. 1 you can see that a single 6SC7 provides two high-impedance inputs suitable for either crystal or dynamic mikes. The mike gain controls were placed in the 6SC7 plate circuits instead of the inputs to reduce control noise and the possibility of the controls affecting the microphone characteristics. Resistors R1 and R2 provide some decoupling to prevent the two mike circuits from interfering with each other. One grid of V2 is the mike mixer, while the other is for phono input. The paralleled plates of V2 feed into one grid of V3. The signal is impressed on the other half of V3 by cathode coupling. This inverter circuit has been used a good deal in oscilloscopes and special test equipment but rarely in audio work. It is not difficult to balance and has good frequency response. There is no cathode-bypass capacitor in the inverter stage or anywhere else in the amplifier. (When an amplifier has sufficient gain it can be made to have a much flatter frequency response, to be less susceptible to hum, and to have better stability by omitting all cathode bypasses.)

Up to now, our description hasn't covered anything new. From here on, though, any similarity to previous amplifiers—past or present—is purely accidental. Note the direct coupling between the cathode-coupled inverter and the 5881 output tubes.

Most of us know the difficulty in constructing direct-coupled amplifiers. It usually takes a wizard to balance one. However, no attempt has been made here to direct-couple the entire amplifier. This would entail a very large assortment of adjustable resistors. We have *only one* adjustable resistor here (R3) for balancing the direct-coupled circuit.

The d.c. voltage on the plates of the 6SN7 inverter-driver (approximately 100) is impressed directly on the 5881 grids. In any circuit the grid bias of

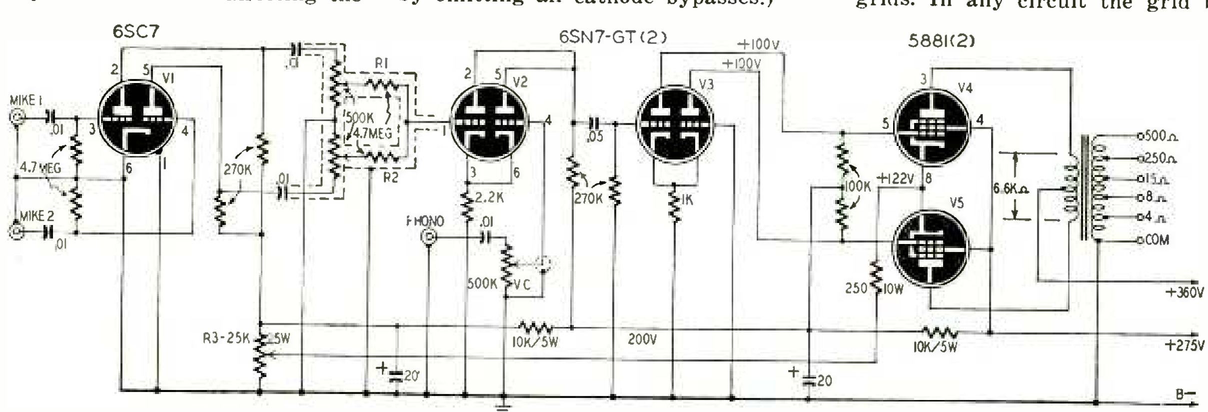


Fig. 1—Circuit of the direct-coupled amplifier and input mixer. R3 is the bias adjustment for the output tubes.

a tube is the potential difference between grid and cathode. Here the 5881 cathodes must be returned to a point that is more positive than the grids. In this circuit the 5881's require about 22 volts of bias. This is provided by returning the cathodes to the slider of R3, which is adjusted so that the 5881 cathodes are 122 volts positive with respect to the chassis ground. R3 does not require readjustment unless the output tubes are replaced.

If desired, you can use 6L6's instead of 5881's. The characteristics are practically identical except that the 5881's are more rugged.

Materials for amplifier

Resistors: 4—4.7 megohms, 4—270,000 ohms, 2—100,000 ohms, 1—2,200 ohms, 1—1,000 ohms, ½ watt; 1—250 ohms, 50 watts; adjustable; 1—25,000 ohms, 25 watts, adjustable; 1—500 ohms, 20 watts; 1—250 ohms, 10 watts; 2—10,000 ohms, 5 watts; 3—500,000-ohm potentiometers (audio taper).
Capacitors: (Electrolytic) 5—20 μf, 450 volts. (Paper) 1—.05 μf, 7—.01 μf, 600 volts.
Transformers: Power transformer, 800 volts, center tapped, at 150 ma; 5 v, at 3 amp; 6.3 v, at 6 amp. Output transformer, primary impedance 6,600 ohms plate-to-plate, secondary tapped at 4, 8, 15, 250, 500 ohms (Stancor A-3801 or equivalent). Filter choke, 8-10 H, 100 ma, 500 ohms.
Miscellaneous: 1—6SC7, 2—6SN7, 2—5881 or 6L6 (see text); 1—5U4-G tubes; 1—115-v pilot lamp; 6 octal sockets, 1 pilot-lamp socket with jewel; 3 shielded input connectors; 2 single circuit phone Jacks (see text); 1—s.p.s.t. toggle switch; chassis, terminals, hardware, wire, solder.

Materials for tone control

1—.002-μf, 600-v, paper capacitor; 1—680 ohms, 1—470 ohms ½-watt resistors.

The power supply shown in Fig. 2 provides the well-filtered voltages needed and should be duplicated as closely as possible. If you have some other power

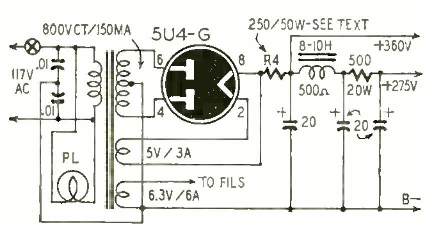


Fig. 2—Schematic of the power supply.

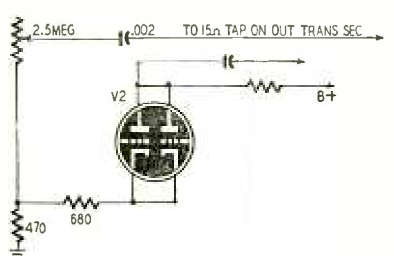


Fig. 3—Inverse-feedback tone control.

transformer or filter choke on hand, it might be advisable to make R4 adjustable. A 250-ohm choke can be used instead of R4 for even better filtering. All amplifier ground returns are made to a heavy bus which is grounded to the chassis at only one point.

No tone control has been provided because of the amplifier's excellent frequency response. Fig. 3 is a degenerative-feedback tone-control circuit which can be added to the amplifier.

The parts placement in the amplifier chassis is not critical and there was no feedback or motorboating.

IMPROVED FIDELITY for the PORTABLE PHONO

By JOHN HARWAY

THERE seems to be an opinion prevalent these days that a record player employing a 6-inch speaker and a low-cost crystal pickup deserves only the barest minimum for an amplifier. On the contrary, this is where a carefully engineered amplifier is needed most! Every trick at the audio engineer's command should be used to get the most out of the meager capabilities of the pickup and speaker.

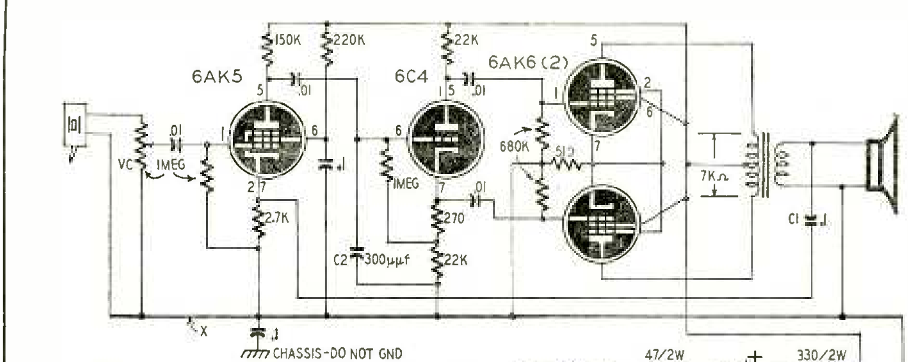
Taking a popular portable record player, we examined it critically. The pickup was a conventional crystal type with a precious-metal stylus in a turnover cartridge for three-speed operation. The amplifier was a simple two-tube a.c.-d.c. affair. It was nearly new and its owner considered it to be in top condition.

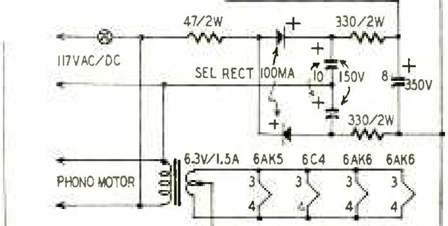
Testing revealed several faults. There was noticeable distortion at normal listening level. At a level sufficient for dancing in an ordinary living room, the distortion was great enough to make vocals nearly unintelligible. There was severe 60-cycle intermodulation at some frequencies, complete lack of response below 300 cycles, and a sharp resonant rise at 7,000 cycles. The 7,000-cycle peak resulted in objectionable surface noise from the record.

A check showed there was nothing defective in the circuit; the amplifier was in "perfect" condition. The shortcomings were the natural result of a skimpy design. The 60-cycle intermodulation was the result of mounting the output transformer too close to the phono motor. In addition, the output transformer had a very small core and was completely saturated by the heavy plate current of the 70L7 output tube, a factor which had as much to do with the lack of bass response as did the 6-inch speaker. This transformer was also responsible for the 7,000-cycle resonance.

Circuit design

The logical place to start the new design would be at the output stage. But a few general plans were laid first. To keep the hum level as low as possible, it seemed advisable to use 6-volt tubes and a small filament transformer. This meant that low-drain filaments were necessary in order to avoid a costly transformer. And to get enough peak power output from the amplifier,





The two telephone jacks in the underchassis photograph are connected to the 8- and 500-ohm taps on the output transformer. Of course, a multiterminal strip or a single output socket with an impedance-selector switch can be used as well.

References

A Direct Coupled Amplifier with Cathode Follower, by Raymond H. Bates. *Radio & Television News*, Nov., 1949.
Short Circuits, by Robert F. Scott. RADIO-ELECTRONICS, May, 1952. END

Fig. 1—Circuit of the improved phonograph amplifier. Push-pull 6AK6's give adequate output with low distortion and minimum current drain.

a plate voltage of 200 or more would be needed. The best answer was a voltage doubler, which combines economy with efficiency and compactness.

The output stage was to have the best low-frequency response possible. Good peak-power output, good low-frequency response and low hum level call for a push-pull output stage. A pair of 6AK6's fit the picture nicely, since they combine reasonable power output with low filament drain.

The output transformer selected had enough iron to be useful at low frequencies. Far from being a super-high-fidelity type, it nevertheless could be depended upon for good output at 100 cycles. Since the primary was push-pull, the core did not saturate, which left room for large bass-frequency flux excursions. And negative feedback around it would smooth out the bumps nicely.

Now the amplifier was beginning to take shape. But negative feedback calls for quite a bit more gain than is ordinarily used in small amplifiers of this type. Several combinations were tried before we settled on the circuit of Fig. 1. The 6AK5 is a high-gain pentode stage driving a cathode-follower phase inverter. This type of phase inverter was desired, for freedom from distortion and balancing troubles. The 6AK5 provided the required high gain with ease. Although primarily a v.h.f. tube, the 6AK5 is becoming increasingly popular in low-frequency equipment.

The negative-feedback loop is unconventional in some respects. The feedback circuit is a frequency-selective network between the voice-coil winding of the output transformer and the cathode of the 6AK5. This network provides a full 15 db of feedback at mid-frequencies. However, the increasing reactance of C1 reduces the feedback at low frequencies. This results in a substantial bass boost to compensate for the poor low-frequency response of the small speaker.

It was necessary to add C2 to prevent oscillation at a supersonic frequency. This capacitor, however, does not reduce the high-frequency response of the circuit. With this addition, the circuit is completely stable and noncritical in all respects.

Materials for phono amplifier
Resistors: 2—1 megohm, 2—680,000 ohms, 1—220,000 ohms, 1—150,000 ohms, 2—22,000 ohms, 1—2,700 ohms, 1—510 ohms, 1—270 ohms, ½ watt; 2—330 ohms, 1—47 ohms, 2 watts; 1—1-megohm potentiometer (audio taper with on-off switch).
Capacitors: (Electrolytic) 1—8 μf, 350 volts; 2—10 μf, 150 volts. (Paper) 3—0.1 μf (Ceramic) 3—.01 μf, 400 volts, 1—300 μμf, 500 volts.
Transformers: 1 push-pull output transformer, 7,000 ohms plate-to-plate, to voice coil, 10 watts; 1 filament transformer, 117 volts, 60 cycles to 6.3 volts, 1.2 amp.
Miscellaneous: 2—100-ma selenium rectifiers; 1—6AK5, 1—6C4, 2—6AK6 tubes; 4—7-pin miniature sockets (see text and photos); chassis; 6-inch PM speaker; terminals, hardware, wire, solder.

Construction details

Most of the components of the amplifier were mounted on the *Vector* turret type sockets of the 6AK5 and the 6C4 before the sockets were installed on the chassis (Fig. 2). This made the wiring job quite simple.

The power supply was mounted at the other end of the chassis with plenty of space in between to prevent hum pickup. See Fig. 3. The power-supply parts were not crowded together, since we have vivid memories of tightly packed power supplies overheating and blowing electrolytic capacitors.

The assembled amplifier was mounted on the motor board as shown in Fig. 4. In order to prevent hum pickup, the output transformer was mounted on the speaker, away from the motor. Because there was insufficient clearance between the motor board and the bottom of the record-player cabinet, the tubes were mounted on the end of the aluminum chassis.

The aluminum chassis is completely enclosed when mounted on the motor board. This prevents dust and grime from covering the parts and further shortening their life.

(It is possible for the operator to receive a nasty shock if he should touch the phono input jack or tone arm while standing on a damp floor or touching a water pipe or radiator while the line plug is polarized to make the chassis hot to ground.

To minimize shock hazard, connect a 0.1-μf, 600-volt paper capacitor at point *x* in the input circuit. This capacitor may cause a slight increase in hum level. If it does, increase its size. Do not make the capacitor larger than necessary to hold the hum to a tolerable level. If you use a phono-input jack, be sure to insulate it from the chassis.—*Editor*)

The performance of this amplifier has been remarkable. Everyone hearing the record player for the first time is convinced that it has at least a 10-inch speaker. The clean, strong highs and "presence" usually attributed to costly speakers, hi-fi amplifiers and precision magnetic pickups are gratifyingly present with this circuit. Hum and noise are completely inaudible. Its success shows that the addition of less than ten dollars in parts to the amount generally spent for low-cost phonographs can result in a great improvement in the quality of this type of record player. END

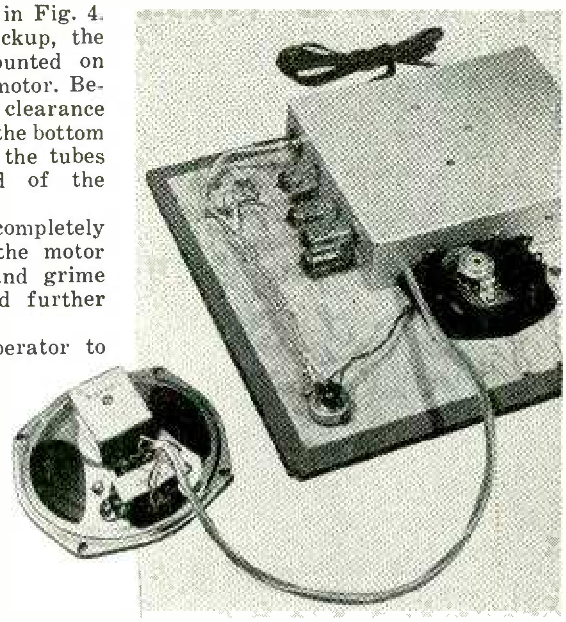
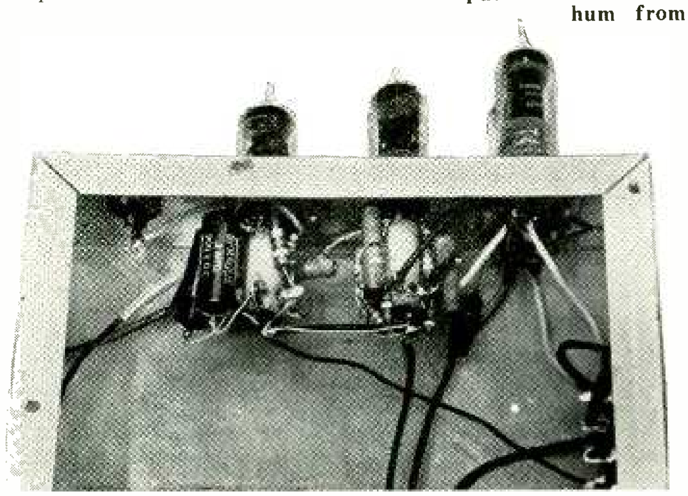
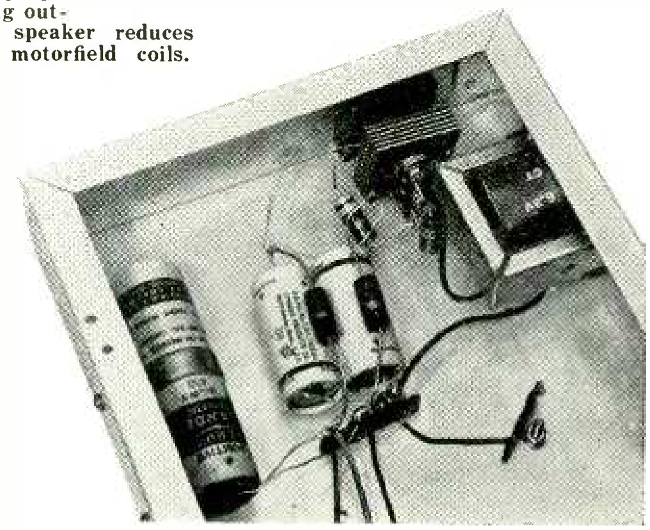


Fig. 2 (below left)—Amplifier end of chassis with components mounted on turret-type sockets for extra compactness in the layout.
Fig. 3 (below right)—Power supply installed at opposite ends of chassis from amplifier cuts hum.
Fig. 4 (right)—Amplifier mounted on phonograph motor board. Mounting output transformer on speaker reduces hum from motorfield coils.





PUSH - PULL

Part I—Some commonly used inverter circuits are not quite all they are cracked up to be.

By GEORGE FLETCHER COOPER

THE majority of amplifiers in the 5-watt class and higher now use push-pull output stages. I cannot even remember seeing in the technical press a description of a high-quality amplifier which was not push-pull, although single-sided amplifiers are on the market. The reasons for using a push-pull stage are fairly well known, or at least they should be. The textbooks tell all (or almost all) about it. The properly balanced push-pull stage produces no even harmonics, though that is not so important, now that we all use so much negative feedback; the output transformer has no d.c. polarization, which makes it a lot easier to design (though we must allow for at least 10% unbalance in any practical circuit) and the signal does not appear in the plate supply lead, which makes decoupling much less of a headache. There are other aspects, too, such as the possibility of pushing down toward class B working. If the tube cuts off in a single-sided stage, no amount of negative feedback will help the situation, because just at the instant of cutoff there is no gain, and thus no $A\beta$. In a push-pull stage one tube is working away to keep the gain up even when the other grid is far negative, and the feedback can do its work in keeping down the distortion.

There is not much point in using push-pull in the early stages of an amplifier, unless you want to go down to zero frequency and keep a balanced input. The electroencephalograph designers, who want to watch your brain ticking before they try to find what makes it tick, use these all-push-pull amplifiers so that they can record the push-pull signals from electrodes on your head, while eliminating the push-push voltages induced from the supply mains. But that is a special problem, and I am not sure we shall get round to it. For most of us, single-sided stages at low levels, then a phase splitter and a push-pull stage, are the answer.

When I was wondering whether to write these articles, I skimmed through a collection of commercial circuit diagrams to see what other designers thought about phase splitters. Right then I decided that phase-splitting techniques were not as familiar as I had believed, because the most commonly used circuit was a pretty poor one, with plenty of disadvantages and practically no advantages. It does seem worth-while to make a survey of the known phase splitters and to indicate how good or bad they are.

First of all, why should we concern ourselves with making the phase splitter good? We can see the answer most clearly if we consider a class-B output stage. Fig. 1 shows in a very exaggerated way the appearance of the output from a push-pull class B stage if one half is driven twice as hard as the other. As you can see, there is quite a lot of distortion.

More serious, perhaps, is the fact that if the upper half is at maximum drive, the output power is down to $(3/4)^2$, or little more than one-half, of the true maximum. The negative feedback could help the distortion, but it will not get back that extra power.

Another point comes out of this figure: the hard-working tube will take an additional plate current of I_1, while the idler takes only I_2, so that the output transformer will be subjected to a substantial magnetic flux which may (if it is not overgenerously designed) cause stability trouble at low frequencies, trouble which can be caused also by the unbalance signal back in the plate-supply unit.

There may be some more reasons for making sure that the push and pull are equal, but certainly there are no reasons for allowing them to be unequal. One of the main problems of push-pull design is therefore to make sure that the two drive halves are equal, equal at all frequencies, and that they stay equal. As we shall see, the difficulties arise when we demand equality *at all frequencies*, and when we demand that the drives shall stay equal as tubes age and supplies vary.

Two good phase splitters

The best of all phase splitters is the transformer, shown in Fig. 2. A well-designed balanced transformer will produce equal voltages across the two halves with an accuracy of 1 part in 1,000 and will certainly stay like that. The main objection to the transformer is the fact that its frequency response is not too good, and that it makes the use of negative feedback a lot more difficult. Transformers are mainly used, indeed, when other circuit demands must be met. One example is in operating a push-pull rectifier, for which the low direct-current resistance of the transformer is important; another is in driving a push-pull variable stage in a limiter or compressor, when the gain control bias must have a low-impedance path with no time-constant to the grid. Apart from these special circuits, the interstage transformer is rare nowadays, although it was standard practice in the early days of push-pull.

Another excellent phase splitter of limited use is made up of two resistors (Fig. 3). This is of interest when the input source has no ground; for example, if a phonograph pickup or magnetic reproducing head is to work straight into a push-pull circuit. Since the same current flows in series in the two resistors they must be equal in order to give the same voltage at the two push-pull terminals, and any stray capacitances must also be equal. Mr. Cocking has described an application of this idea to the diode detector, which gives the circuit shown in Fig. 4. The ground on the tuned circuit does not affect the balance of the circuit, because to audio frequencies the tuned circuit is a very low impedance. Now that crystal diodes are so cheap I consider that a more economical solution would be obtained by putting a tap on the center of the coil and rectifying the two halves with separate diodes, but Mr. Cocking's circuit dates back to 1934.

Some circuits from life

These circuits are of course the textbook type, well suited to the student and ignored by the engineer. Let us turn to a more practical circuit, which, though very widely used, is not very satisfactory to a critical designer. It is the circuit given in Fig. 5, and is shown as Fig. 21-a on p. 383 of Terman, *Radio Engineer's Handbook*. In this circuit tube 1 is driven by the unbalanced input, while tube 2 receives its drive from the voltage divider made up of R and (n-1)R. We can assume that R is very large indeed and that we are using pentodes. These assumptions have no influence on the final conclusions, but they make the mathematics very easy, with gR_1 instead of

$$\frac{\mu(nRR_1/nR + R_1)}{[\,(nRR_1/nR + R_1) + R_p]}$$

and I know how easy it is to obtain a reputation by the simple process of blinding by science. Anyway, tube 2 has a gain of gR_1 (where g is the transconductance), so that as the voltage applied to its grid is V_1/n, we have $V_2 = gR_1V_1/n$. We want this voltage

DRIVERS

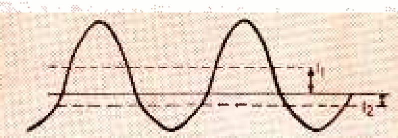


Fig. 1—What can happen to a signal.

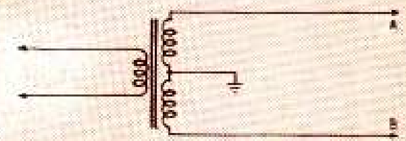


Fig. 2—This is the perfect inverter.

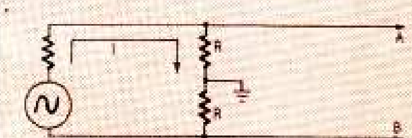


Fig. 3—Sometimes this can be used.

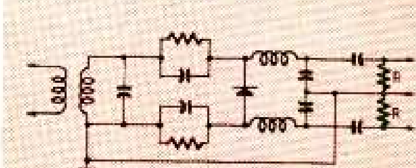


Fig. 4—One application of Fig. 3

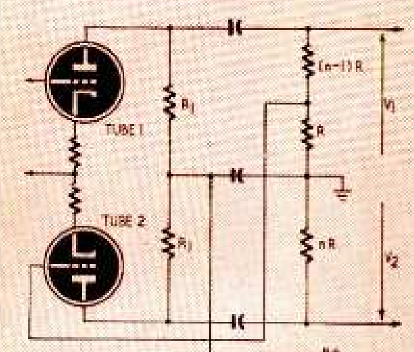


Fig. 5—One of the commonest inverters.

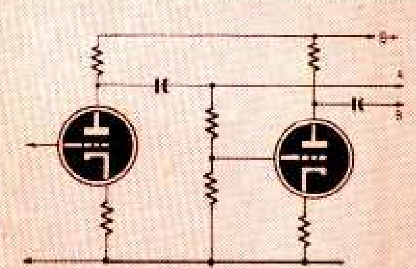


Fig. 6—This shows how Fig. 5 works.

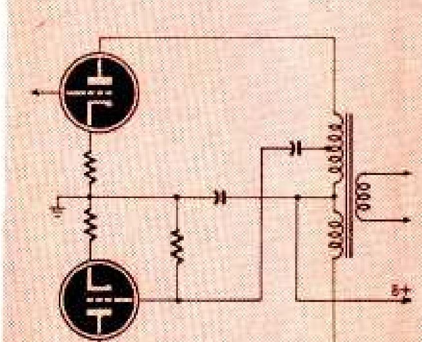


Fig. 7—Another little-used circuit.

to be equal to V_1, and therefore $V_1 = gR_1V_1/n$, or

$$n = gR_1$$

What could be more pleasant: just look up g in the tube handbook, choose R_1 to suit the tube and you know n right away. The total grid resistor nR [$= R + (n-1)R$] will be 100,000 ohms perhaps, so that R is known too.

The only trouble is that although the tube book may give $g = 7{,}650$ μmhos—and I have seen this exactness used—a look in the JAN specifications will leave you slightly worried. Most tubes have a tolerance of about 20% on transconductance, so that if you set the circuit up with a high-g tube it will be more than 30% out of balance with a low-g tube. And, of course, there are the tolerances on the resistors, too, though you can always adjust the circuit to take account of these. But you cannot prevent the balance drifting away as the tube gets old.

Another weakness

If we redraw the circuit as shown in Fig 6, we see a new disadvantage, which we shall find is common in phase splitters. The output voltage to the push-pull stage which appears at A has passed through one tube (tube 1 of Fig. 5), while that which appears at B has passed through tubes 1 and 2. Thinking again of a class B output we can see that if we feed back to the grid (or cathode) of tube 1 we shall be feeding back around two stages for one half-cycle and around three stages for the other half-cycle. The plate capacitance of tube 2 provides at high frequencies an additional phase shift which may make the amplifier unstable. It is not uncommon with circuits of this kind to observe a short buzz of h.f. oscillations on one peak of a low-frequency signal. This effect usually is to be detected only with an oscilloscope, and its cure involves the addition of as many components as would be needed for a more sophisticated phase splitter.

Another circuit given by Terman (loc. cit. Fig 21-c) is shown in Fig 7. The drive for the lower tube is taken from a tapping point on the output transformer. Quite obviously this arrangement cannot be used unless the tubes are operating under strictly class A conditions. If you consider what will happen if the tubes are set to the class B state you will see that when the upper tube is driven negative the lower tube gets no drive at all; when the upper tube is driven positive the lower tube is driven negative and still produces no output. Perhaps the worst feature of this circuit is the fact that if the tap is selected to give a good low-level balance with a poor tube, a high-g sample driven vigorously will oscillate in the Hartley oscillator circuit shown in Fig. 8: it is normally within 6 db of this unstable condition.

It is not impossible to find other disadvantages to this circuit in its practical applications, but it is so rarely used it doesn't seem necessary to do more than indicate it as an undesirable form.

A "simple" compromise

A third circuit belonging to this condemned class is sometimes seen. I found one example of it in a fairly recent car-radio design, though I must admit that it contained a mitigating feature. This circuit is shown in Fig 9. The drive is applied to tube 1, and the grid of tube 2 is fed from the screen of tube 1. As you remember, the signal at the screen of a tube is in the opposite phase to that at the control grid, so that if the grid-screen transconductance is g_{gs} and we connect a load resistor of $1/g_{gs}$ in the screen lead we obtain a voltage equal to the grid voltage but with reversed phase. This voltage is used to drive the grid of the other tube of the push-pull pair.

The circuit shown in Fig. 9 includes a decoupling capacitor in the common screen lead connected above the screen load mentioned in the last paragraph. When this capacitor is used, the circuit suffers from the basic defect of the three circuits discussed in this article: if the tube characteristics change, the balance is destroyed. As we saw at the beginning, a good balance is necessary if the distortion and power output are to be satisfactory. The designer of the car radio which incorporated this screen coupling avoided this difficulty by an ingenious and economical trick. He left out the dotted capacitor! When the circuit is balanced, the capacitor is not needed, because when the grid of tube 1 goes negative the screen current drops, driving the grid of tube 2 positive and increasing the screen current in tube 2 by exactly the same amount. Since the total screen current is constant, the voltage drop in the common screen resistor is constant, and the capacitor would have no alternating voltage across it: consequently it is doing no work, and can be omitted.

Suppose, however, that through wrong choice of the resistor R_1, the grid of the second tube is driven too hard. The voltage appearing at the screen of tube 2 will be greater than that produced by tube 1 at the top of R_1. When the grid of tube 2 goes plus, the top of R_1 will go negative. This negative voltage will be communicated back to the grid of tube 2 to help restore the balance. We have, in fact, negative voltage feedback in the screen-grid circuit of tube 2, which helps to preserve the balance.

Unfortunately, the grid-screen transconductance is too low to be of very much help in such a simple circuit. A typical value of g_{gs} would be 500 µmhos, and the "stage gain" will only be a few decibels, which is not much to use for feedback. So this elegant balancing —although helped by a common cathode resistor—isn't really so good. Of course, if R_2 is made very large, the effect can be increased, but usually you cannot make R_2 large or you will not get any power out of the tubes. The bright boys in the class will have no doubt seen that we could put in a choke instead of R_2, thus providing the balancing forcing action at no cost in d.c. volts. Here, however, we run into a new difficulty. The screen of a normal output tube is not a well-behaved electrode: if you drive the grid hard you get a distorted sort of wave at the screen as soon as you have any substantial screen load. This you would expect, because after all, you have a pentode drive applied to a triode. The result is that as you increase the balancing load R_2 you increase the distortion fed back from the screen circuit into the grids, and the result can be quite unpleasant. My experience is that all these trick circuits which save two components or so usually degrade the system down to the "all right for the price" class.

The tube circuits which we have considered in this article can be seen to have one feature in common: the drive for the pull section is derived from the push section in a way which depends on a knowledge of the gain of a tube stage. As a tube transconductance can vary over a 2:1 range, there is not much hope that the push and the pull will be equal, or if they start equal there is not much hope that they will stay that way. Obviously the designer who wants to get the best performance must think up some better method. Two basic types of solution have been found. One is to use the same current passing through two separate load resistors; the other is to use very large amounts of negative feedback. These solutions will be discussed in later articles.

It is only fair to add that in condemning these widely used circuits I am not suggesting that the designer who uses them does not know his job. It is merely that while their job is to produce plenty of output which does not sound too bad, my job always seems to be to produce plenty of output which gives less than 1%, or 0.5% or whatever the specification says, of distortion. What is worse, there is no tube selection or trimming allowed, though I can always afford an extra tube if I want to apply more feedback. Pity the poor designer who is trying to save two cents, but if you can afford it, make it good! END

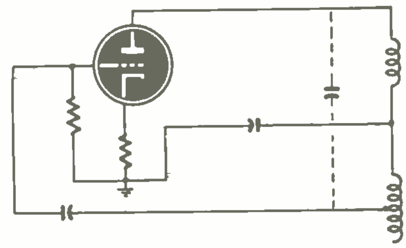


Fig. 8—Oscillator hidden in Fig. 7

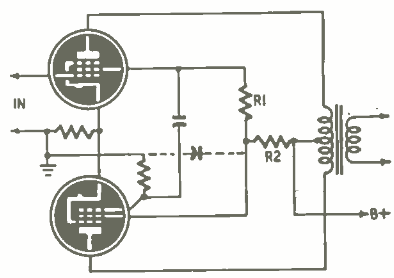


Fig. 9—Inverter with three defects.

Further articles on push-pull drivers will appear in early issues.

"Some day I'm going to have to tell that surgeon next door a thing or two!"

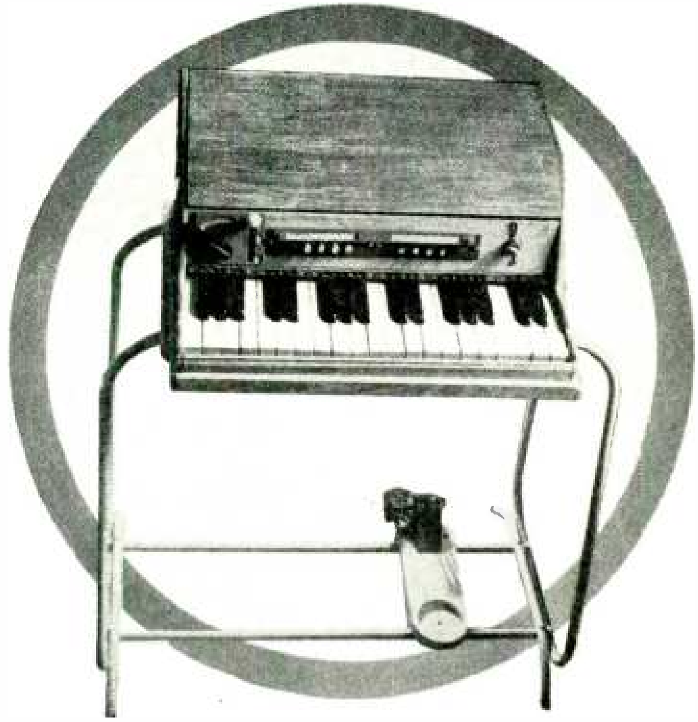
ELECTRONICS AND MUSIC A LIST OF ARTICLES

Below is a list of the series by Richard H. Dorf published under the title "Electronics and Music." These constitute practically all the articles on electronic music published by us in recent years, with the exception of "Electronic Music—the Easiest Way," which begins in this issue.

The issues marked with an asterisk are out of stock. Others are available (at 30¢ for 1952, 35¢ for 1951, and 40¢ for 1950 issues, except the special television issues, January 1951 and 1952, 50¢ each). All issues with electronic music articles prior to October 1950 are out of stock and cannot be supplied.

ELECTRONIC MUSIC ... the easiest way

A solo instrument with wide keyboard range and a variety of tone-color effects —simplified circuits and mechanical construction



By V. FASTENAEKELS

PART I

IF you are intrigued by the possibilities of electronic music, but shudder at the electrical and mechanical problems involved in building a complete electronic organ (such as described in "Electronics and Music," by Richard H. Dorf, in September RADIO-ELECTRONICS and preceding issues.—*Editor*), you can get a great deal of pleasure and musical satisfaction from this relatively simple instrument which I call the *Ondiovox*. In addition, the experience gained in constructing, operating, and experimenting with it should be highly valuable if you ever decide to go on to more complex designs.

All the basic calculating and experimenting has been done, and the only test equipment needed to get it working is an ordinary volt-ohmmeter. There is still plenty of room for experiment—especially in the tone-coloring circuits. This should certainly not be laborious. It can even be thrilling, when you try some simple combination of components and get a particularly melodious or novel sound effect.

This is strictly a solo instrument—that is, it can play only one note at a time. Unskilled musicians can operate it easily. It makes a fascinating accessory to a piano or reed organ; or it may even become a basic element in an all-electronic musical system of your own.

The electronic and electrical sections of the instrument are as easy to build as any standard radio or amplifier. The keyboard may be salvaged from an old piano or harmonium. This article will cover the electrical circuits of the instrument. Because of space limitations keyboard modifications (or construction—if you prefer to make your own), mechanical details, and the metal-frame console will be described in the second installment.

Basic design

A block diagram of the system is given in Fig. 1. All fundamental keyboard tones are generated by a simple multivibrator. Individual notes are produced by changing the time constant of an R-C circuit. The basic keyboard range of the tone generator covers three octaves: from F in the second octave below middle C to E in the second octave above middle C (approximately 85 to 640 cycles). With auxiliary switching the low end can be extended to 27 cycles—the lowest tone on a standard 88-note piano.

The vibrato circuit consists of an 8-cycle oscillator and a buffer amplifier. Vibrato amplitude is controlled by an ordinary potentiometer, and the circuit may be switched off completely if desired.

The outputs of the tone generator and vibrato oscillator are combined in the mixer tube. This tube has a third input from the "attack" circuit, which controls the rise time of the key tones to simulate wind, percussion, or bowed instrument characteristics.

The mixer stage is followed by an isolating transformer, and a series of

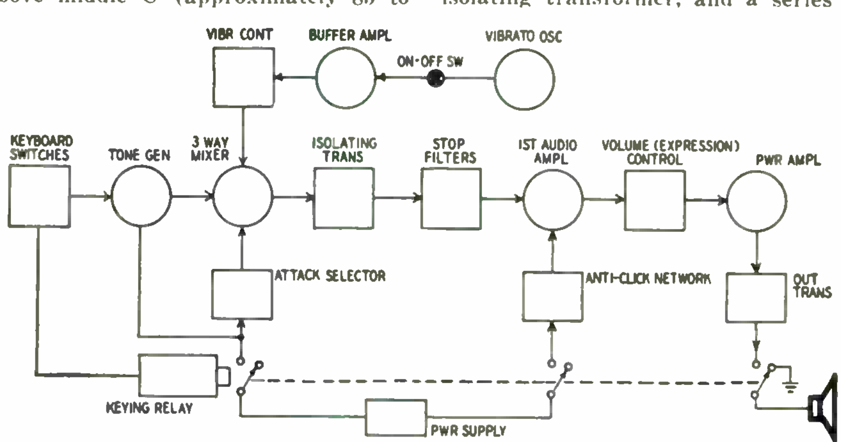
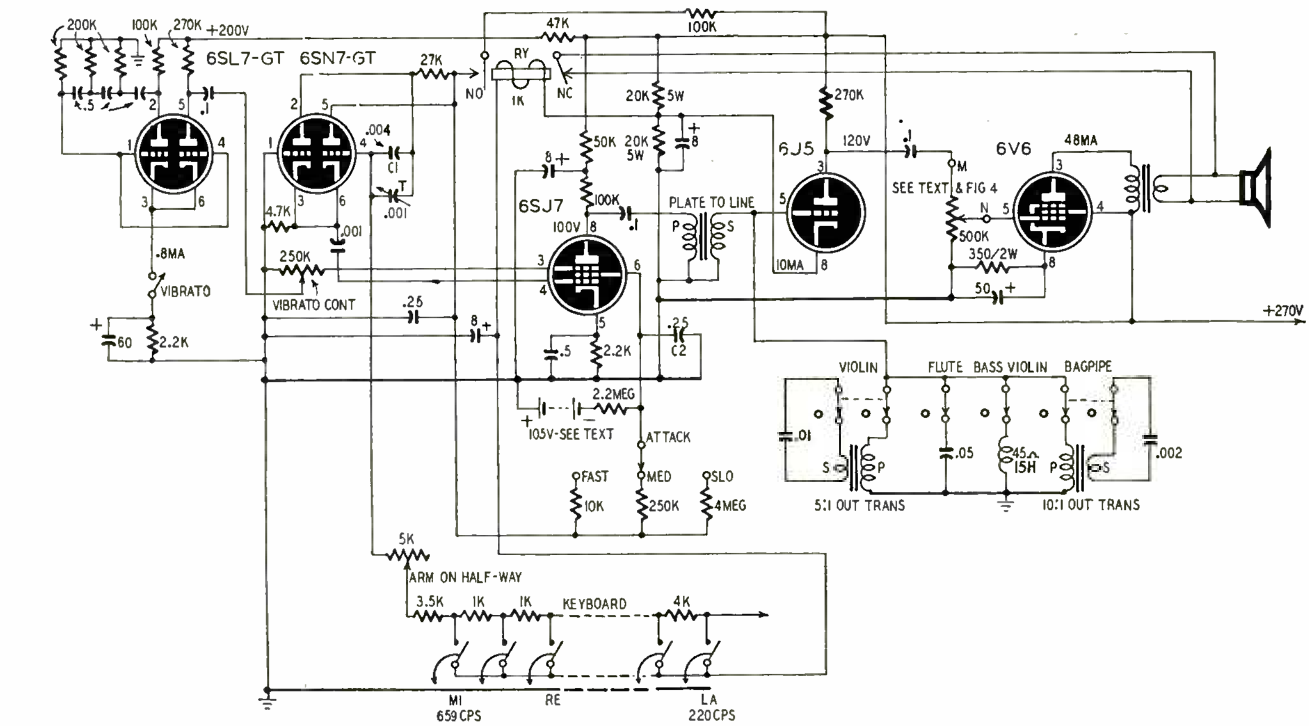


Fig. 1—A block diagram of the *Ondiovox*. The relay blocks noise and keying clicks.



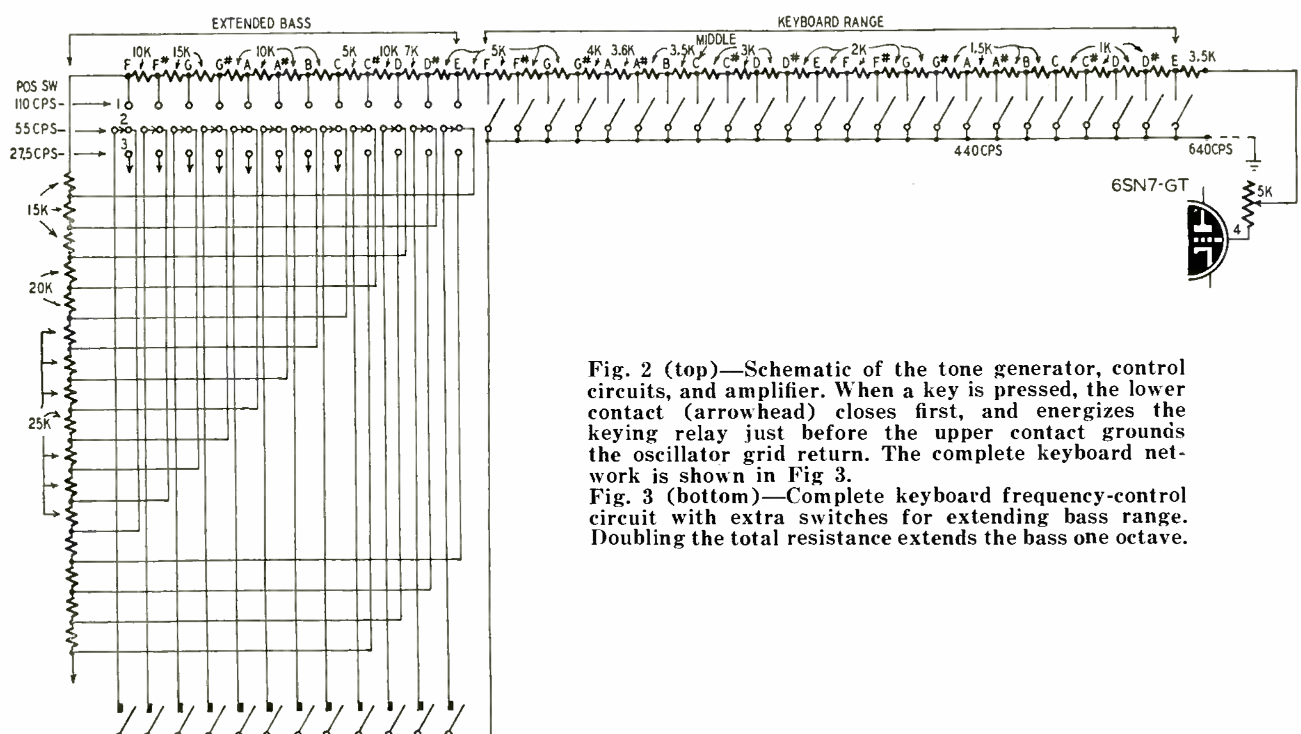


Fig. 2 (top)—Schematic of the tone generator, control circuits, and amplifier. When a key is pressed, the lower contact (arrowhead) closes first, and energizes the keying relay just before the upper contact grounds the oscillator grid return. The complete keyboard network is shown in Fig 3.
Fig. 3 (bottom)—Complete keyboard frequency-control circuit with extra switches for extending bass range. Doubling the total resistance extends the bass one octave.

selectable tone-color stop filters. These, in turn, feed a standard two-stage single-ended audio amplifier with 6V6 output to the speaker. The main volume (expression) control is in the grid circuit of the 6V6. An anti-key-click relay controls three circuits simultaneously: When no note is being played it cuts off the B supply to the tone generator, blocks the first audio amplifier, and shorts out the speaker voice coil. Striking any of the keys on the manual energizes the relay, and permits the circuit to operate. A delay filter in the relay circuit unblocks the audio amplifier *gradually*, eliminating the sudden rush of current that produces clicks and thumps.

Circuit details

The tone generator is a 6SN7-GT in a cathode-coupled asymmetrical multivibrator circuit (Fig. 2). Its frequency is controlled by the time constant (RC) in the grid circuit of the right-hand triode. ($F \propto 1/RC$.) Either C or R may be varied to change the frequency, but the most practical method is to use a fixed capacitor and a variable resistor. Reducing the value of the grid resistor raises the frequency, and vice versa. The three-octave range is covered by changing the total resistance in fixed steps with switches actuated by the notes of the keyboard. The trimmer across C1 allows the entire range to be shifted about one full tone up or down for tuning against various standards. The range can be extended at the low end of the scale by doubling the total resistance for each octave added. (The wiring of the complete keyboard circuit is shown in Fig. 3.)

The output waveform at the common cathode terminal is a small positive pulse. This is coupled through the .001-µf capacitor to the control grid (pin 4) of the 6SJ7 mixer tube.

The vibrato oscillator

In this circuit the left-hand triode of the 6SL7-GT is a phase-shift sine-wave oscillator. Each R-C section of the feedback network between plate and grid shifts the signal phase approximately 60 degrees at a frequency of about 8 cycles per second. The three sections give the total shift of 180 degrees required for oscillation. (Other frequencies are shifted more or less than 180 degrees by the constants of the feedback network, and do not reach the grid in the correct phase to maintain oscillation.) Losses in the feedback filter are more than compensated by the voltage gain of the triode. The right-hand triode is a direct-coupled buffer amplifier whose output is fed through the "vibrato-control" potentiometer to the suppressor grid (pin 3) of the 6SJ7.

The attack circuit

The 6SJ7 is the workhorse of the instrument. It not only modulates the output of the tone generator at the 8-cycle vibrato frequency, but also provides control over attack time.

In all pentodes, the screen grid has the greatest degree of control over the plate current. In voltage amplifiers like the 6SJ7, the screen voltage also determines the amplification factor of the tube. In this circuit, the screen of the 6SJ7 (pin 6) is supplied from the 0.25-µf capacitor C2. This capacitor is charged from two sources: The 105-volt battery supplies a steady *negative* charge through the 2.2-megohm resistor, which cuts off the plate current of the tube. When the relay contacts are closed by pressing any of the keys, the power supply provides about 170 volts *positive* at the common terminal of the three attack resistors. The time required for the screen capacitor to charge to this new voltage depends on the attack resistor selected. In the FAST position the combination of 10,000 ohms and 0.25 µf has a time-constant of 0.0025 second. In this time the screen voltage rises to 63% of the difference between —105 and +170, or about +68 volts. After about 4 time-constants (0.01 second) the screen reaches the full 170 volts, less a small drop in the attack resistor due to the screen current. Thus the 6SJ7 swings from cutoff to full gain in approximately 0.01 second.

In the MEDIUM position the 250,000-ohm series resistor increases the time required for the 6SJ7 to reach full gain to 0.25 second; and in the SLOW position it takes about four seconds.

There is no current drain on the 105-volt battery, so it should last as long in the equipment as it would on the shelf. If you want to eliminate the battery altogether use the simple regulated supply shown in dashed lines in the power-supply diagram) (Fig. 5).

The plate of the 6SJ7 is coupled through a 0.1-µf capacitor to the primary of a low-level plate-to-line transformer. The capacitor blocks d.c. from the primary to prevent any drop in inductance due to core magnetization. A high-fidelity type is not essential, but the primary impedance should be as high as possible for good low-frequency response. Since there is no unbalanced d.c. flowing through the windings, a push-pull plates-to-line type, such as the Thordarson T-22S90 or UTC 0-10 will give maximum primary impedance.

Tone-color circuits

An infinite variety of tone colors can be produced with various combinations of resistance, capacitance, and inductance across the secondary of the isolating transformer. Only a few representative effects are shown in Fig. 2. These were obtained with components that happened to be available.

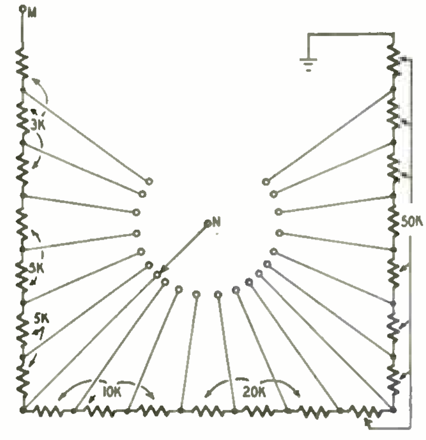


Fig. 4—Step-by-step volume control.

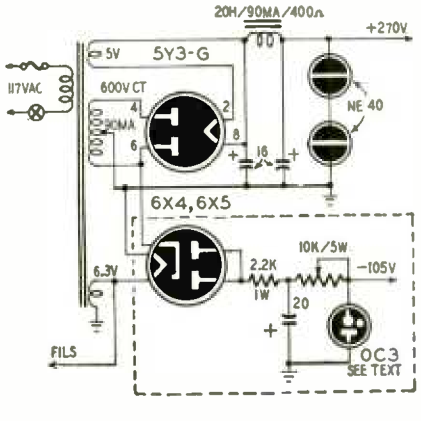


Fig. 5—Power-supply circuit diagram.

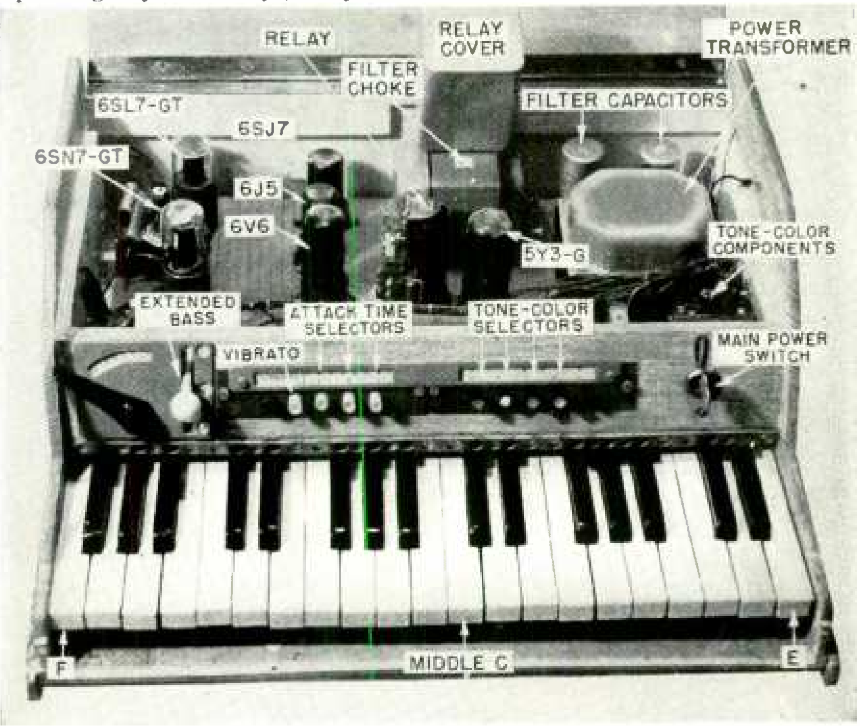


Fig. 6—General layout of the chassis, keyboard, and main operating controls.

Audio amplifier

Except for the volume (expression) control, this part of the circuit is perfectly straightforward. In order to obtain the greatest ruggedness and freedom from noise with foot-pedal operation the expression control is made up of individual fixed resistors on a 21-point wafer switch. The values are given in Fig. 4. The mechanism will be described in the next installment.

Power supply

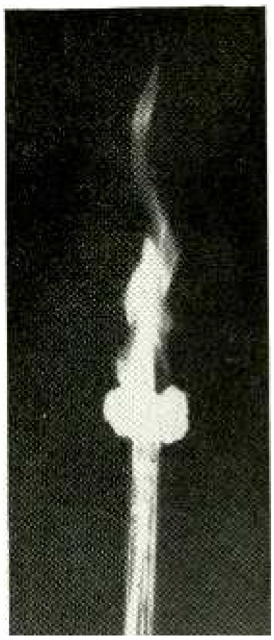
The power supply too follows standard practice. See Fig. 5. The series-connected neon lamps across the output act as a bleeder and provide some regulating action to hold the output voltage constant. The circuit in dashed lines may be added to replace the 105-volt battery in Fig. 2.

Construction

The general layout of all components can be seen in Fig. 6. The entire assembly (except for the keyboard switches and frequency-controlling resistors) can be mounted on a 7 x 17 x 2-inch chassis. Each resistor in the frequency-control circuit is mounted directly behind its associated key on a long terminal board. This part of the assembly will be described in the next installment.

(To be continued)

ELECTRONIC FLAME*



Zinc rod, showing the formation of oxide as the flame consumes it.

Is this a new discovery? Or is it an effect that goes back to Tesla's days?

By THOMAS E. FAIRBAIRN

WHILE a friend and I were talking over ham station W8SYK to another ham in Australia, a large flame started shooting off the capacitor stator of the antenna-coupling tank. At the same time we lost our contact and shut down the transmitter as quickly as possible to prevent breakdown. I remarked to my friend that this was such a different flame that I wanted to see it again—would he please turn the transmitter back on?

Upon a closer look I noticed that even though the flame was burning vigorously, the transmitter remained properly tuned and suffered no damage.

The sight of metal burning like a stick of wood was very curious. If one metal burned so might others, if they were placed at the point on the transmitter where the flame was first noticed. I took a 6-inch piece of No. 14 copper wire and put it on this point on the capacitor stator. With a slight retuning of the final amplifier and antenna coupling tank, the end of the copper wire burst into a long, bright green flame about six inches high and very hot. The wire melted and burned down very slowly. About this time an r.f. arc jumped across the plates of the variable antenna output capacitor and shorted out the high-voltage power-supply transformer. Our experiment was over, and my friend would not renew it.

Nearly two years later I acquired this transmitter, to conduct experiments to see if the flame would reappear and at the same time try to find out what it was.

I knew that if I was to prevent the transformer or something else from burning out, the unit used must be so changed as to prevent arc-overs and overloads. The antenna output and coupling circuits were redesigned as pictured in the photo opposite. Note also the schematic diagram of this output circuit in Fig. 1. The main change in this transmitter was increasing the spacing between the antenna output tuning capacitor plates from one-quarter inch to one inch. The antenna was completely removed to give the highest Q in the output tank. A specimen holder was also put at a convenient high-voltage, high-impedance point on the antenna output tank coil, so metal and glass rods to be burned could be held firmly and changed easily.

A new phenomenon?

What is this electronic flame? It does not appear to be an electric or r.f. arc, but looks more like a flame of a torch or burner. Only a conductor of electricity such as zinc, steel, tungsten, or leaded glass, will burst into flame. Such nonconductors as wood or paper will burn only when placed in the electronic flame. To find out what the electronic flame is, many experiments were conducted.

First because of the unusual electrical properties of glass—which conducts electrical current only when in the melted state—a Pyrex rod about six inches long was placed in the metal holder shown in the photo opposite When the transmitter is tuned to resonance by regular methods the glass rod will burst into a large yellow flame about five inches long as pictured. When a tool steel drill was placed in the holder and the current was turned on a very brilliant display was seen with white-hot sparks spitting into the air as well as a brilliant flame with some smoke slowly burning the drill. What happened to the drill is shown in Fig. 2. A zinc rod showed that chemical compounds also could be formed. The photo above shows white zinc oxide in a ball about one inch in diameter. The flame of the zinc is blue when it first starts to burn and as the white zinc-oxide ball starts to form the blue flame becomes very active.

Other metals such as tungsten burn very hot with a red flame; iron burns white hot, sodium glass burns with an orange color, and cobalt glass burns with a deep red flame about six inches high. All these metals are very hot, with the temperature of their flames exceeding their melting point.

In summation, glass, graphite, zinc, steel or copper burn very hot and very vigorously in the electronic flame. Each flame has its own color and can be identified by it. Only conductors of electrical current will burn. Magnetism does not affect the flame. The elements

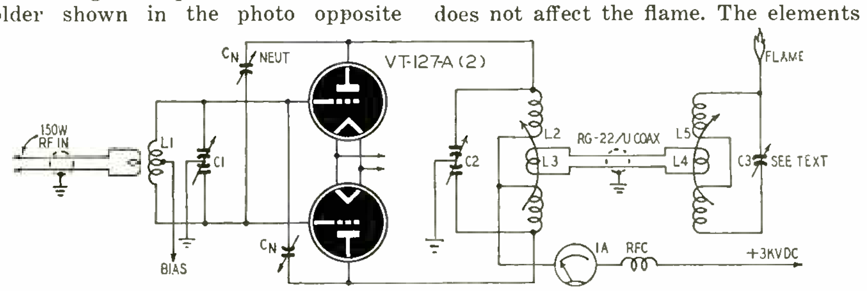
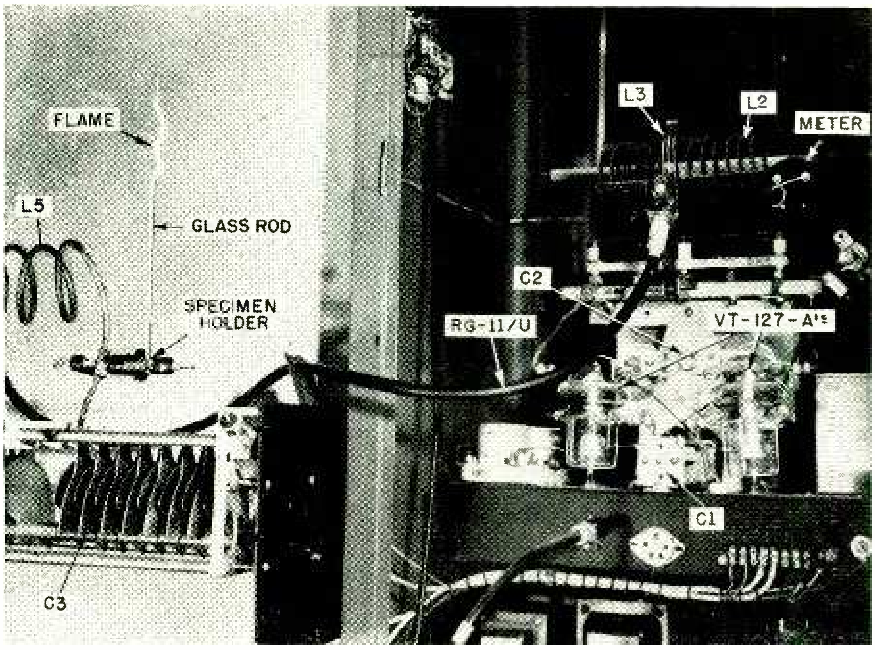


Fig. 1—Schematic of the power amplifier stage that feeds the electronic flame.

* patent pending



Setup of the electronic flame equipment, including the final transmitter stage. Half the parallel-resonant-circuit capacitor is beyond left edge of photo.

Fig. 2—Copper wire, steel drill and iron clothesline after burning. The single strand of clothesline was observed to burn down one inch in ten seconds.

that are burned reduce very slowly to ash, compounds, and melted material. The flame needs little or no oxygen (but might need a supporting gas about it). Compounds can be formed which are nonconductors of current. When the plate current is turned off the flame goes out but comes on again when the current is turned on. The electronic flame looks and acts like any other fire.

No complete transmitter schematic is given, for the results can be duplicated by any 1,000-watt, high-Q short-wave transmitter, with a high-voltage output tuning capacitor a necessity. The master oscillator is a crystal-controlled 6AC7 oscillating at about 7 megacycles. It drives a 6Y6 doubler-amplifier. The 5U4 supplies B plus for these two tubes. A 6L6 doubler drives the 813 buffer amplifier at 14 mc. It supplies the final amplifier tubes, a pair of VT-127-A's, with 150 watts of grid drive. The buffer amplifier is supplied 400 volts d.c. by a pair of 816's, and the final amplifier gets 3,000 volts d.c. from a pair of 866's. A 5U4-G also furnishes grid bias for the class C final amplifier. The VT-127-A's are surplus radar tubes similar to the Eimac 100T's and 304T's. They can stand very high plate currents. This is why we can allow the electronic flame to burn in excess of ½ ampere plate current without damage to the tubes.

The output frequency of the unit is located in the 14-megacycle amateur band. The station was operated by Wardel Mitchel, W8SYK, during experiments. (Don't forget FCC regulations with respect to unmodulated carriers.—*Editor*) The output of the final amplifier is coupled to the output circuit by a coaxial cable RG-11/U. This coupling circuit is so designed as to prevent the 3,000-volt d.c. to the final amplifier tuning tank from getting into the flame output circuit. Refer again to Fig. 1. It is important to maintain a very high Q in the output circuit where the rod to be burned is placed.

To find the right place to put the rod to be burned on the output tank I suggest that a large highly insulated screwdriver be touched to the high-voltage point to find the place where the largest arc is drawn off. Be very careful, as an r.f. burn is bad and will jump as far as an inch to one's hand. Keep your hand back on the handle!

Tuning is the same as that of any transmitter except I recommend that the final amplifier and output tuning tanks be tuned with the final amplifier plate current *off*. It is well known that the final amplifier plate current can be tuned by watching the very small dip in the final plate current meter even though near zero. The output tank can be tuned the same way after the rod to be burned is properly placed—except we tune the output tank for the least amount of movement of the plate current meter when it is dipped by the final plate tank capacitor. After the current is turned on, touch up the final and output tanks by regular methods for the best resonance.

When resonance is reached, the end point of the metal or glass rod will burst into fire. The coupling from the final amplifier tank to the output tank can also be tuned for more or less coupling. The greatest coupling does not always make the biggest flame. About one half coupling is recommended for maximum Q.

Why does the glass or metal rod act as it does? When a parallel-resonant circuit is tuned to resonance it has a very high impedance and consequently a high voltage across it. If the Q of our circuit is high then there will be a very high voltage at a very low current across the output tank at resonance. This voltage is in the millions. Oscillating at 14 megacycles, there is no way to radiate this high power. A small six-inch rod when placed at this point offers very little impedance to the resonant tank; therefore the Q of the circuit is not affected and the high voltage will be at the end point of the rod. This high-potential energy has no place to go other than out the end point of the rod into the air. As this energy is rushing out the small end point of the rod the rod is bound to get hot. It appears that it is not the current that is making the rod hot enough to burn, but the high voltage constantly pounding away at 14,000,000 times per second. Almost anything would get hot if you pounded it at that pressure and frequency!

The temperature of the flame depends on the type of metal burning. Metals with a higher melting point will take a fraction of a second longer to reach that melting point. As long as a metal has not reached its melting point its end point remains small, giving the energy leaving it a small path out, but when its melting point is reached, the end is much larger and offers less resistance to the outgoing energy and the temperature will stay at the vapor and melting point of the metal used.

The only factor that would seem to limit the temperatures that may be attained would be the amount of energy used and the pressure behind it. In this experiment 1,000 watts appear to be sufficient to burn almost any metal.

Upon closer examination of the contents of the flame it was found to contain vapor of the element that was emitting the flame as well as a mixture of the oxide of that element. The light that comes from the flame is that which is given off from any metal when it burns, plus some ionization of the vapor by the r.f. in the tank circuit. END

PLATED CHASSIS

New production technique forecasts drastic changes in methods of production

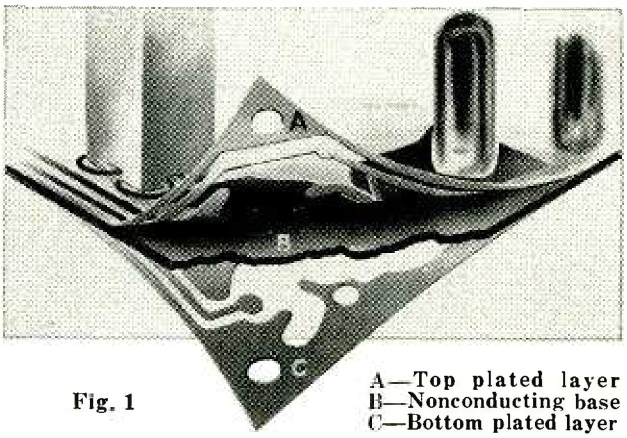


Fig. 1

A—Top plated layer
B—Nonconducting base
C—Bottom plated layer

PLACIR is the name of a new plated-circuit process used by Motorola in the construction of the 5-tube a.c.-d.c. broadcast receiver models using the HS-289 chassis. In these sets, the usual metal chassis has been replaced by a stamped plastic base appliquéd on both sides with a thin layer of copper in a pattern which duplicates the wiring layout of the receiver. Each line of the pattern is a conductor which replaces the hookup wire or bus bar used in standard wiring techniques. The metal plating extends through all holes in the chassis to connect circuits on the front with those on the rear. A cross-section drawing of one corner of the chassis is shown in Fig. 1 and the underside of the chassis is shown in Photo A.

This type of construction minimizes lead breakage through vibration and eliminates problems of hum and feedback caused by variations in lead dress.

Sockets are integral parts of the chassis. They are made by boring holes in the plate and inserting small clips which fit over the tube pins. The clips connect to the proper circuit elements through plated leads.

The outer edges of the chassis and the large plated areas in the center form the common B minus return. Other short leads carry r.f., i.f., and a.f. signals, and filament and d.c. operating voltages.

There are *no* printed-circuit components in the receiver. All resistors and capacitors are conventional components soldered to the plated-circuit leads on the chassis. Photo B shows the major components mounted on the top or front of the chassis.

Servicing precautions

The circuit (Fig. 2) is conventional but the physical construction requires modifications in service methods.

Always observe the following precautions when servicing or handling plated-circuit chassis:

1. Use an isolation transformer between the set and the power line. The edges of the chassis and the large plated areas in the center are connected directly to one side of the line, so there is a danger of a serious shock or a short circuit if the transformer is omitted and the line polarity makes the chassis hot with respect to ground.

2. Do not service the chassis on a metal plate. A short circuit is likely.

3. Handle the chassis with care. All voltage-carrying leads are exposed.

Replacing components

The unusual construction of this chassis makes it necessary to use new techniques and precautions when replacing components. Follow these rules:

1. Avoid tube breakage by removing them before starting work. Pull the tubes *straight* out. Wiggling them may deform a socket clip and cause a poor

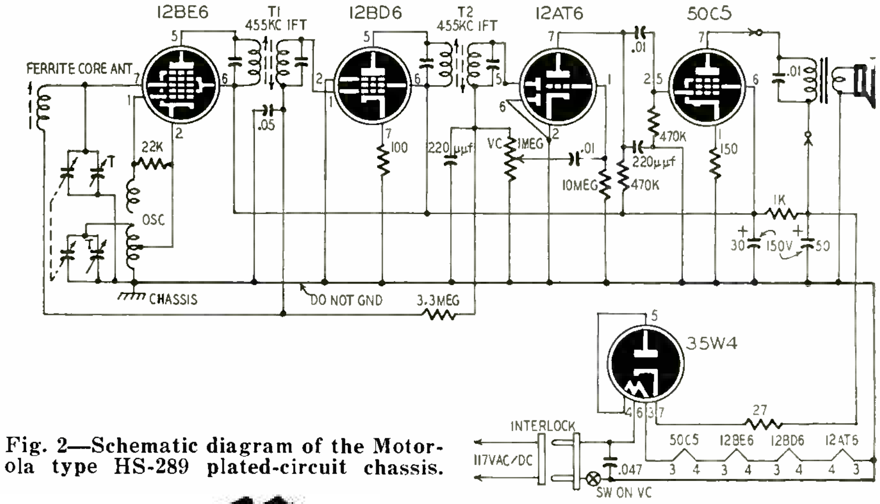
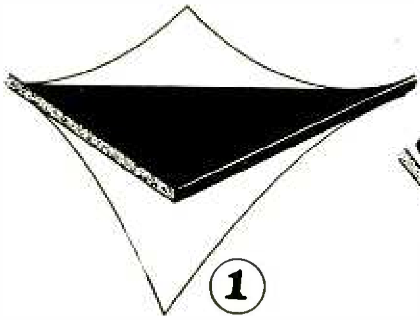
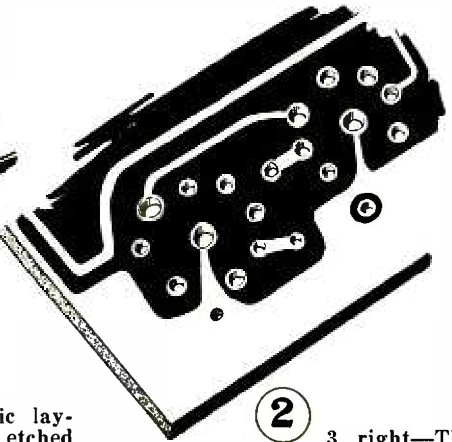
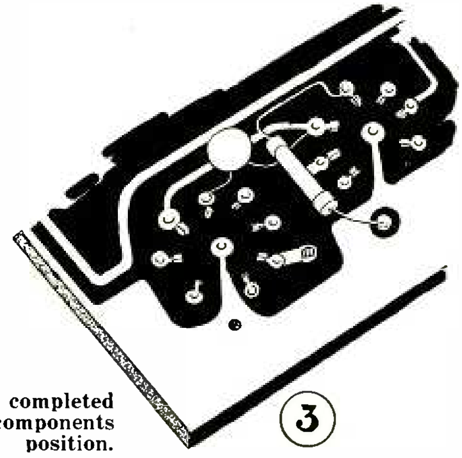


Fig. 2—Schematic diagram of the Motorola type HS-289 plated-circuit chassis.

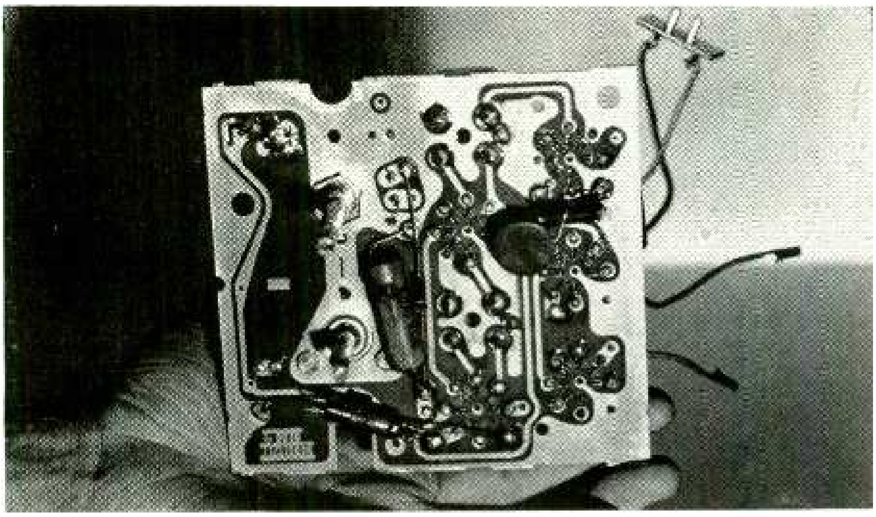




1—Insulating base and two metallic layers form a sandwich. 2—Metal is etched out by photoengraving techniques, leaving metal circuit lines on nonconductive base.



3, right—The completed chassis, with components soldered into position.



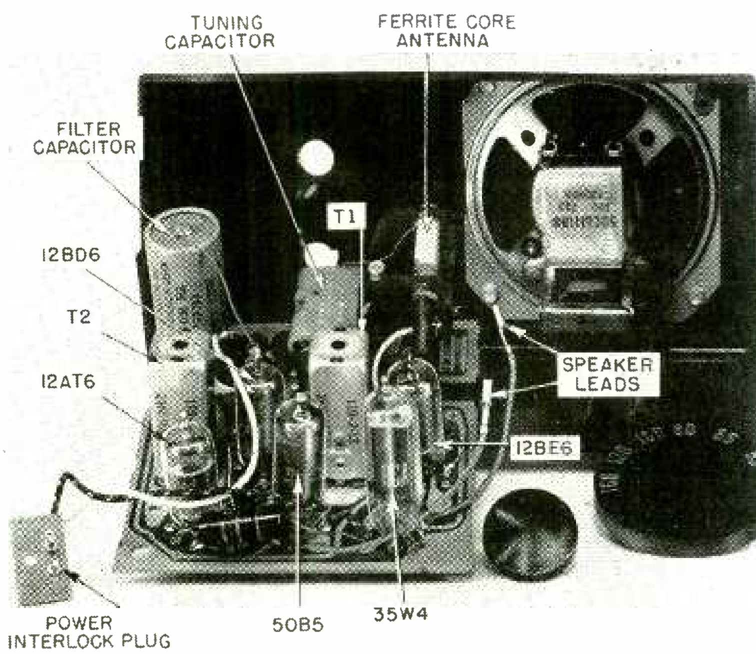


Photo A (top)—Underside of the Motorola HS-289 chassis. Photo B (bottom)—A top view of the new chassis. Photo at right shows the smart cabinet of the five-tube a.c.- d.c.-type receiver which uses the new HS-289 chassis.

contact between it and the tube pin.

2. When removing defective components, use a *small* soldering iron (60 watts or less) to avoid damage to the wiring. *Do not use a soldering gun.* The leads are very thin and too much heat will burn them or cause them to pull away from the base material.

3. Replace damaged circuit leads with regular hookup wire.

4. When removing i.f. transformers, the volume control, or electrolytic capacitor, the recommended procedure is to immerse all lugs simultaneously in a small soldering pot. The component can then be lifted away from the chassis. If a soldering pot is not available, heat each lug individually with a *small* soldering iron, and shake off as much molten solder as possible. The component can be removed by alternately heating and loosening each lug. Take care that you do not pull the plated connection away from the chassis.

5. Damaged tube clips can be removed by squeezing with pliers and then unsoldering. Snap the new clip into the hole and solder it to the lead.

6. To remove resistors and capacitors, unsolder one lead at a time. Be sure to remove all solder from the holes and do not permit it to run into adjacent leads where it will cause a short circuit.

7. Be extremely careful not to damage the plating while removing or replacing the volume-control mounting nut or the tuning-capacitor mounting screws.

8. Insulating washers must be placed under the heads of the chassis-mounting screws when reinstalling the chassis in the cabinet. These washers prevent the screw heads from damaging the plating on the chassis.

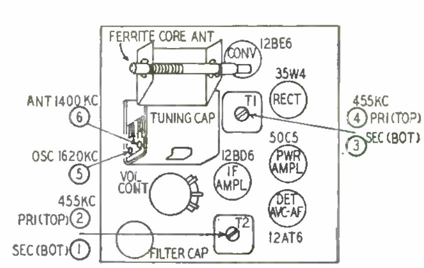


Fig. 3—Location of alignment points.

Alignment procedure

The alignment procedure is standard. An isolation transformer should be used between the receiver and the power line to avoid shock, short circuits, and hum. If a transformer is not available, connect the low side of the signal generator output lead to the chassis or negative leg of the filter capacitor through a 0.1-µf capacitor rated at 400 volts or higher.

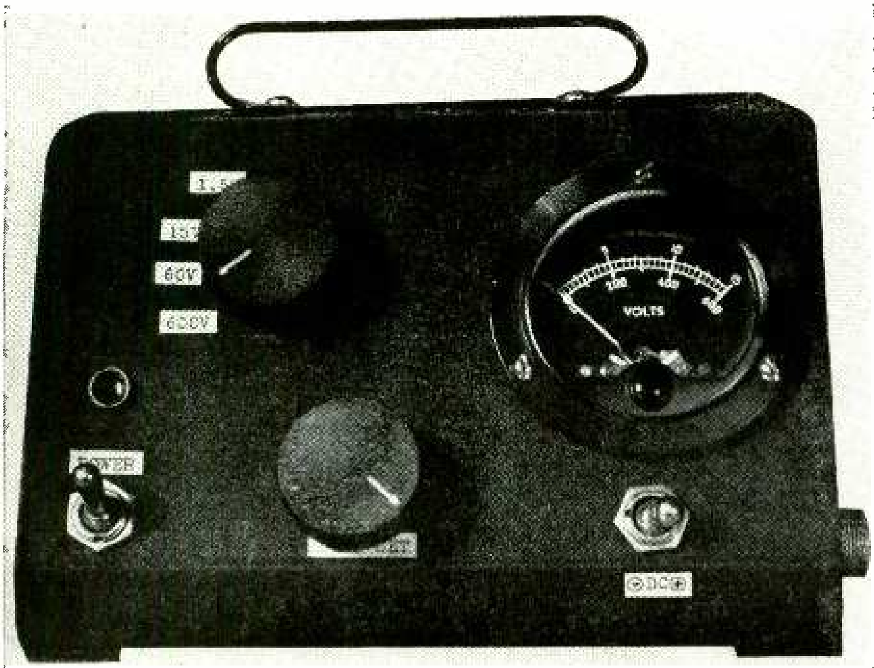
Alignment Table

Sig. Gen. Connection	Sig. Gen. Frequency	Tuning Gang	Adjust. (See Fig. 3)
Pin 7 of 12BE6	455 kc	Fully open	1, 2, 3, and 4.
Pin 7 of 12BE6	1620 kc	Fully open	5 (Osc. trimmer)
Loop*	1400 kc	Tune for maximum	6 (Ant. trimmer)

**Connect signal generator across a 5-inch diameter, 5-turn loop placed at least 12 inches from the antenna of the receiver.*

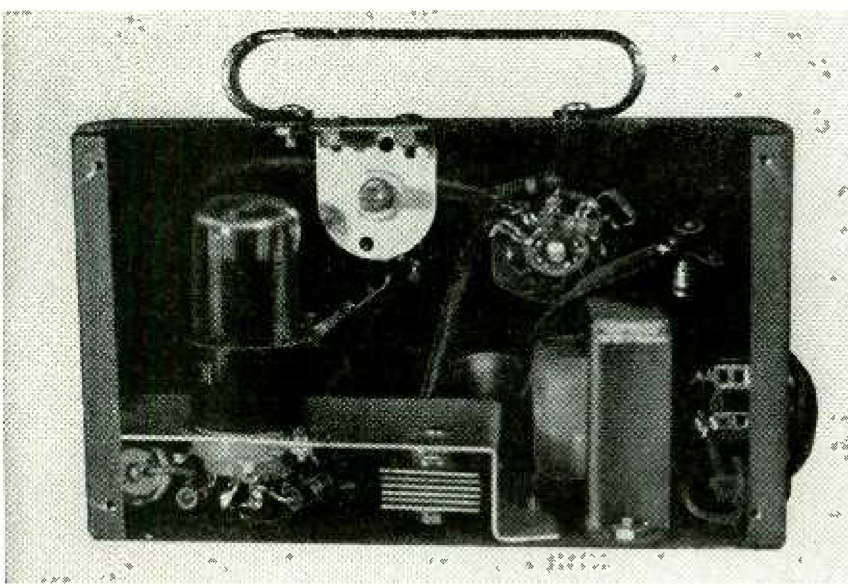
All circuits are tuned for maximum output on an output meter connected across the voice coil of the speaker. The signal generator should be set for 30%, 400-cycle modulation. A 0.1-µf capacitor in series with the hot lead from the signal generator acts as a dummy antenna.

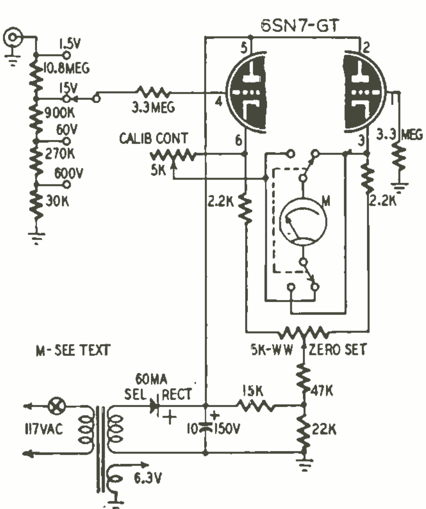
Alignment procedure is given in the table. Begin the alignment with the volume control set for maximum output. Reduce the output of the generator as the circuits are brought into resonance so the signal across the voice coil does not exceed 0.4 volt (.05 watt). This prevents the receiver from being overloaded. END



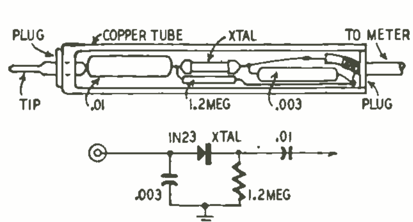
Inexpensive electronic meter simplifies many servicing tasks

LOW COST VTVM





(Photo above)—Rear view of the v.t.v.m showing slotted-shaft calibration adjustment. Fig. 1 (left)—Schematic of the inexpensive v.t.v.m. Fig. 2 (below)—Schematic diagram and construction details of the rectifier-type test probe.



By JULIAN P. FRERET

THE 20,000 ohms-per-volt multimeter has become the basic item of test equipment for shop and laboratory. The popularity of the vacuum-tube voltmeter has also increased substantially during the past few years. With greater complexity in FM and TV receiving equipment, the v.t.v.m. has become a necessity for many jobs which require high-impedance measurements.

The home constructor and small shop owner is confronted with the dilemma of either buying a ready-made instrument, assembling a kit, or making up a meter from scrap and surplus components lying around in the extra parts department. The technician who has learned to make full use of his 20,000 ohms-per-volt meter may not feel like spending the $50 to $200 required for a factory job, nor even making up one of the several kits on the market ranging from $20 upward. A home-built job may fill the bill insofar as basic measurements and ranges are concerned, and at the same time dent the pocketbook only slightly, depending, of course, upon the number of spare parts that can be gathered from the junk box.

A glance at the back issues of radio construction periodicals and at the various v.t.v.m.'s made up by acquaintances reveals that they fall into two classes: the super-duper jobs including ohms scales reading to thousands of megohms, supplied with 1% resistors, 4-

inch meters and voltage-regulator tubes (and incidentally priced out of the average shop operator's budget) and the "look-it's-no-larger-than-a-match-box!" type (accompanied by a photo showing that it is, in fact, no larger than the box of safety matches posed beside it). The latter type—the cute-toy variety—is of little practical value, and generally requires diminutive parts that are not readily obtainable.

The meter shown in the photographs was made up as a happy compromise between the extremes of high cost and tiny impracticability. Except for resistance measurements, it will perform most of the functions of the larger models at a considerable saving in original cost. Resistance measurements were omitted, as it is seldom necessary to obtain readings in excess of 20 megohms, and all values below that may be obtained with the usual high-resistance multimeter. Too, a measuring device of high input impedance for determining resistance is of limited value to the average repairman or experimenter. The additional switch and switch bank, resistances, voltage cell, and recalibrated meter-movement scale necessary for resistance measurement not only would increase the cost and complexity of the instrument but might also result in expanding its size or severely overcrowding the interior of the cabinet.

The meter was constructed in a small sloping-front sheet-steel box more or less as a novelty, as horizontal face meters always seem to necessitate leaning over to observe small changes in readings, while the vertical models on a bench or work table usually require stooping for careful scrutiny. Dimensions of the cabinet are 4 by 4½ by 7 inches long, a standard size readily obtainable from supply houses. It was adequate to house the parts without undue crowding. A miniature tube was decided against, on the basis of availability, lower replacement cost and greater ruggedness of the 6SN7. A 12AT7 might be substituted for the octal tube, with a saving of space, but the 6SN7-GT has furnished satisfactory service since the instrument was completed, and the decision against a miniature tube was apparently a wise one.

Details of construction are shown in the accompanying photographs. The power transformer is mounted directly on the floor of the sloping-face cabinet, and the switches and controls are held to the front panel by their retaining nuts. The rest of the parts are mounted on a small aluminum chassis bent out of a 3 x 4-inch piece of scrap cut down to size and drilled for the socket and various mounting lugs. The chassis is provided with sheet-metal screws to the bottom and side of the cabinet to retain it in place. The scrap pile also furnished another piece of thin aluminum, which was used for a cabinet back. The back was carefully drilled near the tube to provide ventilation and prevent overheating, which might cause inaccurate readings.

The tube filament is heated by a transformer secondary winding rather than by a dropping resistor. (See Fig. 1.) This precaution was incorporated so that the 117-volt a.c. supply would be divorced completely from the meter circuit, since much work involves a.c.-d.c. sets, and a direct 117-volt line in either the plate or filament power supplies is likely to produce fireworks and misfortune. The high-voltage secondary of the power transformer furnishes 117 volts, which, when used with the selenium rectifier, produces a low and stable plate supply for the tube.

A word about the meter movement. The one shown was bought surplus from Sun Radio of Washington, D. C., for $2.97, and has a 500-microampere movement with 0–15 and 0–60 volt scales. These scales lend themselves to easy multiplication and the finished instrument was designed for a.c. and d.c. ranges of 0–1.5-, 0–15-, 0–60-, and 0–600-volt full-scale measurements, which have proved the most handy around the shop. Any other low-current movement that may be available can be pressed into service. Remember that the lower the basic movement the better. A 0–50 microampere movement, for example, will permit operation over a smaller portion of the tube's characteristic curve, and consequently allow greater linearity and accuracy, than a 0–1 milliampere meter. Of course, since the price of meters is generally directly proportional to their sensitivity, the limiting factor will be the expense, unless a spare meter of high sensitivity is lying around the extra-parts bin.

Resistors for the "resistance stick" are of the inexpensive half-watt variety, but were chosen with care to assure values as close as possible to 30,000, 210,000, 900,000, and 10.8 megohms. Since the basic accuracy of the meter depends directly on the tolerance of these resistors, selections were made from the stocks of a tolerant retailer after many measurements with an accurate ohmmeter. Precision or semiprecision resistors could have been substituted, but, again, the cost was the limiting factor and the more accurate and expensive units were decided against.

In the front-view photo, controls, from left to right, are: on-off switch in the power line, with pilot-bulb indicator above it, range-selector switch, balance-control potentiometer, polarity-reversing switch, and (at the side) the connectors for input leads. At the rear, as shown by the other photo, the calibration control is mounted behind the meter movement and once adjusted need not be moved unless the tube is changed or the resistance stick changes markedly in value.

The circuit is of the balanced type. The balance control makes the two halves of the dual triode draw such current that both plates are at the same potential. A change in the grid voltage of one will upset the balance and cause the meter movement to register according to the impressed voltage. The 6SN7-GT was found to have sufficiently straight characteristic curves to make readings linear over the instrument's basic operating range, which is from − 1.5 volts to + 1.5 volts for full-scale movement.

Bill of materials for meter.

Resistors: 2—2,200, 1—15,000, 1—30,000, 1—47,000, 1—270,000, 1—900,000 ohms ½ watt; 1—1.2, 2—3.3, 1—10.8 megohms, ½ watt; 1—22,000 ohms, 1 watt; 2—5,000-ohm wirewound potentiometers.

Capacitors: 1—.003, 1—.01 μf, paper; 1—10 μf electrolytic, 150 volts.

Switches: 1-single-pole, 5-positions; 1 s.p.s.t., 1-d.p.d.t.

Miscellaneous: 1 60-ma selenium rectifier, 1-1N23 crystal; 1-half-wave power transformer, 117-120 volts, 40 ma or more, 6.3 volts, 1 amp or more; 1 meter, as per text, 1 6SN7-GT tube and socket for same, jack, plug material, hardware, wiring, etc.

The d.c. probe (Fig. 2) contains a 1-megohm isolating resistor which results in reduced capacitive loading of the circuit under test. Most a.c. measurements are made at higher frequencies, so it was decided that no rectifier be built into the cabinet. Instead, a probe with crystal and coupling capacitor was assembled from the junk box. It has been more than adequate for general shop and home construction work. The probe was constructed in a short section of ½-inch diameter thin-walled copper water pipe such as is used in ordinary house plumbing. Formica plugs for the ends were cut to general shape with a coping saw and turned down to size in the chuck of an electric drill. The tip consists of a screw-type earphone tip threaded into one plug. Shielded cable connects both the d.c. and a.c. plugs to the connector fitting at the side of the meter, reducing hand capacity to a negligible amount. The scale readings for a.c. measurements with the probe are a trifle higher than the actual values of potential. Since the difference is slight (about 10%—*Editor*) it can be ignored in favor of comparative measurements, or may be compensated for with a correction factor on the meter scale, if desired.

The v.t.v.m. shown has been in service for several months now. Though it lacks hairline accuracy and large-instrument versatility, it has provided creditable results for all service and the usual home-experimental type of work. An aluminum strap handle completes the job, and makes the instrument readily portable for service calls or movement about the house and shop. At a total outlay in the neighborhood of $5 plus parts salvaged from the average spare-parts bin, it will represent an asset of far greater value to the average radioman and experimenter.

Calibration is no problem if your meter is identical to the one used in this instrument. Feed in a known voltage which has been measured on an accurate multimeter or v.t.v.m. and adjust the CALIBRATION CONTROL for a correct reading. If you use a different type of 500-μa meter, you will probably have to prepare a new dial scale or calibration chart. Use variable-voltage a.c. and d.c. supplies and an accurate meter to supply calibration points. END

CONFIDENCE IS SALABLE

By JAMES M. HARTLEY

ELECTRONIC service technicians complain constantly that the public considers them "gyps," or that that stories to that effect are printed or circulated. The associations pass resolutions; the press is appealed to; signs are posted in stores. But no one presents the technician's side of the story to the ones who count—the public!

When an automobile manufacturer wants to plug a new model, he doesn't just scream, "It's the best!" in three-inch headlines. Look at the ads. He gets down to the meat of the subject, with text and pictures to show the car's features and advantages. And when you go for a demonstration ride, the salesman shows what the car will do besides simply talking about it.

How does that apply to TV service? Well, what have we to sell? Parts? Tubes? Soldering irons? NO! All we have to sell is *know-how*. And the only time to sell it, effectively, is when you are face-to-face with your public—right in the customer's home.

Resentment—or appreciation?

Take, for instance, an intercarrier set—complaint, sound but no picture. Do you go in, open up the back, pull off the cage, slap a new 6SN7 in, wait for the picture tube to light up, button up the set, and say (nearly your first words): "It was a tube, lady. That'll be $5.70," and bolt out of the house in 10 minutes?

If you do, that lady will soon be telling her friends: "It was such a little tube, and he was only in the house 5 minutes, and he charged me $5.70!" (In a tone which brackets you with the James boys.)

Same set—same complaint—but this time a *service salesman* makes the call. He turns on the set before he starts to get out the tools, lets it warm up, tries the controls (you'd be surprised how often the brightness is turned full off and the customer didn't try it before she called!). All the time, he is showing his know-how by explaining what he's found out and what he's doing. (Most customers want to know what's going on, even if it's only so they can give the details to Pop when he gets home that night.)

He explains, even before the back of the set is off, what parts of the set *aren't* giving the trouble. "We have sound," he says, "so we know right away that the tuner and the picture circuits and the sound tubes and the power supply are working. In these sets, you see, the picture and sound come all the way through the set together, and the sound is picked off just before the big tube, so that means all those tubes are working."

By this time, the back is off the set. "Well, the big picture tube is lit! I'm glad that's not burned out! So, the only place left to check is the part that produces the high voltage—in this cage, here."

The lady is nearly sure to look to see what cage, and this is a good time to ask for a dust-rag, turn off the set, and clean the dust off the big tube. (You should, anyhow, to make sure it's not leakage that's giving the trouble, and you get a reputation for neatness and carefulness in the bargain.)

Our salesman then opens up the cage and makes a spark test on the horizontal amplifier plate. "No spark there," he says. "The trouble must be in the part of the circuit before that point." He puts in a 6SN7; the face of the C-R tube shows a cooking class or something, and he starts to put the set back together as he says, "I'm glad it wasn't the 6BG6—that's a $4.80 tube. The one that went bad is only $2.20; so with our minimum service fee, that's just $5.70."

Then he goes around to the front of the set, takes a look, sets the contrast and brilliance controls, goes "tsk! tsk!" gently, and says, "Have you noticed some of the people have sort of flat heads (or short legs, as the case may be)?" He gets out his mirror, goes behind the set, and adjusts the vertical controls until the picture just fills the screen and is linear, then puts the set back against the wall, saying: "There, I'm sure you'll find that will be better."

Our service salesman is out of the house within minutes of the time our first example took; but what a different result! Our lady now boasts to all who will listen: "Why, he was only in the house a few minutes, and before he even took the back off he knew what was wrong! Why, did you know that the sound and picture go all the way through the set together, and the sound is separated right at the big tube? And he was the *nicest* man—he even dusted the insides, and he was *so* glad it wasn't an expensive tube he found bad! Why, he only had to charge me $5.70!" (And this time, the tone of voice brackets you with Einstein and "Break the Bank.")

Pop wants to know, too

When the man of the house is around when you call, you probably have trouble keeping him out from under you as you work. But that, too, can be an asset. Every man is convinced he could have been a Steinmetz if he'd only gone to M.I.T. instead of where he did go. So your running patter is stepped up to include some technical terms, and when you spark-test the plate cap, you let him see the spark, and explain how the 15 kv is generated, "just like the ignition in your car, where the 6 volts is jumped up to 6,000." By the time you leave, you and he are fellow-experts, and you're a cinch to be called the next time the set has troubles.

Psychology at work

This idea of selling yourself as an expert is just applying what the psychology boys have been reporting for years. People have been conditioned to listen to authority, from school days on. The teacher who knew the answers without looking in the back of the book, the doctor who knows what ails you, the cop who can direct you through a strange city, all represent authority giving out with knowledge. And by a subconscious association, the technician who "talks a good game," who imparts information with his work, who *shows* he knows more than the customer by explaining something that to him is obviously simple, but to the customer is terribly complicated, is classed, in the client's mind, as an "authority."

You don't need a club

Technicians wail, among themselves, that the public doesn't appreciate the overhead they have to carry. But what do they do to help it sink in, when they're in a position to do so? It's not hard, and shouldn't be obvious. But, when you're reaching for a tube, customers will say: "My, what a lot of tubes you have there!"

This is the point at which to say: "Yes, there's over $120 worth of tubes in that box, and that's only what I carry with me." You are imparting by implication that you also keep an excellent stock at your shop, and, without any more effort than that, you have established yourself as a solid businessman, with a good layout. If you're an independent, with no salesroom, it's doubtful that your customers will ever see your shop, so you have to let them know that the shop *is* there, backing you up—that you're not just a man with a black box of tubes and tools, with an office under your hat.

Similarly, when you have to yank a chassis to the bench, explain that you're taking it there only "because I have over $1,200 worth of instruments on the bench, and they'll tell me what's wrong much faster and more accurately." A man with $1,200 of equipment on his bench is *obviously* a better repairman than the one with only a little meter in his kit, so let them know about the bench. The average set owner will respond readily to the proposition that it's easier to take a chassis to the shop than to take a shop to the set.

If you *can* fix the set with only your meter, apologize for taking so long to find the trouble. Tell the customer: "My bench equipment would have located the bad part sooner, but I didn't want to have to charge you for transporting the set to the shop." You get the shop idea across, and the customer is pleased that you are trying to save him money on the job.

Don't overdo it, of course. If a man talks too much about his shop, he begins to make the owner suspicious. You don't want him to wonder if you may not just be talking to cover up the fact that you haven't got a shop at all. Let your reference to the shop be natural and justified.

Remember that a service technician has only two assets, his reputation and his knowledge. Your reputation can be built up only over a long period of absolutely honest and fair dealing. But some confidence in your know-how can be imparted to the customer on your very first visit.

The active selling of your stock-in-trade, your knowledge, will keep you from being classed by your customers as "one of those gyp TV men." As proof, our shop (a bench in the cellar of our home) services only customers who have heard about us from other customers, and we have five times as many on our list today as we had a year ago! END

RADIO DETONATION OF BLASTING CAPS

SOME time ago, a small boat conducting seismographic explorations in the Gulf of Mexico was wrecked by a mysterious explosion. (Seismographic exploration—generally used in searching for oil—is the technique of mapping underground formations by setting off explosions below the surface and measuring the time required for blast waves to reach various receiving points.)

Investigation definitely established that the boat's store of blasting caps had been set off accidentally by *radio waves*.

Although this is the only known case of its kind, the possibility that it might happen again prompted E. I. du Pont de Nemours & Company to make a detailed study of all the factors that could conceivably cause such an accident. Their *Technical Bulletin No. 13*, released this year, gives the results of their investigation, and recommends specific methods for checking suspected hazardous areas.

The danger involves only the *caps* used to set off the main blast. (Dynamite and similar high explosives are detonated by mechanical shock or extremely high pressures. Blasting caps are filled with an ignition-type explosive, fired by a spark or the heat of an electric current. The shock of the cap explosion sets off the blasting charge.)

The current required to fire commercial caps ranges between 0.25 amp and 0.5 amp. Anything over 0.15 amp is considered potentially dangerous.

R.f. pickup

This much current may easily be developed if the cap is at the *center* of a circuit (Fig. 1-a) *one half-wave long* at the frequency of a nearby transmitter; or at the *end* of a circuit *one quarter-wave* long (Fig. 1-b). In the first case the blasting circuit forms a resonant dipole with the point of maximum current in the center. In the second case, the circuit acts as a quarter-wave, grounded (Marconi) antenna, with maximum current at the grounded end.

Since blasting leads are usually run along the surface, or supported on stakes over swampy ground or water, the greatest amount of energy will be picked up from horizontal transmitting antennas. Pickup is reduced if the wires are laid directly on the ground.

Danger points

AM broadcast and commercial stations constitute the greatest hazard because of their high power, relatively low frequencies (which may match the long firing leads required by ordinary safety practice), and their presence in open country where blasting may be common. FM and TV stations also use high power, but are seldom considered dangerous since they operate at very high frequencies. Besides, their antennas are usually located on top of the tallest building available, so that blasting operations in the vicinity are fairly well shielded.

Mobile transmitters are definitely potential hazards in spite of their low power, because they may be brought directly into the blasting area.

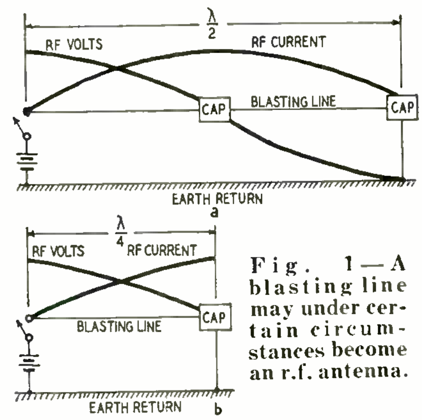


Fig. 1—A blasting line may under certain circumstances become an r.f. antenna.

Amateur, microwave-relay, radar, and loran transmitters are not usually dangerous. In the first place, they are almost always located in areas where there is little likelihood of blasting. Furthermore, they are generally characterized by one or more of the following: relatively low power; v.h.f. or u.h.f. operation; restricted radiation patterns.

Safety measures

The bulletin gives a table of minimum safe distances based on transmitter power, and allowing for all possible combinations and layouts of blasting circuits that might pick up enough r.f. energy to cause a premature explosion:

Power (Watts)	*Distance (Feet)*
5- 25	100
25- 50	150
50- 100	220
100- 250	350
250- 500	450
500- 1,000	650
1,000- 2,500	1,000
2,500- 5,000	1,500
5,000- 10,000	2,200
10,000- 25,000	3,500
25,000- 50,000	5,000
50,000-100,000	7,000

It also suggests an extremely simple safety test. With the blasting-circuit wires in position, a 150-ma pilot lamp (No. 47 or equivalent) is connected in place of each cap. Electric blasting should not be attempted if the bulb glows at all. END

Unusual circuits demonstrate engineering abilities

circuit

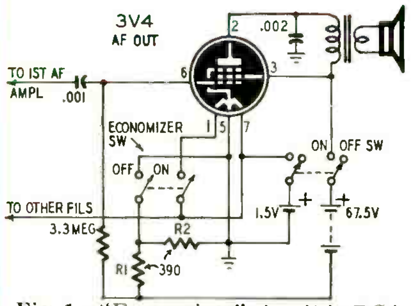


Fig. 1—"Economizer" circuit in RCA.

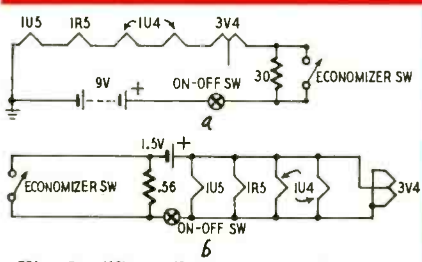


Fig. 2—"Saver" circuits in other sets.

THE comparatively short life and the high cost of dry batteries used in battery and 3-way portable radios are major disadvantages which keep many persons from using their sets more than a few months a year. For this reason, set manufacturers have developed different schemes for lengthening the life of batteries used in portable sets. These devices—called *battery economizers* or *battery savers*—may consist of built-in charging circuits like that used in the Hallicrafters *Sky Traveller*, or a switching circuit which permits the operator to reduce the drain on the batteries while listening to strong local stations.

Fig. 1 shows the battery economizer which RCA uses in its model 2B400 personal portable receiver. The ECONOMIZER switch is usually operated in the OFF position. One section connects the halves of the 3V4 filament in parallel to provide greater cathode emission and output from this stage. Approximately 3.29 volts of bias is applied to the 3V4 control grid by the voltage drop across R1.

When the switch is thrown to ON, one side of the 3V4 filament is disconnected from the battery and R2 is connected in series between R1 and ground. This raises the bias to about 4.25 volts and reduces the current drawn by the output stage.

The 2B400 uses a 1R5, 1U4, and 1U5 in addition to the 3V4 shown in the diagram. With the ECONOMIZER switch closed (OFF position) for maximum output, the life of the batteries is approximately 100 hours of intermittent service. Operating the set with the switch open (ON position) reduces the A-battery drain 50 ma and the B drain 3 ma. This raises the life of the batteries to about 130 hours.

In some receivers (Airline for example) the "saver" switch is connected across a resistor in series with one of the filament leads. See Fig. 2.

The circuit at *a* is used in sets with series-connected filaments. The filaments are connected in series across a 9-volt A battery. Opening the switch brings the 30-ohm resistor into the circuit and reduces the A battery drain by approximately 8 ma.

In the parallel-connected filament string at *b*, the 0.56-ohm resistor reduces the A drain by about 30 ma. In both of these circuits, opening the saver switch reduces the voltage on the filament string and causes the filaments to operate at lower temperature. The drain on the B battery is reduced in proportion. In circuits such as these, the values of the current-limiting resistors vary with the make and model of the receiver.

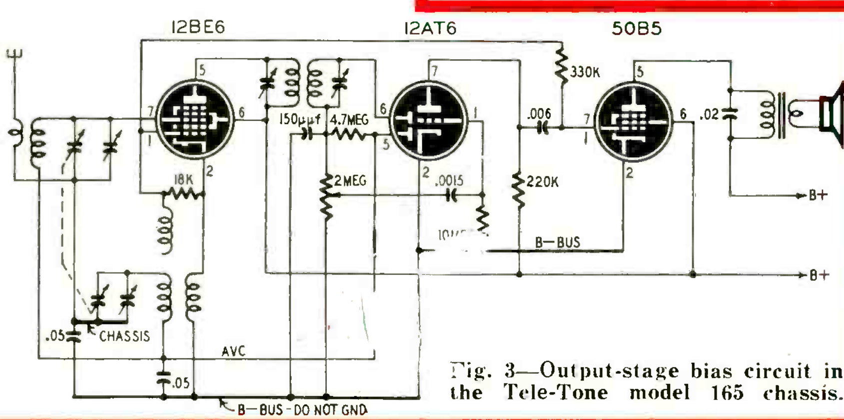


Fig. 3—Output-stage bias circuit in the Tele-Tone model 165 chassis.

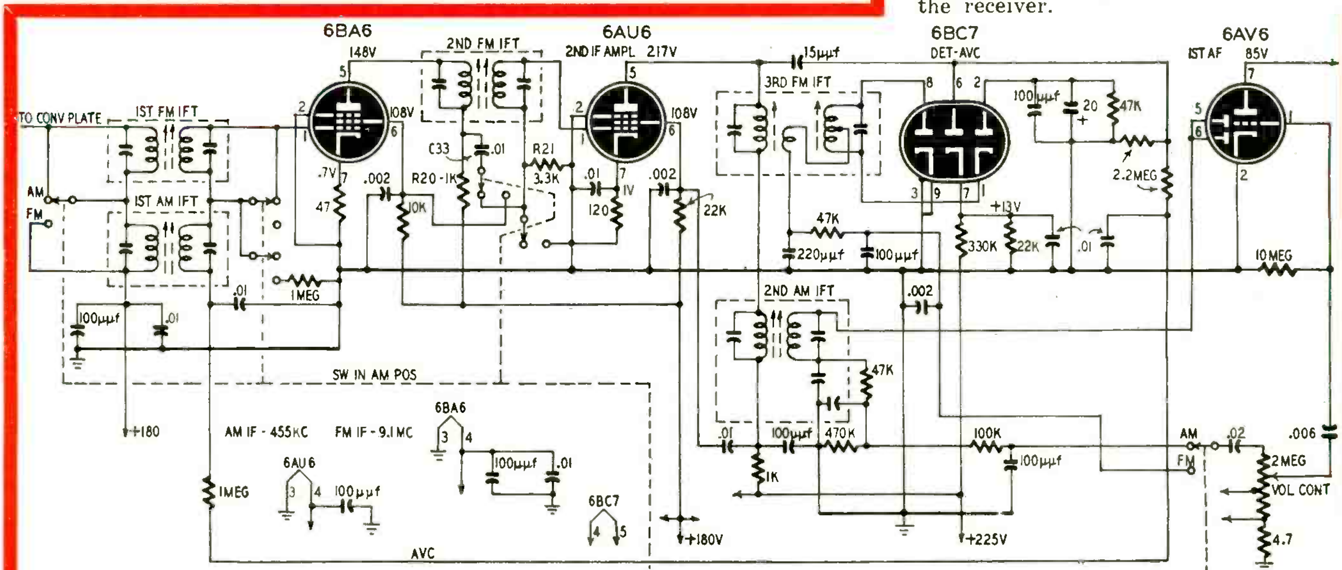


Fig. 4—Many of the recent Philco AM-FM receivers use the 6BC7 triple diode as the ratio detector and a.v.c. rectifier.

shorts

By ROBERT F. SCOTT

Novel bias circuit

In most a.c.-d.c. sets, the output tube is biased by a cathode resistor or the drop across a choke, speaker field, or resistor in the negative leg of the B supply. In these circuits, the effective B voltage on the plate is reduced by an amount equal to the drop across the biasing resistor. There is a waste of power in the resistor.

To eliminate this waste of power and available voltage, some receiver manufacturers use the voltage developed across the oscillator grid leak to bias the output stage as shown in Fig. 3. This circuit, used in the Tele-Tone model 165, eliminates the cathode biasing resistor and bypass capacitor which are generally used. This circuit is certainly not new, but it is unusual enough to be a source of trouble to service technicians who may have occasion to service the set without consulting the schematic diagram. A change in the characteristics of the 12BE6, or in the value of the oscillator grid leak can vary the bias on the output stage and cause symptoms of far more common troubles.

Leakage through the .006-μf coupling capacitor between the plate of the 12AT6 and the grid of the 50B5 will probably cause other troubles in addition to the distorted output which is the usual result of coupling capacitor failure. The positive voltage which would appear on the oscillator grid (pin 1 of the 12BE6) would be likely to cause the oscillator to fail or operate erratically.

In one set which used this bias circuit, the set would cut out or shift frequency when operated at high volume levels or when loud passages came through. The first audio amplifier acted like a reactance tube and caused the oscillator to shift frequency or cut out entirely.

Unusual tube

While reviewing the circuits of current Philco receivers, I noticed something that I had overlooked during previous studies. For the last two years, a *6BC7 triple diode* tube has been used in the 8-tube AM-FM receivers. The application of this tube is shown in Fig. 4.

Diodes connected to pins 1 and 2 and 8 and 9 are used in the ratio-detector circuit for FM reception. The diode connected to pins 6 and 7 is the a.v.c. rectifier used during AM reception. An a.v.c. delay bias of approximately 13 volts is obtained by connecting the cathode of the a.v.c. rectifier to the junction of the 330,000- and 22,000-ohm resistors in the voltage divider between B plus and ground.

Another unusual feature of these sets is the use of resistance-capacitance coupling between the first and second i.f. amplifiers for AM reception. R20 and R21 are the plate-load and grid resistors. C33 is the coupling capacitor. At the AM i.f. (455 kc), the impedance of the FM i.f. transformer windings is negligible and has little effect on the operation of the resistance-coupled circuit.

During FM reception, R20 and C33 form the plate decoupling filter. R21 is shorted out and the 6AU6 grid is returned directly to ground. The grid of the 6BA6 first i.f. amplifier and the a.v.c. line are connected to ground through the 1-megohm resistor. Sections of the selector switch short out the primaries and secondaries of the first AM and FM intermediate-frequency transformers when they are not being used. This eliminates interference by preventing signals at the intermediate frequency from entering the amplifier system. This is not necessary in the remaining stages.

Noise-compensated squelch

Some types of FM squelch circuits are comparatively ineffective in the presence of high noise levels. When the noise level is high, the limiters may draw enough current to open the squelch and permit the noise pulses to come through the speaker. To avoid nuisance noise in the output of its FM receivers, Motorola uses the noise-compensated squelch shown in Fig. 5.

In the absence of an r.f. carrier, any noise strong enough to produce limiter grid current passes through the discriminator and is fed to the grid of V1-a, the noise amplifier. A high-pass filter (C1 and R1) attenuates audio frequencies vital to good speech readability while passing the higher noise frequencies. The squelch control varies the gain of V1-a by controlling its cathode bias.

The output of the noise amplifier feeds the noise rectifier (V1-b). The rectified noise appearing across R3 is positive at the cathode and negative at the plate. A negative voltage produced by grid current in the second limiter is applied to the plate of the noise rectifier through R2.

The algebraic sum of the negative limiter-grid voltage and the positive noise voltage charges C2 and biases the grid of squelch-control tube V2-a. As long as there is no r.f. signal coming in, the voltage on the grid of V2-a varies from zero to a few volts positive, so V2-a conducts heavily and produces a large voltage drop across R4. The grid of V2-b is kept at the same d.c. potential as the plate of V2-a because it is connected to it through a 1-megohm resistor. The cathode of V2-b connects to a voltage divider which maintains it at a constant positive potential which is sufficent to cut off the audio amplifier when the squelch control tube (V2-a) is conducting.

When a modulated r.f. signal comes in, the negative limiter-grid voltage is greater than the noise-voltage output of the rectifier. The sum of the positive and negative voltages on C2 becomes sufficiently negative to cut off V2-a. With V2-a cut off, there is no voltage drop across R4. The grid of V2-b rises to the point where the grid-cathode bias is correct for normal operation. V2-b conducts and amplifies the signal applied to its grid through the arm of the volume control and the .0015-μf coupling capacitor. END

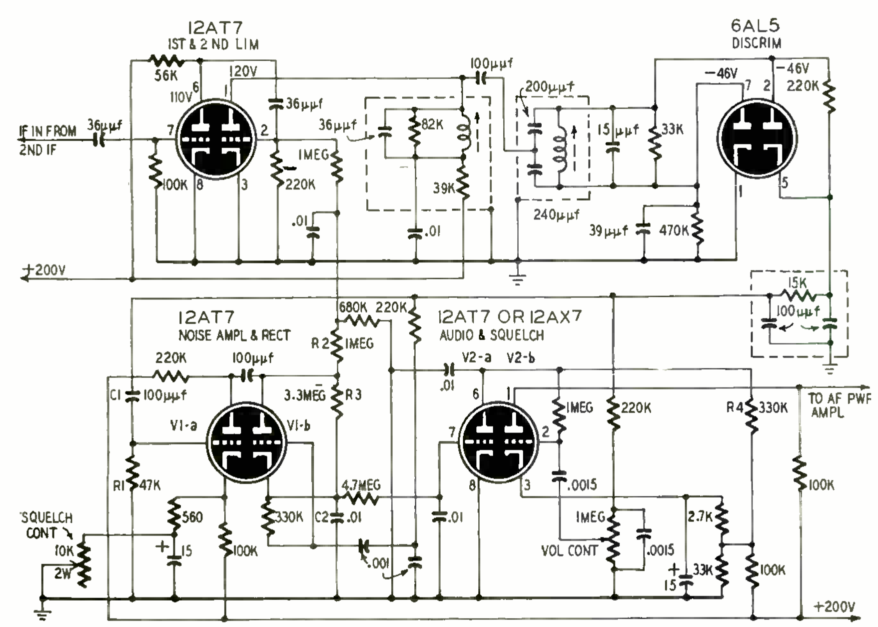


Fig. 5—Squelch circuits of Motorola *Sensicon* FM communications receivers.

General Electric's two *Translators*—for full-band or 3-channel coverage

more UHF converters

By FRED KING*

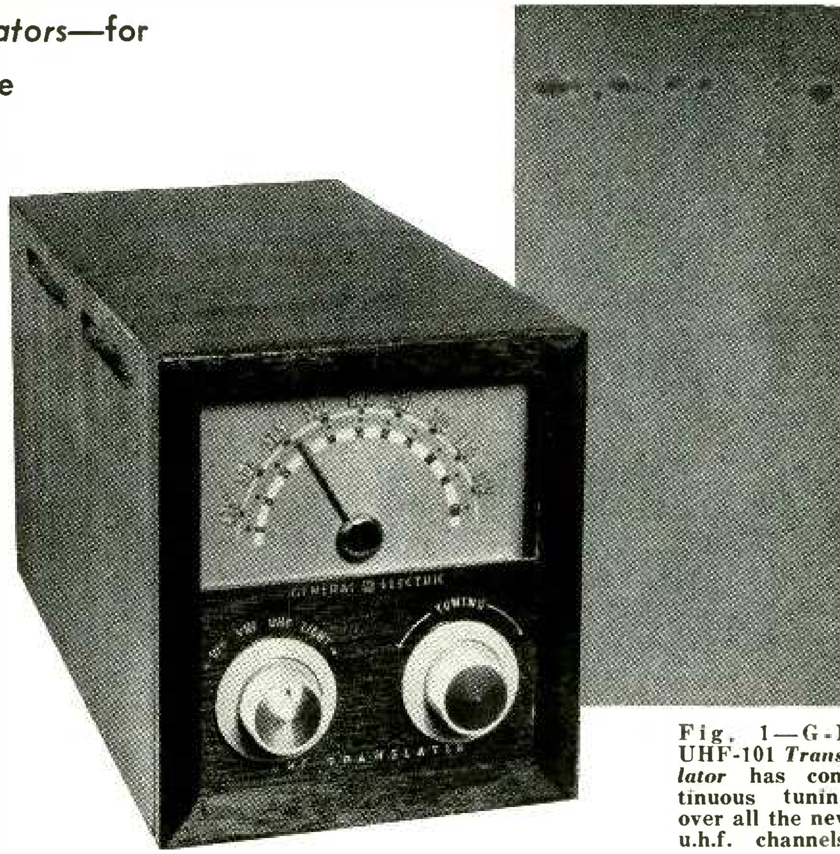


Fig. 1—G-E UHF-101 *Translator* has continuous tuning over all the new u.h.f. channels.

IN the October issue, I discussed the basic requirements for u.h.f. TV converters and described the Kingston continuous-tuning converter which employs a parallel-lines tuning system. The G-E model UHF-101 converter shown in Figs. 1, 2, and 3 employs a similar circuit in an entirely different physical arrangement. (This tuner is no longer being sold, but service technicians will run into numbers of them.)

Fig. 1 shows the appearance of this all-channel converter. The cabinet is 7½ inches high, 6⅞ inches wide, and 13⅜ inches deep, and is finished in mahogany veneer. The dial is calibrated in megacycles from 470 to 890, with an auxiliary 0–100 scale. A pilot lamp travels with the dial pointer and spotlights each numeral on the dial. The v.h.f. set is plugged into an a.c. receptacle at the back of the translator. The v.h.f. antenna is also connected to the translator. The selector switch on the translator, Fig. 1, has four positions marked: OFF, VHF, UHF, and LIGHT. Throwing the selector switch to the VHF position turns on only the v.h.f. receiver and connects it to the v.h.f antenna. The UHF position of the switch turns on the translator, disconnects the v.h.f. antenna, and connects the translator output to the v.h.f. set. The LIGHT position turns on the dial lamp for convenience in tuning. The light may be turned off by returning the switch to the UHF position after

*Chief Engineer, Radio Station WELI, New Haven, Conn.

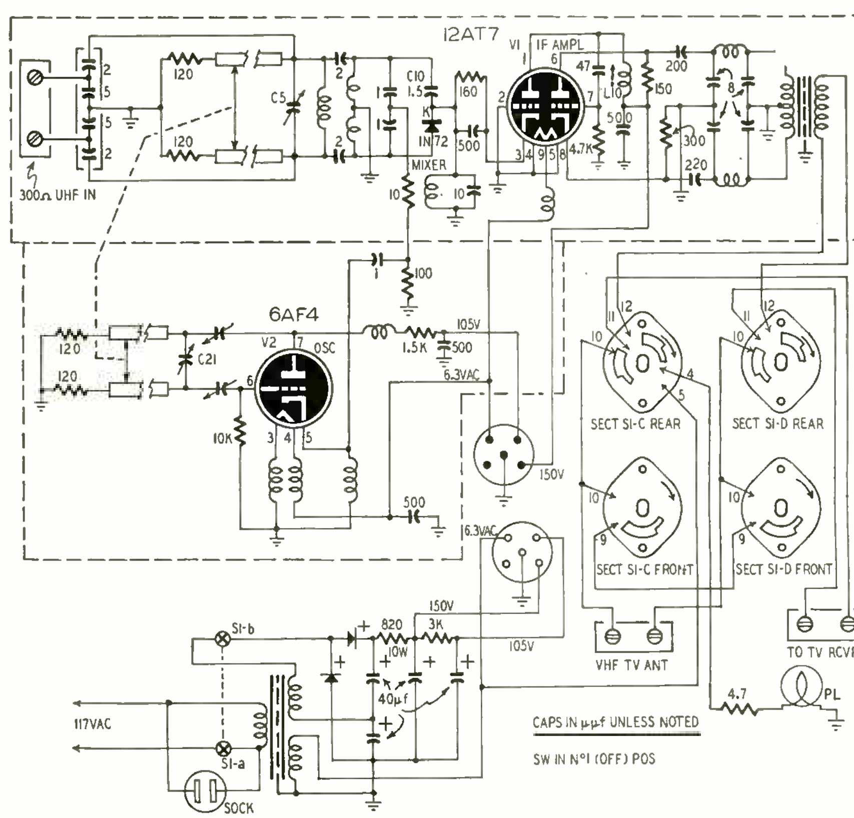


Fig. 2—Schematic of the G-E UHF-101 *Translator*. Oscillator and r.f.-input circuits are tuned by shorting bars across quarter-wave parallel lines. Switch S1 controls both *Translator* and TV receiver, selects either v.h.f. or u.h.f. input, and has extra position for turning on u.h.f. tuning-dial light if desired.

a u.h.f. channel has been selected. The right-hand knob is the tuning control.

Fig. 2 is the schematic of the UHF-101. Balanced lines tune the mixer input and the local oscillator circuit. A ganged drive-screw arrangement slides the shorting bars up and down the lines when the tuning control is varied. The 6AF4 triode oscillator is cathode-coupled to the 1N72 crystal mixer through a 1-μμf capacitor (C24). The mixer i.f. output is fed to the cathode of the first half of the 12AT7. This section is operated as a grounded-grid amplifier. The second half of the 12AT7 is a phase splitter with equal and opposite outputs taken from its plate and cathode. This allows the output circuit to be balanced to ground in the primary of the output transformer (T1), for minimum v.h.f.-noise pickup. The i.f. output is tunable between 79 and 85 mc to provide against the possibility of interference from strong local signals. If there is interference on channel 5 the slug in L10 may be adjusted from the rear of the converter to channel 6 (or vice versa). The power supply uses an isolating transformer and two selenium rectifiers in a half-wave doubler.

The diagrams in Fig. 3-a and 3-c are the alignment setup and diode detector network recommended by the manufacturer. Fig. 3-b shows the locations of the various adjustments. Precise i.f. alignment on either 79 mc or 85 mc is obtained by adjusting the slug in L10 for maximum reading on the microammeter. If one is not available the v.h.f. receiver can be connected to the translator output terminals, set on channel 5 or 6, and an ordinary v.t.v.m. connected across the picture-detector load resistor. Since u.h.f. signal generators are still scarce and very expensive, the oscillator and mixer sections can be aligned on a u.h.f. station. For oscillator alignment with a station between 475 and 675 mc, after setting the dial at the proper point adjust C21 for maximum output. With a station between 675 and 890 mc, adjust the tuned-line nut "A" for maximum output. For mixer alignment adjust C5 for stations between 475 and 675 mc and nut "B" for stations between 675 and 890 mc. Both of these adjustments are made for maximum output, with the translator dial set at the proper channel frequency.

The UHF-101 will operate with all types and makes of v.h.f receivers. It has been tested over a two-year period at u.h.f. monitoring stations maintained by WELI at New Haven, Connecticut. Reception of the Bridgeport RCA-NBC experimental u.h.f. station KC2XAK has been excellent, and there were no mechanical or electrical failures.

G-E UHF-103 translator

This 3-channel unit (Fig. 4) is designed to mount inside the v.h.f. set cabinet without affecting normal operation of the receiver on v.h.f. channels. It mounts on a bracket attached to the inside of the cabinet and can be installed easily, without removing the chassis.

When installed in the new G-E v.h.f. sets the translator's station-selector switch and a u.h.f. station dial plate are mounted behind the present v.h.f. tuning knob. On G-E sets made before the spring of 1949, the u.h.f. tuning knob and station dial plate must be installed in some convenient position on the side of the cabinet.

The translator can be set with a screwdriver to any three u.h.f. stations in the band from 470 to 890 mc. If the set is moved to a new location, the unit may be retuned as simply as the push buttons on an AM radio.

The schematic has not been released yet but units are available to the public.

We plan at present to describe the Zenith and Mallory ultra-high-frequency tuning equipment in the next article in this series. END

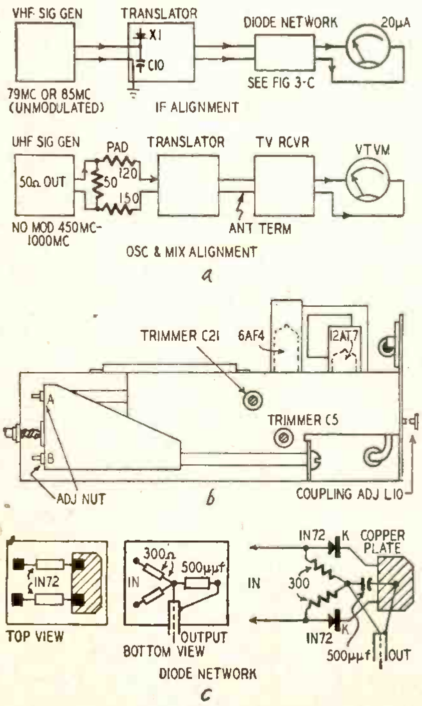


Fig. 3—Setup for *Translator* alignment.

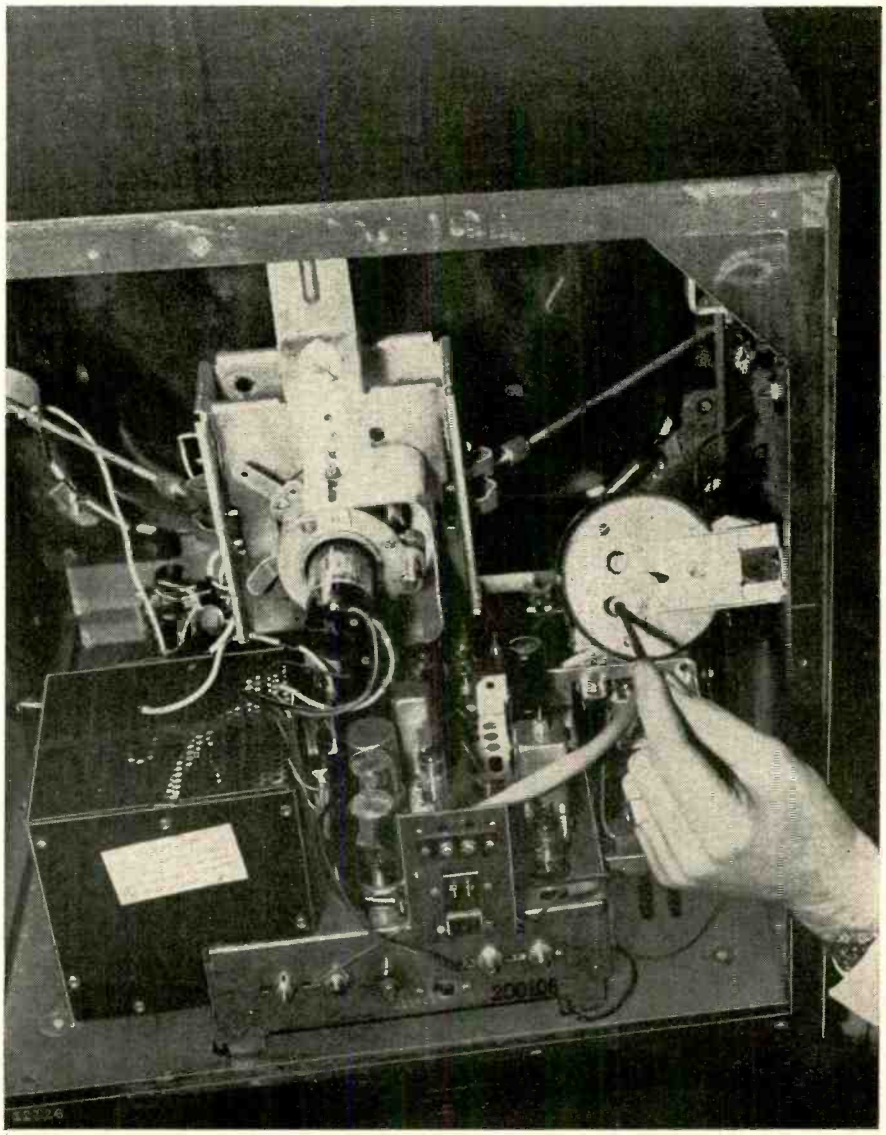
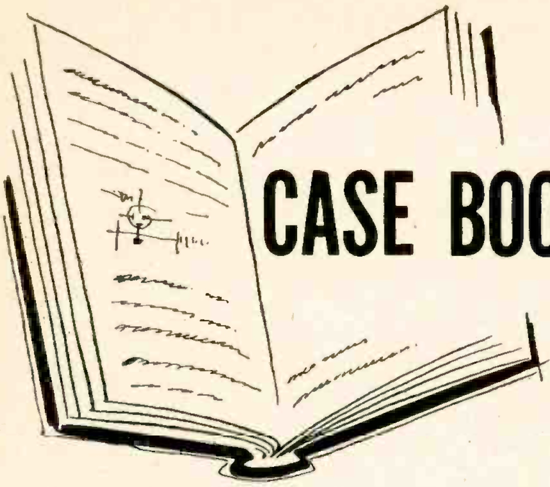


Fig. 4—Service technician making one of the screwdriver adjustments on a General Electric UHF-103 three-channel Translator mounted in a v.h.f. receiver cabinet.



CASE BOOK of a TV DIAGNOSTICIAN

By LARRY A. QUINLAN

Case 60552: Du Mont RA-109A

This is a fantastic story illustrating one of the reasons why some segments of the public mistrust the service technician. One bitter experience spread from person to person gets worse at every retelling.

A Du Mont dealer called me and told me he had sold an expensive set to a lamp manufacturer. After only four days of satisfactory operation the customer reported trouble. A relatively large service organization was handling the dealer's service. The service technician on the call took the chassis out and informed the lady of the house it would cost about $45 to repair. The lady didn't object, but when her husband came home he blew his top.

He called the dealer and demanded to know what kind of set was being sold for the king's ransom he had paid. As a clincher he told the dealer that for $45 he could get a Du Mont engineer to service the receiver because all the parts were still under warranty. The dealer realized that $45 seemed like an exorbitant charge for labor. How many things *could go wrong* in a brand-new set?

This was a new model at the time and there were no schematics available. The repair card indicated that the service technician had found hum in the sound and a ripple on the picture.

With the irate customer practically breathing down the dealer's neck, I got *carte blanche* to go ahead and do the best I could in the shortest possible time and—of course—for the lowest possible price. All service seems to be like that. Everybody wants the chassis back yesterday and a bill that represents 1939 prices.

I decided to start from scratch. There was a ripple on the picture and hum on the carrier. But there was no audible hum except when the receiver was tuned to a station. The horizontal sweep was very unstable, with a tendency to go out of sync at the drop of a hat. Trouble like this could be almost anywhere—horizontal sweep, tuner, picture i.f., video.

The most logical place to start was at the horizontal oscillator. Removing one of the horizontal sweep tubes would eliminate the probability of horizontal trouble. I could have pulled the 6K6 horizontal oscillator first, but the 6SN7 discharge tube was easier to get at. After all, why put out extra effort needlessly? Lo and behold, the hum disappeared from the sound! (The picture disappeared too, but this was due to the absence of high voltage because the 6SN7 was out of the socket.)

Checking the tube-location chart on the side of the cabinet indicated the other half of the 6SN7 was an a.g.c. clamp. It is possible to have a bad tube that has interaction between the two triode sections. At first I thought this was silly and too simple because certainly the other technician must have tried a new 6SN7 here. But since I was doing this on my own without any preconception that the other fellow had done a job, I decided to try another 6SN7. Result—a new tube—a new set!

With that kind of luck on the first try I am now one Du Mont dealer's boy wonder. Saved the dealer $40; got a lamp as a present from the lamp manufacturer; and who knows how much good gossip as the customer tells that story around.

Checking the 6SN7 later on a tube tester showed nothing, but testing it in another Du Mont RA-109A created the same hum on the carrier and ripple on the picture. My guess is: Some 15,750-cycle interference was getting into the a.g.c. half of the tube and was messing up the a.g.c. line, *but good.* It would be even better if one could be sure about some of these hunches.

Case 60652: Du Mont RA-147A

Complaint was: no picture, no sound. Raster was there. Seemed like trouble in the tuner, or in the first or second video i.f.'s, as these are the only parts of this receiver where picture and sound are common. Could be the power supply, but it would have to be the low-voltage section since the raster was present.

Pulling the first video i.f. tube and reinserting it immediately provided a disturbance test which gave a flash on the screen and a sound in the speaker. This quick check suggested the video i.f. strip was O.K., but a signal generator on the grid of the first i.f. gave double assurance. Black bars appeared on the screen of the CRT when the signal generator was tuned through the 20–30-mc range. Well, at least that part of the circuit seemed all right.

Next to try the tuner (see Fig. 1). All voltages going into the tuner checked O.K. Pulled the 6J6 mixer and inserted it quickly—*no* click in the speaker or flash on the CRT. Removed the 6CB6 r.f. amplifier; checked plate, screen, and cathode voltages at top of tube sockets. Tubes were heated; therefore, it seemed unnecessary to check the filament voltages.

There was no voltage on pin 1 of the 6J6 (oscillator plate), and none on pin 5 of the 6CB6 (r.f. amplifier plate). There *was* voltage on pin 6 (screen

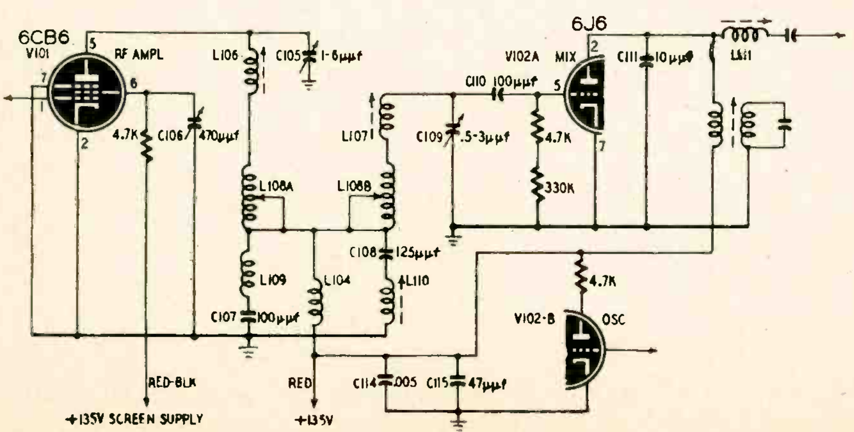


Fig. 1—Partial schematic of the Inputuner used in Du Mont RA-147A Telesets.

grid) of the 6CB6. In the Du Mont Inputuner the 135 volts B plus for the screen of the 6CB6 comes through a red and black lead and is separate from the 135-volt line to the plates of the 6J6 and the 6CB6. (These are fed through a red lead.) There was no voltage on pin 2 of the 6J6 (the mixer plate).

Nothing to do now except to remove the tuner from the chassis for careful analysis. There are five leads to unsolder before one can inspect the chassis of an Inputuner.

A resistance check from pin 2 of the 6J6 to ground gave no reading. This eliminated a short in any of the B+ bypass capacitors which might show up on a static test; of course this did not eliminate the possibility of a capacitor short under dynamic conditions. A check of the 135-volt supply line showed continuity. This suggested one of the bypasses might be breaking down under voltage.

Jumpers were used to connect the Inputuner filament, a.g.c., screen, plate, and mixer-output leads to the main chassis. The set worked and played for five hours in the shop. Next morning the set was dead again.

Checking the tuner now revealed a short from pin 2 of the 6J6 to ground. Checking the circuit suggested that trouble might possibly lie with C111, C114, or C115. These are the only bypasses to ground between the 135-volt supply and the plate of the 6J6. The short read approximately 2 ohms. Suddenly the short opened up, and the receiver began to work normally. (That eliminated the probability of capacitor trouble, because when a ceramic shorts, it usually stays shorted.)

The 2-ohm short might indicate a coil. No genius in diagnosis here because outside of the capacitors the coils are the only components in the B plus line that might cause trouble. On a visual check the sound trap, L104, L108A, L108B, L106, and L107 did not seem to be causing the trouble.

L111 was another matter. This was mounted very close to the chassis. The manufacturer had wrapped a piece of insulating tape around the coil. Touching the coil lightly with a polystyrene probe instantly created a short from pin 2 of the 6J6 to chassis. One of the L111 leads had been grounding intermittently, probably with the expansion of the wire as the chassis warmed up, or as a result of vibration.

A piece of high-voltage electrical tape fastened to the chassis and around the coil eliminated the trouble.

Case 61052: Fada S6C55

Picture closed up vertically once every 10 to 15 minutes—then righted itself almost immediately. There are about as many ways to service such a difficulty as there are service technicians, but one way which "gits thar fustest with the mostest" is to start at the *midpoint* of the circuit, say the grid of the 6S4, with a scope or a v.t.v.m. (See Fig. 2.) Working all the way back from the picture tube can consume valuable time.

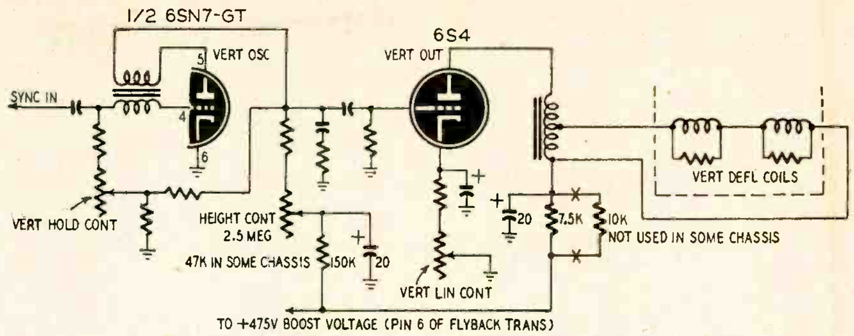


Fig. 2—Vertical sweep circuit of the Fada model S6C55 and S7T65 TV receivers.

When the trouble shows up on the picture tube watch for any change in the v.t.v.m. reading or shrinkage in the height of the scope pattern. If there is no such change the trouble obviously lies beyond the point in the circuit where you are checking.

Both the scope pattern at the grid of the 6S4 and the picture shrank vertically after the set had warmed up for half an hour. This repeated at intervals of about 15 minutes. At each repetition there was an audible click, but it was not coming through the speaker. It was like the sound of a filter capacitor popping. Not all service technicians may have heard this sound. When the popping continues it indicates the capacitor is breaking down layer by layer. There are a number of intermittent pops until the outer layer breaks down.

Examination of the circuit showed a 20-μf filter from the slider of the height control to ground. I connected a voltmeter across this capacitor. With a 400-volt reading the picture size was satisfactory. Each time the picture shrank the needle dropped to 100 volts (sometimes with this audible pop). After each pop the needle went slowly back to 400 volts (taking about 5 seconds) and the picture height returned to normal.

This 400 volts is picked off the horizontal sweep boost circuit. A 150,000-ohm resistor (47,000 ohms in some chassis) isolates this part of the vertical sweep from the horizontal branch of the boost line. As there was no visible effect on the horizontal size of the picture, it seemed to point decisively to the 20-μf capacitor.

As a matter of routine, and to avoid callbacks in the near future, it is good practice to check the boost voltage at pin 6 of the flyback transformer. A reading of 475 is about normal. This was correct in this case, with a drop of 10 volts at each click and accompanying picture shrinkage. This confirmed the diagnosis that the trouble was on the height-control side of the 150,000-ohm resistor.

Replacing this 20-μf, 450-volt capacitor corrected the difficulty immediately and permanently. This was part of a four-section filter. The bad section was replaced with a single-unit 20-μf, 600-volt capacitor. (In cases such as this, it is advisable to replace the entire capacitor rather than the defective section alone.—*Editor*)

Case 61652: Fada S7T65

The complaint was that picture was not clear on most channels. No evidence of a negative-looking picture, and plenty of brightness. One service technician had suggested there might be picture-tube trouble. This is the last thing a service technician should ever mention to a customer. It's O.K. for a little tube to fail, but the customer never expects the big picture tube to go, at least not for two or three years.

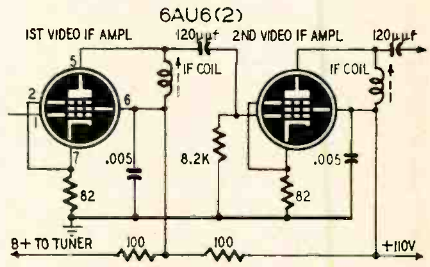


Fig. 3—Part of the Fada model S6C55 picture-i.f. amplifier B supply circuit.

Close observation of the picture showed lack of detail. This could be passed off as poor reception due to location of set or to antenna trouble. Don't brush off such a complaint as due to ignorance on the customer's part. Remember, the customer has been living with the set and knows it was once better than it is now. That's why he called for service. I emphasize this point because two service technicians preceded me on this call and both reported the set O.K.

When I went on this job I took along an indoor antenna. Turning the antenna showed no improvement on any channel. I removed the chassis and made voltage checks on the video amplifier, video detector, and the i.f. amplifiers, because these are the most logical places for this type of trouble. All checked O.K. with the exception of a reading of 20 volts *positive* on pin 1 of the 6AU6 second video i.f. amplifier, *with the tube in or out of the socket.*

Analysis of the circuit shown in Fig. 3 shows the only possible path for positive d.c. voltage to reach the grid would be through the 120-μμf ceramic coupling capacitor from the plate of the first i.f. tube. Cutting the capacitor at the grid pin showed a voltage on the open end. This was a leaky capacitor with a resistance of only 120,000 ohms. END

TV SERVICE CLINIC

Conducted By

MATTHEW MANDL*

As MENTIONED in the Clinic, we will, on occasion, pass along some of the servicing problems reported to us by readers. One of these, sent in by C. A. Dixon of Detroit, has to do with converting a TV receiver to 25-cycle operation. The set was an RCA 9T57; the power transformer has two 6.3-volt heater windings as well as a 5-volt winding for the 5U4-G rectifier filament. A conventional center-tapped secondary is used for B plus.

In order to adapt any a.c.-operated receiver from 60 cycles to 25 cycles, the power transformer must be replaced with one having a much larger core and higher-inductance windings than the original. The 25-cycle job of course will have to furnish the same circuit voltages and currents as the original. Because 25-cycle transformers are not readily available, Mr. Dixon solved the problem by getting a duplicate of the original transformer. He wired the two 60-cycle primaries *in series* across the line and connected the respective secondaries *in series* also.

The two transformers act as one, with all windings having greater inductance and the total core area doubled. This arrangement gives adequate protection against overheating for 25-cycle operation.

(Where transformers are connected in series—or parallel—all windings must be phased correctly, or the combination will not operate at all, and may even act as a dead short across the line. For series operation all secondaries must be connected so that their inductances and voltages *add*. This can be checked with an a.c. voltmeter, before final connections are made. *Only the pair of secondary windings being checked should be connected for this test. Tape up the ends of the h.v. secondaries while other windings are being tested.* RCA's TV power transformers have leads of different colors at the ends of each winding. For series operation simply connect *either lead* from one transformer to the *different-colored* lead from the corresponding winding on the other transformer.—*Editor*)

With both primaries and all corresponding secondaries in series, the turns ratios are unchanged, and the same voltages are delivered as with the single transformer.

*Author: Mandl's Television Servicing

Fuse problems

Incorrect drive or a gassy horizontal output tube can cause considerable current drain. The protective fuse may be defective, or have the wrong value, and fail to blow during overload. J. S. Vazalis of Baltimore, Maryland, had this experience with a Zenith 24H20 receiver. Abnormally high current in the 6BG6-G failed to open the ¼-amp slow-blowing fuse. The excessive conduction increased the high voltage, overloaded the 1B3-GT and the 5Y3-GT low-voltage rectifier. The screen resistor of the 6BG6-G also burned out. Fortunately, the horizontal output transformer held up. This emphasizes the necessity of using exact-value fuses of good manufacture.

In many receivers the fuse value is critical. The Philco model 51-T1601, for instance, uses a 6/10-amp fuse. No other value should be used. Fuses smaller than 6/10-amp will blow out repeatedly, and a larger fuse will not give the required protection. In this receiver the filament winding of the low-voltage power transformer is protected by a *fuse link of No. 26 copper wire*. If this protective link opens, the replacement *must not be made with heavier wire*. This stresses the importance of checking the service notes for the receiver under repair to make sure the right replacement components are used.

Poor picture definition

In a Philmore CP-731D receiver using a 19AP4 tube, the picture quality is poor. Contrast seems to be lacking and shades of black and white are not true. There is not sufficient difference between dark and light signal areas to distinguish objects in the scene clearly. What could cause this trouble? G. P., Detroit, Mich.

As you probably know, this receiver uses the RCA 630 circuit to which keyed a.g.c. and a new tuner (usually a Standard Coil turret tuner) have been added. The washed-out picture may be caused by any of the following:

Improperly aligned i.f. system.
Poor tuner tracking.
Defective a.g.c. system.
Defective d.c.-restorer system.
A combination of above troubles.

Since you have changed all tubes, you should check the d.c.-restorer system first, and all its associated resistors and capacitors. Replace the .047-μf coupling capacitor to the grid of the picture tube, for this may be leaky.

Next, check the a.g.c. system. Too much a.g.c. bias will cut down the gain of the r.f. and i.f. systems and cause the poor picture gain you mentioned.

Finally, check the tuner tracking and video i.f. alignment with an accurately calibrated marker, sweep generator, and scope. Refer to the RCA 630 service notes for video i.f. alignment, and follow the step-by-step procedure. From your description of the symptoms, it seems very likely that poor tuner tracking and i.f. misalignment are the major causes for the poor picture quality.

Static in sound

I would like to know why there is considerable static from the sound portion of a Tech-Master model 1930 receiver. We are situated in a fringe area but it was my belief that the FM system in the receiver would prevent noises from appearing in the speaker.

I would also appreciate your giving me the length in inches of the quarter- and half-wave-length jumper bars used on double antenna arrays. W. E. R., Plymouth, Fla.

This condition is quite common in fringe areas where the signal is weak and the gain of the television receiver is increased by a.g.c. action. The noise-reducing feature of the frequency modulation sound circuit in this receiver is effective only with signals strong enough to saturate the limiter and obliterate any noise (AM) riding on the carrier. Noise will be even more pronounced if the receiver sound system is out of alignment. Proper alignment, plus a good antenna system to increase signal strength, should help considerably.

The quarter- and half-wavelength bars used on antennas depend on the lowest frequency to be used. For example, if the antenna is cut for channel 2, the quarter-wavelength spacing would be 50.5 inches and the half-wavelength 101 inches. Quarter-wavelength spacing helps the higher channels; half-wavelength spacing favors the low channels.

Sync instability

In a Tech-Master 630 type receiver the vertical sweep is unstable whenever there is a commercial or when films are shown. The receiver acts fine for other programs. I have replaced the vertical oscillator and output tubes as well as the d.c. restorer. I have also put in a new sync-separator tube without much change. What could cause this condition? F. A. R., Ridgewood 27, N. Y.

Check the tubes ahead of the sync take-off point in the video section. There is some overmodulation of the video carrier during film commercials.

(This is generally due to large transients set up by sudden changes from black to white in printed matter and animated cartoons, and sometimes caused by 36-cycle and 84-cycle beats between the 24-frame film and the 60-field vertical scanning.—*Editor*)

This increase in signal strength is causing sync clipping in your set. A weak video-amplifier tube also could cause this by cutting off at lower signal levels. In Fig. 1 shaded area of sync tip

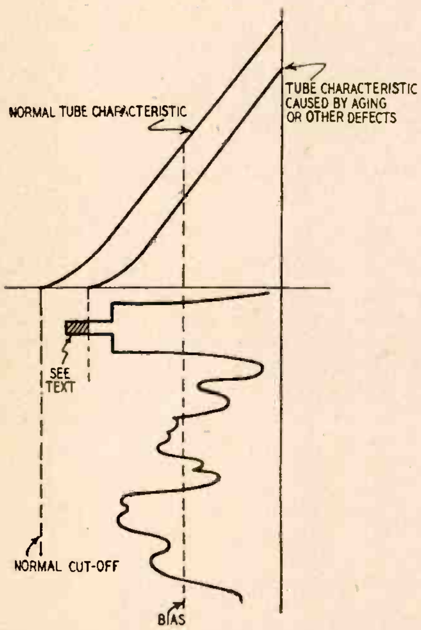


Fig. 1—Tube aging, low voltages, or circuit defects may weaken sync by clipping signal peaks (shaded portion).

is clipped when tube characteristic shifts. Because of its a.f.c. system, the horizontal sweep is not affected as much.

Poor tuner tracking or video i.f. alignment is another possible cause. Since the trouble occurs only on film commercials, it may not be worth the trouble to undertake complete realignment of the receiver. Proper setting of the contrast control might help the condition—particularly if tube replacement in the video stages improves the operation.

Horizontal instability

In a Magnavox CT-257 receiver there is horizontal instability. I can adjust it to stay in sync either during warmup or after, but not at both times. I have adjusted the horizontal oscillator circuit according to the manufacturer's instructions. How can I correct this trouble? A. A., Bronx, N. Y.

If you followed the manufacturer's suggestions in all respects and the trouble still persists, try new tubes in the modified Synchrolock circuit. First, try a new 6AU6 reactance tube, and if this doesn't help, replace the 6AL5 and the 6SN7-GT. Readjust the frequency and phase adjustments slightly after the new tubes are installed (following the procedures given in the service notes for this receiver). Differences in emission between the two diodes of the 6AL5 or a change in the characteristics of the 6AU6 often cause the stability to be affected after warmup.

If these measures fail to help, you will have to check all parts in discriminator and reactance-tube circuits. In particular, see that the two 470,000-ohm resistors in the discriminator are within the required 10% tolerance. Make sure all voltages on the three tubes conform to those given by the manufacturer.

Snow in booster

In a Masco model MBT-13 booster I get considerable snow in the picture though the sound is not affected. There is less snow on the screen without the booster and I am wondering what the trouble could be. F. R., Pawtucket, R. I.

This would indicate that any one of the following troubles exists in the booster:

- Defective tubes.
- Loose sockets or wiring.
- Improper tracking of tuned circuits.
- Mismatch between antenna and booster, or between booster and receiver.

First, check the booster tubes and look for loose parts or defective sockets. Make sure each tube is seated firmly in the socket. Inspect wiring, to see that all parts are well soldered and check all operating voltages. Try to improve the impedance match between the booster and the receiver by varying the length of the connecting lead. Finally, you may have to check the booster tracking with a calibrated marker, sweep generator, and oscilloscope.

H.v. resistor failure

In a Philco 50-T1600 the 2-megohm resistor in the high-voltage compartment burns out repeatedly. It is connected from pin 1 of the first 1X2 to the plate cap of the second 1X2. I have replaced both rectifiers as well as the 6BQ6-GT. The high voltage can be raised or lowered by adjusting the drive trimmer. Would this have any effect on the condition? The high-voltage filter capacitors check all right. P. S., Jamaica, N. Y.

As you pointed out, the drive control affects the high voltage at the first 1X2 tube. Excessive voltage can break down the 2-megohm resistor, and the drive control should be set just below the point where left-hand stretch and center compression occurs. It is also possible that you replaced the original resistor with an ordinary radio type. An exact replacement should be used, or one recommended by the manufacturer. These are usually the deposited-carbon type, and are longer than ordinary resistors, in order to prevent flashover. Also try a new damper tube, for this also may be causing some trouble, besides the 1X2 and the 6BQ6-GT which you have already replaced.

(An identical trouble in the same receiver model was recently traced to a tiny crack in the insulation of the filament winding for the first 1X2. An intermittent arcover between the filament winding and the flyback-transformer core—visible only in total darkness—was shorting the pin-1 end of the 2-megohm resistor to ground. As a precaution, *both* black-plastic-insulated filament windings were removed and replaced with high-quality polyethylene-insulated wire. This cured the trouble completely.—*Editor*)

Boost voltage

In many receivers the boosted voltage from the damper circuit supplies the plate of the horizontal oscillator. When h.v. failures occur in such receivers I find it takes considerable time to learn whether the trouble is in the oscillator or the sweep output circuit. The drive at the horizontal output grid has low amplitude and incorrect waveshape. Voltage readings at the plate and cathode of the damper show it is conducting but no pulse of any magnitude is being rectified. Voltages and resistances in the horizontal output and damper circuits are O.K. considering the lack of boost voltage. Is the horizontal oscillator off because its own parts are defective or because there is no boost voltage? Are there any short cuts for localizing the trouble? A. L. D., Nanuet, N. Y.

You should build a test power supply delivering approximately 350 volts across a bleeder network tapped at several points for lower voltages (Fig. 2).

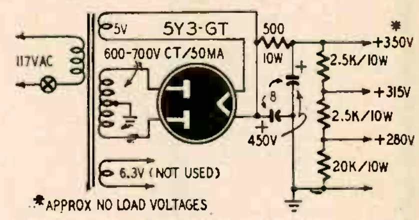


Fig. 2—Boost-voltage substitution unit.

Parts values are not too critical so long as several voltages are available. You can then disconnect the boost-voltage supply from the horizontal oscillator and apply approximately normal boosted voltage from the test supply. Check the drive waveform at the horizontal output grid for normal peak-to-peak voltage. If it is low, the trouble is in the oscillator. If the drive is normal, it indicates trouble in the horizontal output system (usually the transformer, if the tube is all right). This solves the problem of whether the boost voltage is low because of insufficient oscillator output, or because of other defects.

Some manufacturers give the ohmic values of the windings in the horizontal output transformer. In such instances continuity and resistance readings can be taken with an accurate, low-range ohmmeter. Sometimes this check is useless because the transformer breaks down only under load. If all other factors in the sweep system have been checked, a new flyback transformer will probably solve the problem. END

TV SERVICE NOTES

By JOHN B. LEDBETTER*

PART II

Horizontal pulling (Du Mont RA-112A, 113, 117A).
In most of these models, horizontal pulling can be corrected by careful re-adjustment of the a.g.c. control and alignment of the narrow-band sync amplifier i.f. transformer (Z209 in Fig. 1). The manufacturer's notes must be followed very closely. If adjustment does not correct the trouble, look for an open 2,400-ohm, 2-watt resistor (R304) in the power-supply bleeder circuit. This supplies 32 volts to the plate and screen of the sync-clipper stage. (An open resistor will be indicated by excessive plate and screen voltages on this stage.)

Horizontal pulling or bending (Stromberg-Carlson C317 series).
Check resistor R152 in the 12AU7 first sync-clipper grid circuit (Fig. 2). If this is 18,000 ohms (the value used in earlier models), replace with a 10,000-ohm unit.

Horizontal pulling at top of picture (Du Mont 112A, 113).
Check for a leaky or shorted 180-μμf plate-coupling capacitor in the 6SN7-GT sync-clipper stage (C264 in Fig. 1).

Horizontal pulling; ringing in picture; vertical hold adjustment critical (Du Mont RA-117A).
Many times the adjustable core of the 27.75-mc adjacent-channel trap (located on top side of tuner) works loose in shipment. Readjust by moving the core *counterclockwise* until the trouble is eliminated.

Horizontal hold extremely critical (all makes).
Insufficient filter capacitance in the B supply. If the horizontal oscillator and output tubes check good, and no apparent defect is noted in the associated circuits, try additional filter capacitance (as much as 40 μf may be required in some models, while 8 to 20 μf will serve in others).

Horizontal hold extremely critical (Emerson 664B).
If the horizontal oscillator and output tubes are O.K., check for low plate voltage to the horizontal oscillator. The 150,000-ohm oscillator plate resistor has a habit of increasing in value, often to 250,000 ohms or more.

Horizontal hold extremely critical or completely out of adjustment (Sentinel 401, 402, and other receivers using phase-detector horizontal a.f.c.).
Check the .047–.05-μf, 600-volt feedback capacitor from the horizontal output transformer to the phase detector cathode. If this is leaky, also check the resistor in series with this capacitor, the cathode resistor in the 6AL5 phase detector, and the plate resistor of the input triode in the 6SN7-GT horizontal oscillator. Leakage through the capacitor usually causes these resistors to change value.

No horizontal or vertical sync; picture overloaded; brightness low; sound weak; tuning eye dull green (Du Mont RA-112A, 113).
Check for a shorted 820-μμf screen bypass capacitor in the narrow-band sync amplifier stage (C233 in Fig. 1).

Insufficient width (General Electric 805, 806, 807, 809).
If operating voltages to the horizontal oscillator and output stages are normal, check for parasitic oscillation in the 19BG6-G. If this tube is good, connect a 47-μμf, 500-volt mica capacitor from pin 7 to ground. This will eliminate all parasitic oscillations.

Insufficient width (Capehart CX-33L and similar models).
Check the 0.1-μf cathode-bypass capacitor in the 6BG6-G horizontal output stage. Also, try adding a 30-μμf, 6,000-volt capacitor from the 6W4-GT plate to ground or from the 6BG6-G plate to ground. (Later models included one or more of these changes.)

Heavy foldover on right side of picture (Du Mont RA-112A, 113, 117A, 120A).
Leaky 270-μμf coupling capacitor to the grid of the horizontal output amplifier.

Vertical lines about 10 inches in from right side of picture (Du Mont RA-119 and similar models).
Usually due to Barkhausen oscillation in the high-voltage rectifier circuit. Interchange the 1B3's or try substituting one or two new 1B3's.

Insufficient brightness on left side of raster; brightness varies with horizontal hold adjustment; sync extremely critical (Du Mont RA-112A, 113, 117A).
Replace the 50-μf filter capacitor in the 58-volt negative bias-supply circuit (C253 in Fig. 1).

High-frequency whistle or buzz on all channels; picture and sound normal (Du Mont RA-112A, 113; Stromberg-Carlson model 17 series).
Check for a loose terminal board on the horizontal output transformer. Tighten the terminal board mounting screws; use lock-washers if necessary.

15.75-kc radiation from horizontal sweep circuit (any receiver using a metal-cone picture tube).
This trouble appears on nearby AM receivers as "birdies" or high pitched whistles every 15.75 kc on the broadcast band. Try a 500-μμf, 20,000-volt filter capacitor from the second anode lead to ground *outside the h.v. compartment.* Also try an 0.1-μf, 600-volt bypass capacitor from each side of the a.c. line to ground.

Erratic focus (Motorola TS-53).
Intermittent short between adjacent turns in the focus-coil winding. Several models have turned up with this complaint. Coil replacement is necessary in this case.

High-voltage section

No high voltage (Du Mont RA-119A; other makes).
Open filament in the 1B3-GT, or improper positioning of the filament winding on the high-voltage transformer. Try moving this winding 3/16 inch away from the h.v. winding if the 1B3-GT checks good.

Slight fluctuations in brightness (all makes).
Look for an intermittent condition in the high-voltage filter capacitor. Check by disconnecting one lead. If the fluctuations stop, replace the capacitor.

Power-supply troubles

Blown fuses (Sentinel 438, 439, 440, 441, 443, 446).
The No. 8 self-tapping screw on the back of the chassis (near the interlock plug) is too long and sometimes shorts out to the plate of the 6W4-GT or 6BY5-G. Replace with a shorter screw or use several washers under the old one. *Note:* If the line fuse is a 2.5-amp Slo-Blo, replace with a 3.0-amp fuse of the same type. A few chassis have no line fuse but *do* have a 0.5-amp Slo-Blo fuse in the power transformer secondary center-tap return. To prevent possible damage to the power transformer, install a 3.0-amp Slo-Blo in the primary circuit in these models.

Blown fuses (Admiral 20A1, 21A1, 20T1; other makes with 6BG6-G and 6W4-GT).
When the 0.25-amp fuse in the horizontal output transformer secondary blows, check for a gassy 6BG6-G or an intermittent cathode-heater short in the 6W4-GT damper tube.

Blown fuses (Du Mont RA-109A).
If the 0.25-amp fuse in the horizontal output transformer secondary blows repeatedly, check for leakage in the 40-μf output filter capacitor in the low-voltage supply (C288A in Fig. 3).

Replacing a 5U4G with a 5V4-G (all makes).
This is permissible if a 3-amp slow-blowing fuse is installed in the power transformer primary. Otherwise, a plate-cathode short in the 5V4-G may burn out the transformer.

Intermittent shrinkage of raster; bot-

*Engineer, WKRC-TV, Cincinnati, Ohio.

tom shrinks about 3 inches, makes proper vertical linearity impossible (Du Mont RA-109A, 116A, 119A, similar models).

Check for intermittent 40-μf capacitors across the 220,000-ohm resistors in the bleeder network between the slider of the vertical size control and ground (C288B and C294 in Fig. 4).

Picture-tube troubles

Picture blooming; loss of high-voltage when brightness is increased (several makes).

If the high-voltage rectifier tubes and second-anode series resistor are O.K., look for a gassy picture tube.

Magnetized picture tube (applicable only to receivers employing metal-cone tubes).

Check by holding a pocket compass a few inches from the metal cone. Demagnetize the cone by passing an unshielded focus coil, speaker field, or filter choke over the area while the coil is energized with alternating current.

Rapid collection of dirt on picture-tube face; caused by poor dust seal between mask and picture-tube face (any make).

Cement a strip of ¼-inch felt around the mask where it joins the face of the picture tube. Use ordinary speaker-cone cement for the job.

(Some of the above notes were taken from the author's field service notes; others were supplied through the courtesy of the manufacturers whose models are listed.) END

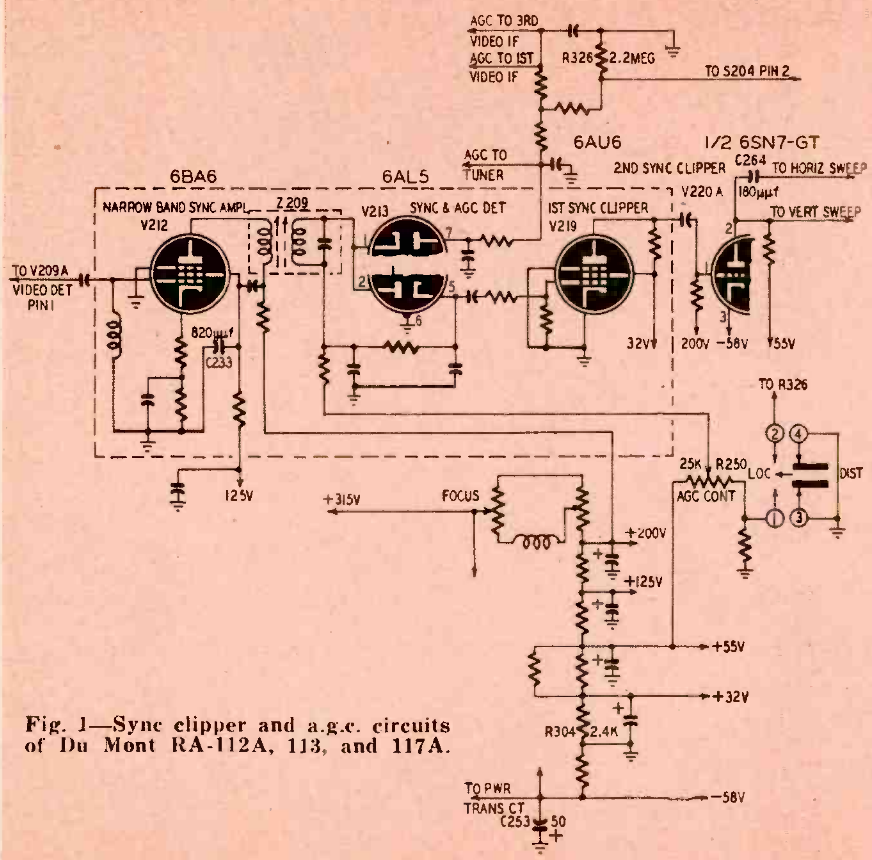


Fig. 1—Sync clipper and a.g.c. circuits of Du Mont RA-112A, 113, and 117A.

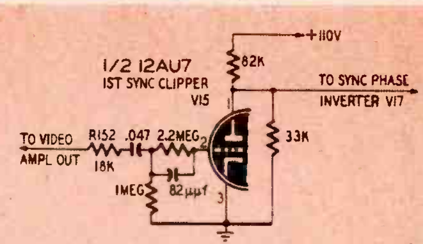


Fig. 2—First sync clipper in Stromberg-Carlson 317 and 417 receivers.

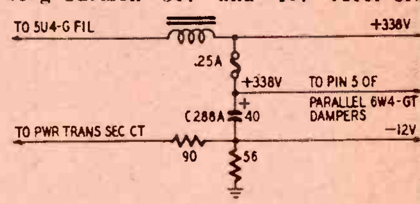


Fig. 3—Power-supply output filter circuit in Du Mont RA-109A *Teleset.*

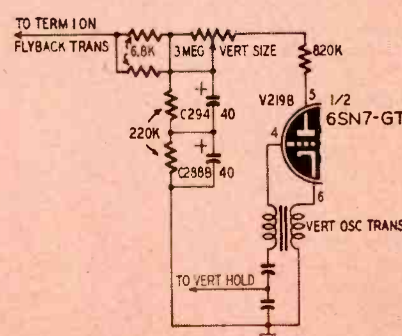


Fig. 4—Partial schematic of vertical sweep oscillator in Du Mont RA-109A.

TV DX REPORTS

TV DX hunters who have turned to stamp collecting for excitement during the last three months can start scanning the channels again during December. There are two principal dx seasons each year, and they are spread either side of the shortest and longest days of the year. The summer period is of course much longer, but the short winter season offers some good hunting, too.

Around the holidays is the time to be on the lookout for the winter dx, though there have been instances of sporadic-E skip all through December in the past. Dx will be more frequent below the Mason-Dixon Line, and it will be a good time for viewers in the middle west and south to watch for Cuban and Mexican stations. There will be some east-west dx, too, mostly around Christmas. Distances of more than 1,300 miles are unlikely, and it will be all on the lower channels.

Tropospheric bending will drop off markedly in the colder areas, though the Gulf States, the southwest, and even the Pacific northwest may still find propagation fair to good. Elsewhere, fringe-area reception will be poor on the average.

When improved conditions for TV dx reception are on the way it will be easy to anticipate them by watching the weather. Fair, cold, and windy weather will be accompanied by weak signals and bad fading. Rising temperatures and increasing cloudiness will mark a turn for the better.

Reception on the low channels will be best in the early morning and around sundown and shortly after; worst from noon through the next four hours. High-band dx will be conspicuous by its absence, and fringe area reception on the high channels can be expected to be far below that experienced in the fall period.

Several interesting high-channel dx reports were received during the fall, as well as hundreds of low-band reception summaries. These will be analyzed and reported on in detail at a later date. END

Details on a two-band rig with a novel plug-in v.f.o.

A COMPACT LOW-POWER TRANSMITTER

By JACK D. GALLAGHER

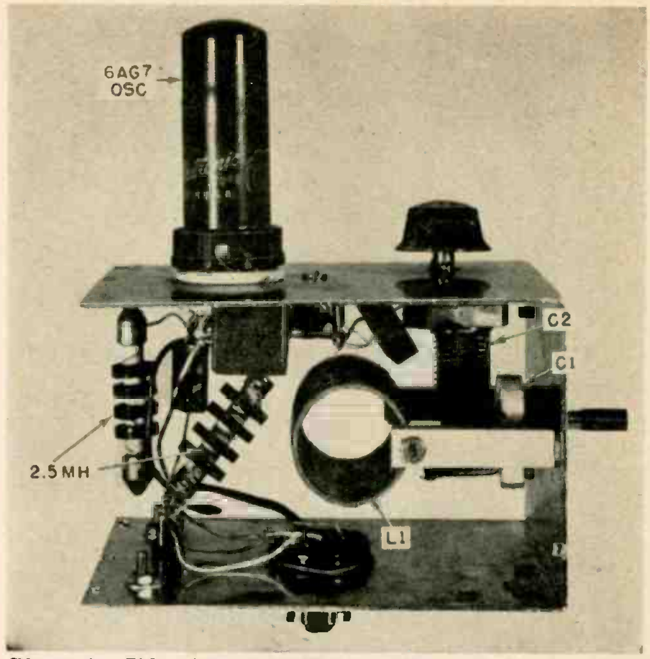


Photo A—Side view of oscillator with one-half of cabinet removed. Follow the layout closely for optimum stability.

THIS compact 75-watt, 2-band c.w. transmitter was designed to meet the needs of new hams who have just received their general-class licenses. While the rig will give a good account of itself on 80 and 20 meters, it is adaptable as a driver for a high-powered final. Its plug-in v.f.o. can be removed and used with any transmitter operating on 80 meters and higher frequencies. The constructor has a choice of tubes for each position, thereby eliminating the need to purchase tubes of a given type when substitutes are readily available.

The transmitter details are shown in the photographs and schematics. The oscillator-amplifier portion of the transmitter is shown in Fig. 1, while the doubler and final amplifier circuits are shown in Fig. 2. The 6AG7 oscillator uses a series-tuned Colpitts (Clapp) for stability and ease of adjustment. It is mounted in a 3 x 4 x 5-inch aluminum cabinet with an octal plug at the base which provides the necessary connections for power input and r.f. output. See photos A and B. The oscillator can be considered to be a separate unit which may be used with any transmitter, simply by mounting an octal socket in the center of a 4 x 5-inch space on the existing rig. While a 6AG7 is recommended for this type of service, a 6AC7, 6SK7, and a 6SJ7 will also work without changing socket connections. Ordinarily, pin 1 of a 6AG7 connects to the shell and suppressor grid. However, the 6AG7 which I used did not have the shell connected to pin 1. This left the tube unshielded. The tube was shielded by soldering a short lead between the shell and pin 1. This connection is shown in Photo A.

The circuitry

The oscillator operates on 160 meters. Coil L1 consists of approximately 110 turns of No. 28 enameled wire closewound on a 1¼-inch form. The circuit is tuned by the bandset capacitor C2 and bandspread capacitor C1. The latter is a 50-μμf unit with three plates removed to give 180 degrees of bandspread on 80 meters. Note carefully that C2 must be reset each time the oscillator tube is changed or replaced. Failure to do this destroys calibration.

The 6AC7 buffer amplifier shown in Fig. 1 isolates the oscillator from the rest of the transmitter, thus preventing changes in loading from affecting the frequency calibration and stability. A 6AB7, 6SK7, or 6SJ7 can be substituted for the 6AC7 without changing the socket or circuit values. The buffer provides an ideal circuit for keying the rig.

Fig. 3 shows one section of a 12AU7 connected as a vacuum-tube keyer to minimize clicks and chirps. You can substitute a 6C4, 6C5, one-half of a 6SN7-GT, or any such small triode. The value of the capacitor between the grid and ground determines the quality of the signal. Its correct value is determined experimentally. Disconnect the transmitting antenna and listen to the signal on a receiver. Key the rig and detune the receiver to listen for the signal a few kc each side of the transmitting frequency. If you hear clicks 8 or 10 kc away, add or subtract a few μμf from the .001-μf unit until the clicks disappear or are reduced to the point where they cannot be heard more than 3 or 4 kilocycles away.

If you don't want vacuum-tube keying, omit the portion of the circuit shown in Fig. 3. Connect the grid-cathode lead from the 6AC7 buffer to a key jack for normal cathode keying. Although we don't recommend it, you can use oscillator keying. Simply ground the grid-cathode lead from the 6AC7 buffer and remove the connection between pins 1 and 4 of the socket which takes the plug on the bottom of the oscillator chassis. The lead from pin 4 can then be connected to a key jack. You don't have to worry about having the continuously running oscillator interfering with reception on 80 or 40 meters. The oscillator is so well shielded that the signal on 80 meters will not be stronger than about an S3.

The circuits of the 6V6 doubler-amplifier and 807 final amplifier (see Fig. 2) are conventional. Disc-ceramic or mica capacitors are recommended for screen-to-cathode bypassing in the 6V6 stage, and mica capacitors are used in the final amplifier. The 47-ohm grid resistor and the plate-circuit trap consisting of 9 turns of No. 28 enameled wire wound around a 47-ohm, 1-watt resistor suppress parasitics in the 807

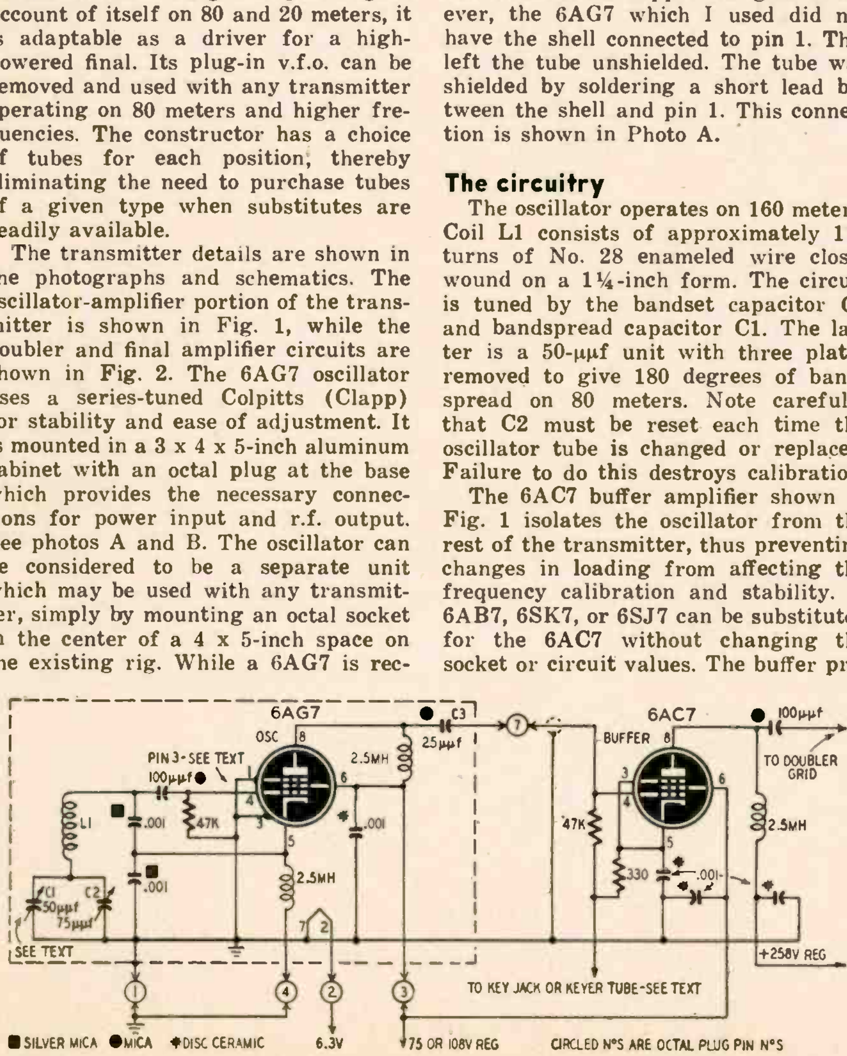
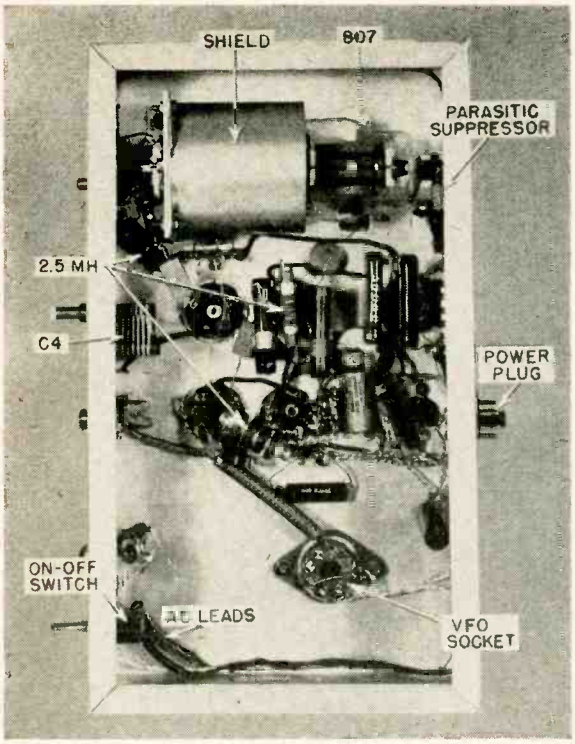


Fig. 1—The v.f.o. is enclosed by the dashed lines. The 6AC7 is the buffer.



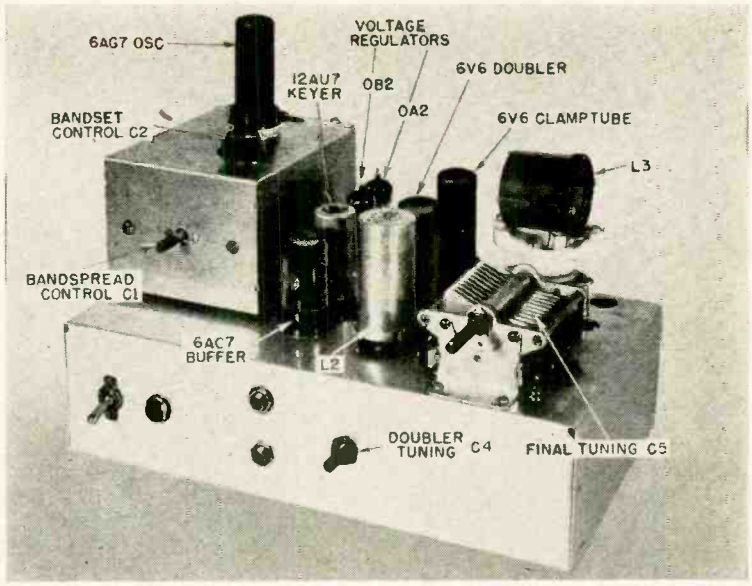


Photo B (Left)—The under side of the complete transmitter. The photo at right shows the v.f.o. plugged in for operation.

stage and minimize spurious radiations.

The triode-connected 6V6 clamp tube protects the 807 against excessive dissipation when excitation is removed. When the key is up, no bias voltage is developed across the 22,000-ohm grid resistor. The clamp tube conducts heavily and develops a large voltage drop across the 75,000-ohm screen-dropping resistor for the 807 stage. The voltage on the 807 screen is reduced far below normal, thus limiting the plate and screen currents to safe values. When the key is closed, the r.f. driving voltage causes a high negative bias to appear across the 22,000-ohm grid resistor. This cuts off the clamp tube and allows the 807 screen voltage to rise to normal.

Regulated voltage for the oscillator and for the buffer screen is obtained from series-connected 0A2 and 0B2 voltage-regulator tubes. The operating voltages for the transmitter may vary widely from those specified in Figs. 1 and 2 without affecting the performance or operation of the circuits. For instance, the oscillator may be operated from a well-filtered source of 50 volts unregulated d.c. without reducing its stability. If the oscillator is used alone to drive a 6V6 or 6L6 in another rig, the 6AG7 screen should be regulated at about 150 volts, the plate voltage should be raised to 250, and coupling capacitor C3 should be increased to 100 μuf.

The 6V6 plate coil L2 consists of 50 turns of No. 30 enameled wire close-wound on a Millen 74002 shielded form. The shield may be omitted if the 807 is always used as a doubler as would probably be the case if the unit is used to drive a high-powered final on 10 or 11 meters. The 807 plate coil L3 for 40 or 80 meters is a Bud or E. F. Johnson 5-prong, air-wound plug-in coil with the link at one end.

The transmitter is simple to adjust and no trouble should occur if care has been used in the construction. For preliminary adjustments, connect a 60- or 75-watt lamp to the link of the 807 plate coil. With the oscillator bandspread capacitor C1 set for maximum capacitance, slowly rotate C2 until a signal is heard on the receiver at 3.5 mc. With coils in place for 80-meter operation, advance C1 until a signal is heard about 3550 kc. Set the 6V6 plate tank to about 80% of maximum capacitance, then rotate the 807 plate-tank capacitor until the lamp reaches its brightest point. This should be about half of full brilliance. Readjust C4 and C5 until this point is reached. Note the final setting of C4. If it is 50 percent or less of maximum capacitance, remove a few turns at a time from L2 until about 75 or 80 percent of maximum capacitance is used.

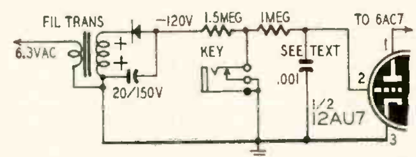


Fig. 3—Diagram of the keyer circuit. This may be replaced by direct keying.

For 40-meter operation, simply change the 807 plate-tank coil and repeat the operation. However, the setting of C4 should not have to be changed when changing bands. Of course, changing from one end of the band to the other with the oscillator will cause noticeable changes in the output, and small changes in C4 and C5 should bring the output back to normal.

Before connecting an antenna tuner and antenna to the output link, listen to the signal in the receiver to make sure there are no clicks in the vicinity of the operating frequency. Switch the receiver to 20 meters and also listen to the signal. It should be clean-cut and free from chirp. END

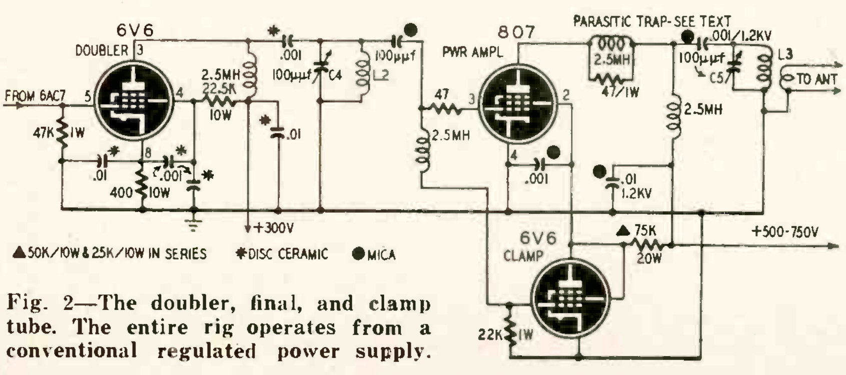


Fig. 2—The doubler, final, and clamp tube. The entire rig operates from a conventional regulated power supply.

Materials for oscillator-buffer

Resistors: 2—47,000 ohms, 1/2 watt; 1—330 ohms, 1/2 watt.
Capacitors: (Ceramic) 4—.001 μf, disc type. (Silver mica) 2—.001 μf. (Mica) 2—100 μμf. 1—25 μμf. (Variable) 1—75 μμf. 1—50 μμf. (See text.)
Miscellaneous: 3—2.5mh r.f. chokes. 2—octal sockets. 1—octal plug. 1—1¼ inch diameter ceramic, plastic, or fiber coil form. Chassis, terminal strips, hookup wire, and tubes.

Materials for double-amplifier chassis

Resistors: 1—47, 1—22,000, 1—47,000 ohms, 1 watt; 1—47 ohms, 1/2 watt; 1—400, 1—22,500, 1—25,000, 1—50,000 ohms, 10 watts.
Capacitors: (Disc-type ceramic) 3—.001 μf, 2—.01 μf. (Mica) 1—100 μμf, 1—.001 μf, 500 volts; 1—.001, 1—.01 μf, 1,200 volts. (Variable) 1—100 μμf, midget; 1—100 μμf, 1-kv spacing or larger.
Miscellaneous: 3—r.f. chokes, 2.5 mh; 1—Millen 74002 coil form. sockets, tubes, plug-in coils for 75-watt stage. 1—12 x 7 x 3-inch chassis. (Following parts used in vacuum-tube keyer: 1—6.3-volt, 1-amp filament transformer, 1—50-75-ma selenium rectifier, 1—1.5-meg, 1—1-meg resistor. 1—.001-μf capacitor.)

SATURATED-CORE LIGHT FLASHER

Magnetic amplifier principles are used in this equipment.

By ERWIN LEVEY

LIGHT-FLASHING systems form the basis for many types of advertising signs and displays. The unusual effects obtainable are proven attention-getters. A number of different types of controls are used for this purpose, but each has its limitations. A mechanical system is subject to wear and is not readily adaptable to a variable flashing rate. Thermal units have limited power-handling capacity. Here too, the flashing rate is fixed, and sustained operation causes the contacts to deteriorate, resulting in erratic performance.

These objections can be overcome by the use of a saturated-core system. This is entirely nonmechanical. The flashing rate can be varied over wide limits and it can control large amounts of power.

The periodic voltage and current pulses are produced by the action of a nonlinear resonant circuit. Before explaining how it works let's review some facts directly related to its operation.

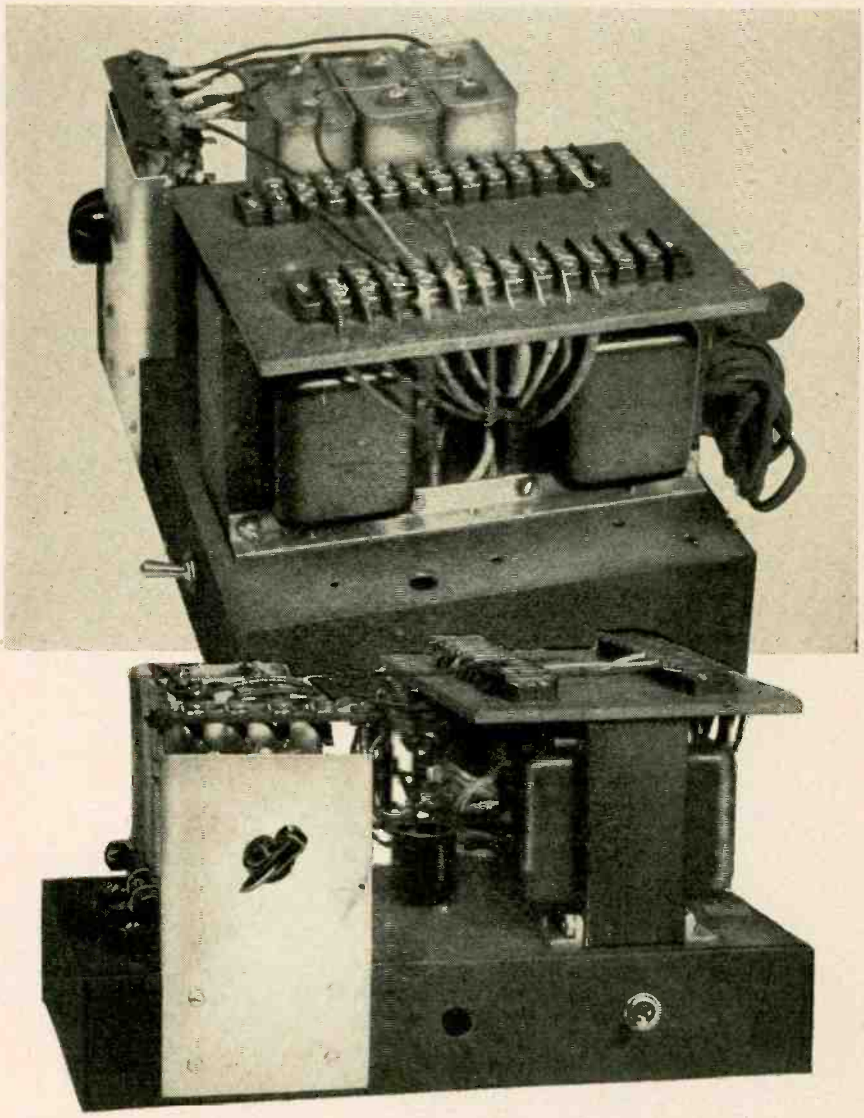
The conventional resonant circuit (Fig. 1) consists of a coil, L, some unavoidable resistance, R, and a capacitor, C. The frequency of oscillation is determined by the values of L and C:

$$F = \frac{1}{2\pi\sqrt{LC}}$$

To sustain oscillations the losses in R must be overcome by power from an external source. This type of oscillating circuit produces a sine wave—the basic a.c. waveform.

The inductance and capacitance in this case are so-called "linear" elements. That is, their values are determined purely by their physical characteristics. For example, the inductance of a coil is determined by the number of turns of wire, the size of the wire and the way it is wound, the relation between coil diameter and length, *and* the *permeability* of the core. (Permeability—or μ—is a measure of the ease with which a material may be magnetized.) The μ of air is 1, so that the inductance of an air-core coil depends only on the physical dimensions given above.

The current through an air-core coil has no effect on the inductance, since it does not change either the physical dimensions of the coil or the permeability of the air core. (The current-carrying capacity is limited, of course, by the size of the wire in the winding.)



Above—Chassis assembly, showing transformer mounting and flexible terminal. Below—Front view. Control potentiometer is at left, power-supply plug at center.

The inductance of a coil with fixed physical characteristics can be increased by using a magnetic core with higher permeability than that of air. Certain types of iron and alloys of other materials have permeabilities ranging from 400 to 20,000.

The permeability of a magnetic material is not constant but depends on the degree to which it is magnetized by the coil current. Therefore the inductance of a coil with a magnetic core may vary over wide limits. Sometimes, of course, this may be a serious disadvantage, especially in power-supply filter chokes. These are rated in both inductance and d.c. capacity. A choke will have its rated value of inductance only if the d.c. rating is not exceeded. If the current is increased beyond the rated value, the core becomes magnetically saturated, the inductance *decreases* and the choke offers less opposition to a.c. This reduces its effectiveness as a filter element, and may introduce considerable hum in the unit supplied.

On the other hand, at low values of current, the inductance is high. Therefore an iron-core reactor can be made to operate as a variable inductance, by varying the current flowing in the circuit. This is what is meant by a "nonlinear" inductance.

Next, consider the circuit shown in Fig. 2. There are three elements: capacitance, resistance, and a *nonlinear* inductance. If an a.c. voltage is applied to the circuit and its value is increased

slowly from zero, the circuit will start to oscillate when a certain critical value is reached. At this point the current is limited only by the resistance in the circuit. The initial increase of voltage causes the current in the circuit to increase. Its magnetizing effect changes the core characteristics and decreases the inductance. When the inductance falls to a certain value, depending on the value of C, a resonant system is formed. The circuit will then produce sustained oscillations.

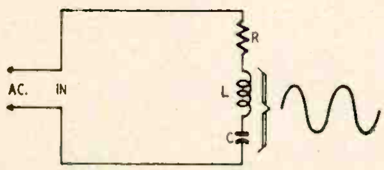


Fig. 1—Basic series-resonant oscillating circuit. Losses in R are made up by power fed in from an external source.

Although the circuit is quite simple it is extremely critical in operation. These limitations can be overcome by replacing the simple iron-core coil with a saturable reactor.

In this device (Fig. 3) the core permeability (and therefore the inductance) are controlled by d.c. Since a completely separate set of control coils is used, the resonant condition is much easier to produce. Transformers T1 and T2 comprise the saturable reactor.

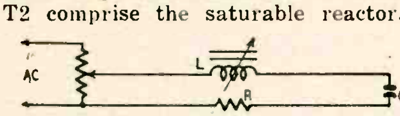


Fig. 2—Oscillating circuit with a saturable reactor as the inductive element. The inductance drops sharply when the circuit current reaches a critical value. When $X_L = X_C$ the circuit oscillates at its natural resonant frequency, regardless of the a.c. input frequency.

The a.c. voltage applied to the circuit is no longer critical. The value applied need be only below the value required to produce oscillations. This gives a wide range of control. A gradual increase in the control current reduces the inductance of the coils. A certain degree of saturation creates the proper conditions for resonance, and the cur-

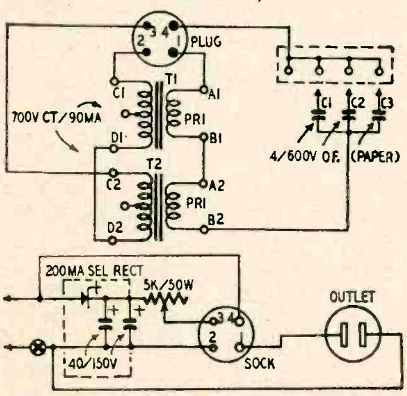


Fig. 3—Complete saturable-reactor control circuit, using d.c. for continuous control of inductance and flashing rate.

rent will start to pulsate. The sudden increase of current at resonance produces a strong a.c. flux in the core. This opposes the unidirectional d.c. flux and reduces the degree of core saturation. This in turn *increases* the inductance and detunes the circuit from its resonant condition. The a.c. drops to a low value and the cycle repeats immediately.

The frequency at which the current pulsates depends on C, R, and the applied voltage. With a set of fixed units the flashing frequency is controllable from a single pulse every 5 seconds up to the point where the lights are lit continuously, simply by varying the d.c. saturating current.

Reactor construction

The saturable reactor was made from the primary and high-voltage windings of two identical 350–350-volt, 90-ma power transformers. The h.v. center taps are not used. A simple check will supply the necessary phasing information for connecting the windings correctly. First consider one transformer. Each of the four leads—two primary and two high-voltage—should be identified by a tag. The primary leads are marked A and B, the high-voltage leads C and D. Connect leads B and C together. Next, apply 117 volts a.c. across primary leads A and B. Then read the total voltage across terminals A and D. (*Use caution here. You are dealing with dangerously high voltages!—Editor*)

If the coils are phased correctly the meter will read the sum of the two individual coil voltages. In this case 700 plus 117 will give 817 volts. On the other hand, if the meter reads the difference between the two voltages (700 minus 117, or 583 volts) the h.v. leads should be reversed. If this is necessary, change the tags so that the h.v. lead connected to wire B of the primary is labeled C, and the free end of the h.v. winding is changed to D. After the leads on one transformer are phased similar tests should be made on the other.

Once the leads have been properly tagged, the two transformers can be connected as a saturable reactor. The interconnections are shown in Fig. 3. The transformer terminals are identified by the codes used for the phasing check. Mounting arrangements can be seen in the photographs. The two transformers are mounted side by side, and clamped together at the bottom by two ½-inch metal angles 6½ inches long. These are tapped for 6-32 screws which fasten the assembly to the 11 x 7 x 2-inch chassis. The mounting should be as rigid as possible, for otherwise the transformers will vibrate audibly in synchronism with the power pulses. A 5 x 6½-inch masonite panel is fastened to the tops of the transformers with small angle brackets. (The screw heads are countersunk and are under the 12-position barrier-type terminal strips.) This arrangement is somewhat elaborate, but the flexibility it offered was a decided advantage for experiments. A simpler arrangement can be used if desired. Connections to d.c. power supply and the output receptacle are made through a four-pin tube socket and plug.

The selenium rectifier and filter capacitor for the power supply are mounted under the chassis on a small insulating panel. Half-inch spacers are used between the board and the chassis.

A 5,000-ohm, 50-watt potentiometer connected as a rheostat is used for the main control. This is mounted above the chassis on a separate bracket.

Materials for control unit

2-Power transformers. 700 volts center-tapped, at 90 ma (Stancor P-6012 or equivalent); 3—4-μf, 600-v oil-filled paper capacitors; 2—40-μf, 150-v electrolytic capacitors; 1—200-ma selenium rectifier; 1—5000-ohm, 50-watt potentiometer; 1—4-pin tube socket; 1—4-pin plug; 1—2-contact outlet receptacle; 1—11 x 7 x 2-inch chassis; 1—s.p.s.t. toggle switch; 1—4-position terminal strip; 2—multiterminal barrier type strips (see photos); line cord, wire, insulating panels, hardware, solder.

The capacitors in the resonant circuit are 4-μf, 600-volts, oil-filled paper units. Electrolytic capacitors *cannot be used here* since they are polarized and will not operate properly on a.c. The leads from the capacitors are connected to a four-terminal strip mounted on top of the rheostat bracket. The lead at the right is the common terminal. This assembly is essentially a switch which allows the capacitors to be connected in parallel as required. Capacitors are removed from the circuit by simply disconnecting the appropriate leads from the terminal screws. See that the free leads (when disconnected) do not touch any other metal part in the circuit since they are hot and will cause a short. The lamp load circuit is connected through a receptacle mounted on the rear of the chassis.

Circuit operation

Best results were obtained with a lamp load of 160 watts. For this condition only two of the capacitors are used in the circuit. The third one must be disconnected as explained above. The flashing rate may be varied with the rheostat from approximately one flash every three seconds up to several per second. The lamp load may be divided any way you wish as long as the total power adds up to 160 watts.

The pulsing rate is much higher when all three capacitors are connected in parallel. Here the load must also be 160 watts. The flashing is so rapid the bulbs appear to be flickering.

If the unit does not operate when the power is turned on make a close check of all wiring. Repeat the phasing check to make sure there are no errors in the interconnection of the two transformers. If all the details explained above have been followed carefully there should be no trouble. (This also means that the exact parts specified have been used.)

The saturable reactor and its associated d.c. power supply can be used as a regular magnetic amplifier if the capacitors are removed from the circuit. However, since it is no longer operated in a resonant state the losses are greater and only about one-half the power can be controlled compared with the flashing system. END

Check these
ADVANTAGES FOUND
Only in HEATHKITS
1. Baked Enamel Lifetime Finish Panels — Oven baked finishes for maximum durability and freedom from mars, scratches and discoloration. Panels that can really take service shop and laboratory abuse.
2. Save Money — You save all expensive factory wiring costs when you build your own. And direct factory to customer sales eliminate all middle man profits. You can have a complete Heathkit laboratory or service shop for what one or two pieces of ready built equipment cost.
3. Modern Styling — New "fitted panels" and formed cabinets with rounded corners present a smart, professional appearance. Dignified appearance for prestige.
4. Quality Components Used Throughout — Heathkits use well known, time and quality tested components such as Simpson, Chicago Transformer, Wilkor, Allen-Bradley, Altec-Lansing, Centralab, Cinch, Oak, Grigsby-Allison, Mallory and many others.
5. Extensive Factory Facilities — Shearing, punching, forming spot welding, etc. is done right in our own plant — controlled production for highest quality and less cost to you.
6. Extensive and careful engineering — A staff of engineers working in a modern, well equipped laboratory carefully develop Heathkits according to highest engineering practices. Your assurance of accurate, up to the minute instruments.
7. Complete Kits — All the parts are right in the kit — you get all tubes, controls, transformers, meters — everything — no other components to buy. And no cutting, punching, or painting necessary — it's all done for you. Heathkits go together easily and smoothly.
8. Only Complete Line — Over 50 kits available — Heathkits form the only complete line of kit-form test equipment on the market. Kits for hams engineers service men, schools and audio enthusiasts
9. Detailed, Complete Instruction Manuals — Comprehensive manuals tell you exactly how to build your Heathkit. Manuals contain easy-to-follow instructions, clear, large pictorials, schematic, detail drawings, etc. They make construction easy, fun, and educational.
1
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Cinch
Simpson
MALLORY
ALTEC
A-B
Electro-Voice
Nine New Heathkits This Year!
EXPORT AGENT
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The HEATH COMPANY
... BENTON HARBOR 20, MICHIGAN

NEW *Heathkit* "Q" METER KIT

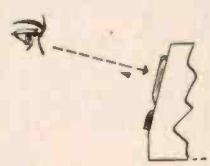
• A HIGH QUALITY Q METER AT LOW COST.

MODEL QM-1
SHIPPING WT. 12 LBS.

$39.50

Measures Q and inductance of coils.

Measures Q and capacity of capacitors.



Slant face cabinet for ease in reading the meter.

- First Q METER within the price range of all.
- Read Q's of 0-500 directly on calibrated scale.
- Stable oscillator supplies R.F. frequencies of 150 kc to 18 megacycles.
- Calibrated capacitor with range of 40 mmf to 450 mmf with vernier of ±3 mmf.
- Simple, easy operation.
- Can be used to measure small inductances or capacitors.
- Measures Q of condensers, RF resistance and distributed capacity of coils.
- Measures capacity by substitution, capacity by resonance, inductance by resonance.
- Slanted panel for convenient operation.

Another outstanding example of progressive HEATHKIT engineering. Now a highly desirable Q METER within the price range of all laboratories, schools and experimenters. No longer is it necessary to deny yourself the many measurement advantages offered by this instrument.

Use the new HEATHKIT Q METER for the following simple basic measurements: capacity by substitution, capacity by resonance, inductance by resonance and Q at the OPERATING frequency all can be read on the calibrated scales. The method used to obtain information regarding the Q of condensers, RF resistance, distributed capacity in coils, etc., is only slightly more involved. In the HEATHKIT Q METER, the generated RF signal is coupled through a cathode follower and injected across a low impedance condenser which is included in the resonant circuit under test. Large 4½" 50 microampere Simpson meter reads Q directly. The resonating condenser and vernier condenser are calibrated in mmf for substitution method capacity tests. The resonating condenser is also calibrated in effective capacity for resonance tests. The inductance calibration serves for rapid determination of the approximate inductance of a coil. The HEATHKIT Q METER has a generator frequency range of 150 kc to 18 megacycles. Vernier capacity covers ± 3 mmf and the resonating condenser is calibrated from 40 mmf to 450 mmf actual capacity or 40 mmf to 350 mmf effective capacity. Meter reads Q directly up to 250. Higher and lower full scale readings can be obtained by varying the injection voltage levels.

The entire kit consists of 12AT7, 6AL5, 6C4, OD3 and 6X5 tubes. 50 microampere Simpson meter, power transformer, cabinet and all other parts necessary for construction as well as instructions for assembling, testing and operation of the completed instrument.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1
SHIPPING WT. 4 LBS.

$19.50

The HEATHKIT DECADE RESISTANCE KIT is widely used by schools, experimenters and laboratories because of the extremely wide resistance range offered and the useful, dependable service provided. The DECADE consists of 5 rotary 2 deck ceramic wafer switches with silver plated contacts and twenty 1% precision resistors in a circuit which provides the resistance range of 1 ohm to 99,999 ohms in 1 ohm steps. The HEATHKIT DECADE RESISTANCE KIT is simple to construct and is housed in a beautiful polished birch cabinet with an attractive panel. The DECADE will furnish years of accurate trouble-free service.

Individual decade sections of above can be purchased separately for special applications.

NEW *Heathkit* DECADE CONDENSER KIT

Extremely useful in all experimental and design work such as determination of condenser values for: compensating networks, filters, bridge impedances, tuned circuits, etc. *Uses all precision silver mica condensers within ±1% accuracy.* Values run in three decades from 100 MMFD to 0.111 MFD in steps of 100 MMFD. Smooth acting, positive detent, highest quality ceramic wafer switches make all capacitor values easy to set up and keep losses to a minimum. Low loss dielectric terminal board mounts on outside of panel for easy cleaning. Heathkit binding posts accommodate a wide variety of test leads. Comes complete with all parts, including polished birch cabinet.

Individual decade sections of above can be purchased separately.

MODEL DC-1
SHIPPING WT. 4 LBS.

$16.50

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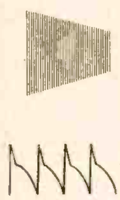
CABLE: ARLAB-N.Y.

The HEATH COMPANY
...BENTON HARBOR 20, MICHIGAN

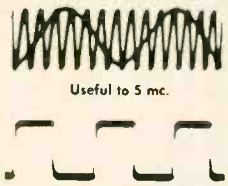
NEW *Heathkit* OSCILLOSCOPE KIT

• NEW WIDE BAND VERTICAL AMPLIFIER ± 2 DB 10 CYCLES TO 1 MC.



Direct plate connections for modulation tests.

Displays TV sync pulses correctly.



Useful to 5 mc.

Good square wave response at 100 kc.

MODEL O-8

SHIPPING WT. 29 LBS.

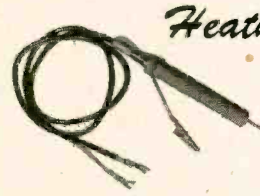
$43.50

- New wider band vertical amplifier ± 2 db from 10 cycles to 1 megacycle useful to over 5 megacycles.
- High sensitivity in vertical amplifier. .025 volts RMS per inch deflection.
- New 3 step input attenuator input ranges X1, X10, X100.
- New 5CP1 intensifier type tube for greater brilliance.
- Terminal board and rear cabinet opening provisions for direct connections to deflecting plates.
- Newly styled formed and ventilated aluminum cabinet.
- Wide band sweep generator, 15 cycles to over 100 kc. Will synchronize with 5 megacycle signal.
- 10 tube circuit featuring push pull operation of vertical and horizontal amplifiers.
- Internal synchronization on either positive or negative peaks.
- Reproduces faithfully the front and back porches of TV sync pulses. Excellent square wave reproduction to over 100 kc.
- Optional Intensifier kit available for 2200 volt operation.

Proudly announcing the new 1953 HEATHKIT Model O-8 OSCILLOSCOPE featuring the finest performance ever offered in this extremely popular kit instrument. Improved wider band vertical amplifier featuring a new 3-step input attenuator affording smooth control of the excellent .025 volts per inch vertical sensitivity. Possibility of overloading the vertical input circuit is minimized. Greater band width in the vertical channel is a decided advantage to TV service men. Permits clear observation of all TV sync pulse detail and excellent square wave reproduction over 100 kc. 5CP1 intensifier type CR tube provides a brilliant trace with normal accelerating voltages. A handsome, ventilated cabinet with smooth rounded corners and a snug fitting drawn panel adds to the smartly styled professional appearance. Longer life is assured through cooler instrument operation. Push pull output stages in both vertical and horizontal amplifiers for balanced deflection of the spot. All of the many fine features of the previous model have been retained. Rear cabinet access to terminal board for direct connection to CR plates. The entire kit of all 10 tubes, parts, cabinet and panel as well as detailed construction manual for assembly and operation of the instrument included.

INTENSIFIER KIT: For extreme trace brilliance in special applications such as photography, group demonstrations or operation in brightly lighted areas an optional Intensifier kit providing 2200 volt operation of the CR tube is available. Kit includes high voltage filter condenser, high voltage selenium rectifier, etc. $7.50.

Heathkit SCOPE DEMODULATOR PROBE KIT



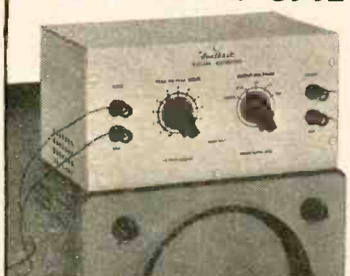
No. 337

SHIP. WT. 1 LB.

$4.50

Trouble shooting or aligning TV, RF, IF and video stages requires demodulation of high frequency signals before Oscilloscope observation. The HEATHKIT SCOPE DEMODULATOR PROBE KIT was specifically developed for this application. Kit consists of a probe housing, crystal diode detector circuit, shielded cable and spade lugs. Assembly is simple and the probe will quickly prove its usefulness as an Oscilloscope accessory.

NEW *Heathkit* VOLTAGE CALIBRATOR KIT



MODEL VC-1

SHIPPING WT. 5 LBS.

$9.50

Use the Heathkit Voltage Calibrator with your oscilloscope to measure peak-to-peak TV complex waveshapes. TV manufacturer's specifications indicate correct peak-to-peak voltages and this kit will permit making these important measurements.

A big help to engineers in circuit work. Makes peak-to-peak voltage measurements of complex waveshapes of all kinds. Flat topped semi-square wave output of calibrator assures fast and easy measurement of any voltage between .01 and 100V peak-to-peak.

The Voltage Calibrator can remain connected to your oscilloscope at all times for instant use. "Signal" position connects signal under study directly through calibrator and into scope input circuit for direct observation. Eliminates transfering leads from calibrator. *A wonderful scope accessory.*

Heathkit ELECTRONIC SWITCH KIT

A few dollars spent for this accessory will increase the usefulness of a scope immeasurably. An electronic switch will open up a whole new field of scope applications for you. The S-2 allows TWO SIGNALS to be observed at the SAME TIME — this important feature allows you to immediately spot phase shift, clipping, distortion, etc. The two signals under observation can be superimposed or separated for individual study. Each signal input has an individual gain control for properly adjusting scope trace patterns. Has both coarse and fine frequency controls for adjusting switching time. Multivibrator switching frequency is from less than 10 cps to over 2000 cps in three overlapping ranges. Kit comes complete including 5 tubes, power transformer, all controls, instruction manual, etc. *Every scope owner should have one!*

MODEL S-2

SHIPPING WT. 11 LBS.

$19.50

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CABLE: ARLAB-N.Y.

The HEATH COMPANY

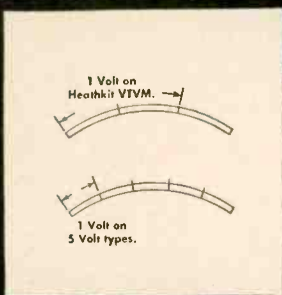
... BENTON HARBOR 20, MICHIGAN

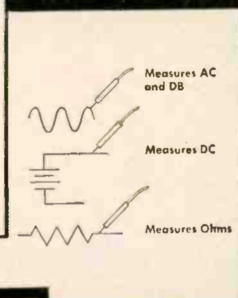
Heathkit VACUUM TUBE VOLTMETER KIT

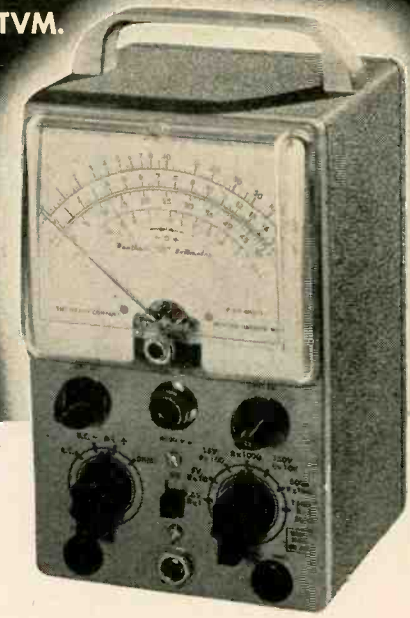
• NEW 1½ VOLT RANGE ON 1953 VTVM.

MODEL V-6
SHIPPING WT., 7 LBS.

$24.50







- New 1½ volt low range gives over 2" of scale per volt instead of less than ¾" found on 5 volt range type.
- Increased accuracy due to expanded scales.
- New 1500 volt DC high range gives 50% greater coverage.
- Seven ranges in all. 1½, 5, 15, 50, 150, 500 and 1500 volts DC (1000 volts maximum AC only).
- Provides proper service ranges 150 volts for AC DC work and 500 volts for AC type service.
- High input impedance, 11 megohms minimizes circuit loading.
- Variety of accessory probe kits available.
- 1% precision resistors in multiplier circuits.
- 200 microampere Simpson meter.
- Center scale zero adjust.
- Transformer operated.
- Test leads included.
- New cabinet styling.
- Large, clearly marked meter scales indicate ohms, AC volts, DC volts and DB.

The 1953 Heathkit V-6 VTVM has improved ranges! The lowest range has been moved way down to 1.5V full scale. This gives 3½" of actual scale length for the 1.5V covered — *that's 2⅓ inches per volt!!* Now you can make your low level measurements faster and with greater accuracy.

And the upper range has been moved up. *Readings up to 1500V DC* can be readily made with new, improved VTVM — plus readings up to 1000V on AC. Higher ranges for extended use.

New vertical chassis mounting gives added chassis space for really easy wiring — no tight corners to worry about. Uses only highest quality components throughout, Simpson 200 microampere meter movement combined with 1% precision resistors in multiplier circuit insure highly accurate and dependable readings.

AC and DC voltage ranges are 0-1.5V-5V-15V-50V-150V-500V-1500V. (1000V max. reading on AC) — a total of seven ranges for convenient, accurate readings. Instrument also measures resistance from .1 ohm to over 1 billion ohms in seven handy ranges of RX1, X10, X100, X1000, X10K, X1 Meg., — all convenient multiples of 10 with no skips. Has Db scale in red for easy indentification.

New panel has tough *baked on enamel finish* for freedom from scratches and maximum durability. Modern styled, formed, compact cabinet with rounded edges and crackle finish is truly handsome.

Comprehensive, detailed instruction manual with step-by-step instructions, figures, pictorials, etc. makes assembly a cinch.

Be sure and look over the special accessory VTVM probes below — for added usefulness.

Heathkit R. F. PROBE KIT

SHIP. WT 1 LBS. **$5.50**
No. 309
Extends RF range of HEATHKIT 11 megohm VTVM to 250 megacycles ± 10%.

Heathkit 30,000 V. D.C. PROBE KIT

SHIP. WT. 2 LBS. **$5.50**
No. 336
Provides DC multiplication factor of 100 for any 11 megohm VTVM.

Heathkit PEAK TO PEAK VOLTAGE PROBE KIT

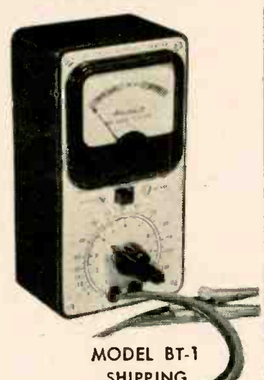
SHIP. WT. 2 LBS. **$6.50**
No. 338
Reads on DC scale of any 11 megohm VTVM 5 kc to 5 megacycle range.

NEW *Heathkit* BATTERY TESTER KIT

The new Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three-color GOOD-WEAK-REPLACE scale that your customers can readily understand. Operation is extremely simple and merely requires that the leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for A or B battery types.

The Heathkit Battery Tester features compact assembly. An accurate meter movement and wire wound control mount in the portable, rugged plastic case.

Use the BT-1 to check portable radio batteries, hearing aid batteries, lantern batteries and photo flash gun batteries.

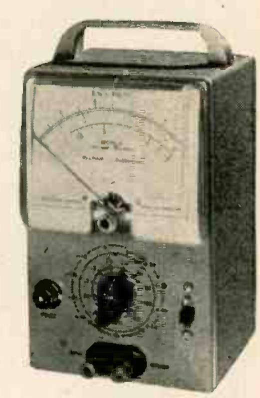


MODEL BT-1
SHIPPING WT. 3 LBS.

$7.50

Heathkit AC VACUUM TUBE VOLTMETER KIT

A new AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Ten full scale ranges of .01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts RMS. 10 DB ranges from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 kc. Simpson 200 microampere meter with large plainly marked meter scales. Precision multiplier resistors. Two amplifier stages using miniature tubes. A unique bridge rectifier meter circuit and a clean layout of parts. Order the AV-2 today and become acquainted with the interesting possibilities offered by this instrument.



MODEL AV-2
SHIPPING WT. 5 LBS.

$29.50

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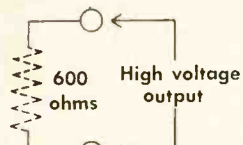
The HEATH COMPANY
. . . BENTON HARBOR 20, MICHIGAN

NEW *Heathkit* AUDIO GENERATOR KIT

• RANGE EXTENDED TO 1 MEGACYCLE



Low impedance output
High voltage output

Sine wave output from 20 cycles to 1 megacycle.

MODEL AG-8

SHIPPING WT. 16 LBS.

$29.50

- Improved design — new low price.
- Frequency coverage in five ranges from 20 cycles per second to 1 megacycle.
- Response flat 1 DB from 20 cycles to 400 kilocycles. Down 3 DB at 600 kilocycles. Down only 8 DB at 1 megacycle.
- Five calibrated output voltage ranges, continuously variable 1 mv, 10 mv, 100 mv, 1 v, 10 v.
- Low impedance output circuit. 600 ohms.
- Distortion less than .4 of 1% from 100 cycles per second through the audible range.
- New HEATHKIT universal type binding posts.
- Durable infra-red baked enamel panel.
- Transformer operated for safe operation.
- Sturdy, ventilated steel cabinet.

A new Audio Generator with features heretofore found in only the most expensive generators. Such features as complete coverage from 20 cycles to 1 Mc — response flat ±1 db from 20 cycles to 400 Kc, down 3 db at 600 Kc and down only 8 db at 1 Mc.

And it has calibrated output . . . Calibrated continuously variable and step attenuator output controls allow you to easily set calibrated output voltage. Moreover, distortion is less than .4 of 1% from 100 cps through the audible range.

Oscillator section consists of a two stage resistance coupled amplifier (6SJ7 and 6AK6) utilizing both positive and negative feedback for oscillator operation and reduction of distortion. Oscillator section drives a cathode follower output power amplifier (6AK6) which isolates the oscillator from variations in load and presents a low impedance output (600 Ohms). Power supply is transformer operated and utilizes 6X5 rectifier with 2 sections of RC filtering.

An unbeatable dollar value — for here is an audio generator with wide frequency coverage, excellent frequency response, stepped and continuously variable calibrated output, high signal level, low impedance output, and low inherent distortion.

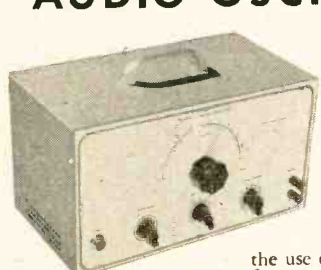
Heathkit AUDIO FREQUENCY METER KIT

The HEATHKIT AUDIO FREQUENCY METER provides a simple and easy way to check unknown audio frequencies from 10 cycles to 100 kc between 3 and 300 volts RMS. The instrument features 7 ranges for accuracy and wide coverage. The meter itself has a quality 200 microampere Simpson movement and large clearly marked scales. The AUDIO FREQUENCY METER is transformer operated and features a voltage regulator tube to maintain constant plate voltage on the second stage. Kit supplied complete with all necessary construction material and a detailed construction manual.

SHIPPING WT. 15 LBS.

MODEL AF-1 **$34.50**

NEW *Heathkit* AUDIO OSCILLATOR KIT



A new Audio Oscillator with both sine and square wave coverage from 20 to 20,000 cycles . . . An instrument designed to completely fulfill the needs of the audio engineer and enthusiast — Has numerous advantages such as high level output (up to 10V obtainable across the entire range), distortion less than .6%, and low impedance output.

Special design features include the use of a thermistor in the second amplifier stage for keeping the output essentially flat across the entire range.

A cathode coupled clipper circuit produces good, clean, square waves with rise time of only 2 microseconds. Oscillator section uses 1% precision resistors in range multiplier circuit for greatest accuracy.

You'll like the operation of this fine new kit.

MODEL AO-1

SHIPPING WT. 14 LBS.

$24.50

Heathkit SQUARE WAVE GENERATOR KIT

The HEATHKIT SQUARE WAVE GENERATOR is an excellent square wave frequency source with wide range coverage from 10 cycles to 100 kc continuously variable. This feature makes it useful for TV and wide band amplifier work as well as audio experimentation. The output voltage is continuously variable between 0 and 20 volts. The circuitry consists of a multivibrator stage, a clipping and squaring stage and a cathode follower low impedance output stage. The power supply is transformer operated and utilizes a full wave rectifier circuit with two sections of filtering. Another excellent HEATHKIT value at this remarkable low price. Kit includes all necessary construction material as well as complete instruction manual for assembly and operation.

MODEL SQ-1

SHIPPING WT. 14 LBS.

$29.50

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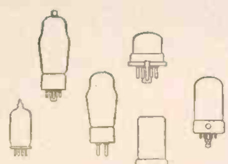
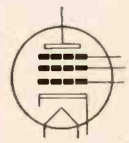
The HEATH COMPANY

. . . BENTON HARBOR 20, MICHIGAN

Heathkit TUBE CHECKER KIT



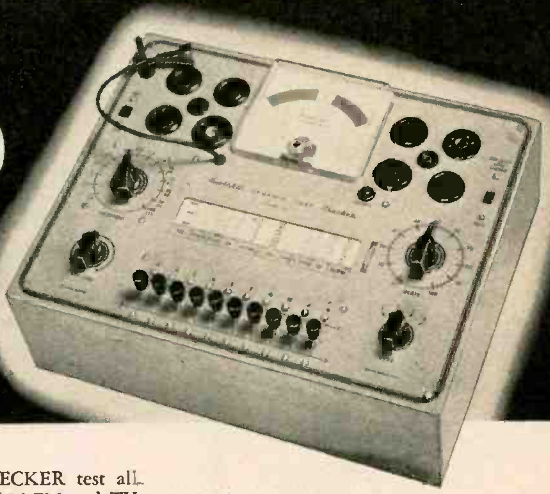
Checks 7, 8, 9 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, pilot lights.



Checks for opens, shorts, emission, filament and filament tap continuity.

MODEL TC-1
SHIPPING
WT. 12 LBS.

$29.50



- Beautiful counter type birch cabinet.
- 4½" Simpson 3 color meter.
- Simplified setup procedure.
- Built-in gear driven roll chart.
- Checks emission, shorted elements, open elements and continuity.
- Complete protection against obsolescence.
- Sockets for every modern tube.
- Blank for new types.
- Individual element switches.
- Contact type pilot light test socket.
- Line adjust control.

PORTABLE TUBE CHECKER KIT MODEL TC-1P

Same as TC-1 except supplied with polished birch cabinet (with removable lid) instead of counter type cabinet. Shipping weight 14 lbs. **$34.50**

No. 365 Polished Birch Tube Checker Cabinet only. Shipping Weight 7 lbs. **$7.50**

With the HEATHKIT TC-1 TUBE CHECKER test all types of tubes commonly encountered in AM-FM and TV receiver circuits. Test setup procedure is simplified, rapid and flexible. Tube quality is read directly on a beautiful 4½" Simpson three color BAD - ? - GOOD scale that your customers can readily understand. Panel sockets accommodate 4, 5, 6 and 7 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, a blank socket for new tubes and a contact type socket for quick checking of pilot lights. Built-in gear driven roll chart for instant reference. Neon short indicator, individual three position lever switch for each tube element, spring return test switch, line set control to compensate for supply voltage variations. At this low price, no service man need be without the advantages offered by the HEATHKIT TUBE CHECKER.

Heathkit TV PICTURE TUBE TEST ADAPTER

Use your HEATHKIT TUBE CHECKER with this new TV TEST ADAPTER to determine picture tube quality. Check for emission and shorts, independent of TV power supply. Consists of standard 12 pin TV tube socket, 4 feet of cable, octal socket connector and data sheet. Quickly prove TV picture tube condition to yourself and your customer.

No. 355
Ship. Wt. 1 lb.
$4.50

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1
SHIPPING
WT. 3 LBS.

$5.50

NEW HEATHKIT RESISTANCE SUBSTITUTION BOX KIT provides switch selection of any single one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 megohms. This coverage available in 2 ranges in decades of 15, 22, 33, 47, 68 and 100. Housed in rugged plastic cabinet featuring new HEATHKIT universal type binding posts. The entire kit priced less than the retail value of the resistors alone.

Heathkit BATTERY ELIMINATOR KIT

A clean 6 volt d-c supply source is definitely required for successful automobile radio servicing. Has a continuously variable d-c output from 0 to 8 volts. It can be safely operated at a steady 10 ampere level and will deliver up to 15 amperes for intermittent periods. The voltage output terminals are completely isolated from the chassis to accommodate additional service applications such as supplying bias voltages or d-c substitution voltages for battery operated tube filament circuits.

The output of the Battery Eliminator is constantly monitored by a d-c voltmeter and a d-c ammeter. The circuit features an automatic overload relay of self resetting type. For additional protection, a panel mounting fuse is provided. Build this kit in a few hours and pocket a substantial savings.

MODEL BE-3
SHIPPING
WT. 20 LBS.

$24.50

Heathkit VIBRATOR TESTER KIT

Repair time is valuable, and the Heathkit Vibrator Tester will save you hours of work. Instantly tells the condition of the vibrator under test — and the check is thorough and complete. Checks vibrator for proper starting, and the easy-to-read meter indicates the quality of output on large BAD-GOOD scales. Tests both interrupter and selfrectifier types of vibrators. Five different sockets for checking hundreds of vibrators.

Operates from any battery eliminator capable of delivering continuously variable voltage from 4 - 6V at 4 amps. The Heathkit BE-3 Battery Eliminator is ideal for operating this kit.

Faulty vibrators can be spotted within seconds and you're free to go on to other service jobs.

MODEL VT-1
SHIPPING
WT. 7 LBS.

$14.50

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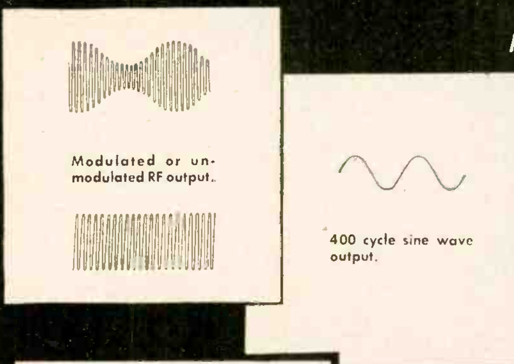
Heathkit SIGNAL GENERATOR KIT



MODEL SG-7

SHIPPING WT. 7 LBS.

$19.50

- Step attenuated RF ouput.
- 6 to 1 vernier dial ratio.
- Turret mounted coil sub-assembly.
- Pre-calibrated and adjusted coils.
- Hartley RF oscillator circuit.
- Colpitts oscillator 400 cycle sine wave output.
- Modulated or unmodulated RF output.
- Frequency coverage on fundamentals 160 kc to 50 megacycles in five ranges. 51 megacycles to 150 megacycles on calibrated harmonics.
- RF output in excess of 100,000 microvolts.
- Audio output 1½ to 2 volts.
- AC transformer operated.
- Professionally styled cabinet.
- Infra red baked enamel panel.

The new HEATHKIT Model SG-7 SIGNAL GENERATOR easily fulfills requirements for a controllable, modulated or unmodulated source of variable frequency. A convenient 400 cycle sine wave output is available for audio work. All RF oscillator coils are precision wound and adjusted to calibration before shipment thereby assuring maximum accuracy. The coils, band switch and tuning condenser all mount as a turret assembly so as to offer the advantage of short wiring leads and easy mounting of parts. The RF output circuit is of the low impedance type obtained by the use of cathode coupling to the output jacks. The level of RF output is varied by means of the RF step and RF output control. Use the HEATHKIT SG-7 as an RF signal source modulated or unmodulated for radio repair, laboratory work, experimental testing, 400 cycle sine wave audio testing, checking RF stages, alignment of both AM and FM IF stages, marker generator for TV alignment, etc. The kit is transformer operated and utilizes miniature tubes for ease in handling high frequency. Panel jacks and a convenient switching system permit either external or internal modulation. The entire kit is supplied complete with tubes and all necessary material as well as a detailed step by step instruction manual for the assembly and operation of the instrument.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

SHIPPING WT. 18 LBS.

$39.50

The HEATHKIT MODEL IM-1 is an extremely versatile instrument specifically designed for measuring the degree of interaction between two signals caused by a specific piece of apparatus, or a chain of equipment. It is primarily intended for tests of audio equipment but may be used in other applications such as making tests of microphones, records, recording equipment, phonograph pickups and loud speakers. Use it for checking tape or disc recordings, as a sensitive AC voltmeter, as a high pass noise meter for adjusting tape bias, cutting needle pitch or other applications. High and low test frequency source, intermodulation section, power supply and AC voltmeter all in one complete unit. Percent intermodulation is directly read on three calibrated ranges, 30%, 10% and 3% full scale. Both 4 to 1 and 1 to 1 ratios of low to high frequencies easily set up. At this low kit price YOU can enjoy the benefits of Intermodulation analysis for accurate audio interpretations.

Heathkit LABORATORY REGULATED POWER SUPPLY KIT

MODEL PS-2

SHIPPING WT. 20 LBS.

$29.50

New HEATHKIT LABORATORY POWER SUPPLY provides continuously variable regulated DC voltage output from 160 volts to 400 volts depending on load. Panel terminals supply separate 6.3 V. AC supply at 4 amperes for filament circuits. A 3½" plastic cased panel mounted meter provides accurate metered output for either voltage of current measurements. Exceptionally low ripple content of .012% admirably qualifies the HEATHKIT LABORATORY POWER SUPPLY for high gain audio applications. Ideal for laboratory work requiring a reference voltage for meter calibration or for plotting tube characteristics. In service work, it can be used as a separate variable voltage supply to determine the desirable operating voltage in a specific circuit. Use it as a DC substitution voltage in trouble shooting TV circuits exhibiting symptoms of extraneous undesirable components in plate supply circuits. Entire kit, including all 5 tubes now available at this low price.

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Heathkit WILLIAMSON TYPE AMPLIFIER KIT

The new HEATHKIT WILLIAMSON TYPE AMPLIFIER incorporates the latest improvements described in Audio Engineering's "Gilding the Lily." 5881 output tubes and a new Peerless output transformer with additional primary taps afford peak power output of well over 20 watts. Frequency response ±1 db from 10 cycles to 100 kc. allows reproduction of highs and lows with equal crispness and clarity. Harmonic and intermodulation distortion have been reduced to less than ½ of 1% at 5 watts. This eliminates the harsh unpleasant qualities which contribute to listening fatigue. Make this amplifier the heart of your radio system to achieve the fine reproduction that is the goal of all music lovers.

The HEATHKIT PREAMPLIFIER (available separately or in combination with the amplifier kit) features inputs for magnetic or low level cartridges, crystal pickups and tuners, turnover control for LP or 78 type records, individual bass and treble tone controls each providing up to 15 DB of boost or attenuation. Special notched shafts on preamplifier controls and switches adaptable to custom installation. The preamplifier can be mounted in any position and a liberal length of connecting cable is supplied. No radio experience is required to construct this amplifier. All punching, forming, or drilling has already been done. The complete kit includes all necessary parts as well as a detailed step by step construction manual with pictorial diagrams to greatly simplify the construction.

ACROSOUND TRANSFORMER OPTION. If desired, the output transformer with the kit will be the Acrosound output transformer, type TO-300. The use of this transformer permits ultra-linear operation as described in Audio Engineering's "Ultra-Linear Operation of the Williamson Amplifier."

PRICES OF VARIOUS COMBINATIONS

W-2 Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs.	$69.50
W-2M Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only	$49.75
W-3 Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. Shipped express only	$69.50
W-3M Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only	$49.75
WA-P1 Preamplifier Kit only. Shipping Weight 7 lbs. Shipped express or parcel post.	$19.75

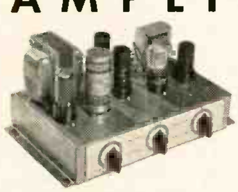
Heathkit FM TUNER KIT

MODEL FM-2
SHIPPING
WT. 9 LBS.

$22.50

The HEATHKIT MODEL FM-2 TUNER specifically designed for simplified kit construction features a preassembled and adjusted tuning unit. Three double tuned IF transformers and a discriminator transformer are used in an 8 tube circuit. Smooth tuning is obtained through a 9 to 1 ratio vernier drive using a calibrated six inch slide rule type dial. The usual frequency coverage of 88 to 108 megacycles is provided. Experience the thrill of building your own FM tuner. Operate it through your amplifier or radio and enjoy all the advantages of true FM reception. Transformer operated power supply to simplify connections to all types of audio systems. The kit is supplied complete with all 8 tubes and necessary material required for construction. A complete instruction manual simplifies assembly and operation.

Heathkit ECONOMY 6 WATT AMPLIFIER KIT



MODEL A-7
SHIPPING
WT. 10 LBS.

$14.50

The HEATHKIT Model A-7 amplifier features beam power, push pull output with frequency response flat ±1½DB from 20 to 20,000 cycles. Separate volume, bass and treble controls. Two input circuits, output impedances of 4, 8, and 15 ohms. Peak power output rated at full 6 watts. High quality components, simplified layout, attractive gray finished chassis, break off type adjustable length control shafts and attractive lettered control panel.

THE MODEL A7A amplifier incorporates a preamplifier stage with special compensated network to provide the necessary voltage gain for operation with variable reluctance or low output level phono cartridges. Excellent gain for microphone operation in a moderate powered sound system **$16.50**

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER KIT

The HEATHKIT MODEL A-8 amplifier kit was designed to deliver high fidelity performance with adequate power output at moderate cost. The frequency response is within ± 1 DB from 20 to 20,000 cycles. Distortion at 3 DB below maximum power output at 1000 cycles is only .8%. The amplifier features a Chicago power transformer in a drawn steel case and a Peerless output transformer with output impedances of 4, 8, and 16 ohms available. Separate bass and treble tone controls permit wide range of tonal adjustment to meet the requirements of the most discerning listener. The amplifier uses a 6SJ7 voltage amplifier, a 6SN7 amplifier and phase splitter and two 6L6's in push pull output and a 5U4G rectifier. Two input jacks for either crystal or tuner operation. The kit includes all necessary material as well as a detailed step by step construction manual.

MODEL A-8
SHIPPING WT. 19 LBS.

$33.50

MODEL A8-A features an added 6SJ7 stage (preamplifier) for operating from a variable reluctance cartridge or other low output level phono pickups. Can also be used with a microphone. A 3 position panel switch affords the desired input service. **$35.50**

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Heathkit SUPERHETERODYNE RECEIVER KITS

- High gain dual iron core tuned type IF transformers
- AC transformer operation for safety
- Continuously variable tone control
- Sturdy punched and plated steel chassis
- Ideal for custom installation
- Full AVC action
- Inverse feedback for improved frequency response
- Kit supplied with all necessary construction material except speaker and cabinet. (Available separately if desired).

6 tube all wave circuit. 3 ranges, continuous coverage 550 kc to over 20 megacycles, shipping wt. 11 lbs.

Model AR-1

$23.50

5 tube broadcast band 550 to 1600 kc coverage, shipping wt. 11 lbs.

Model BR-1

$19.50

Two excellent radio receiver kits featuring clean design and open layout for simplified construction. Satisfy that urge to build your own radio receiver and select the model which meets your requirements. Both receivers feature continuously variable tone control, a radio phono switch and phono input and an AC receptacle for the phono motor. A six inch calibrated slide rule type dial with a 9 to 1 ratio vernier dial drive insures easy tuning.

SHIPPING INFORMATION

ON PARCEL POST ORDERS include postage for weight shown and insurance. (We insure all shipments.) Don't worry about sending more than the correct amount — if you send us too much, every extra cent will be promptly returned.

ON EXPRESS ORDERS do not include transportation charges. They will be collected by Express Agency on delivery.

ORDERS FROM CANADA must include full remittance for merchandise.

Orders processed on the same day received. Customers notified of unavoidable delay.

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	Heathkit Oscilloscope Kit—Model O-8 (29 lbs.)	$43.50	
	Heathkit Intensifier Kit (O-8 only) No. 339 (1 lb.)	7.50	
	Heathkit Voltage Calibrator Kit—Model VC-1 (5 lbs.)	9.50	
	Heathkit Electronic Switch Kit—Model S-2 (11 lbs.)	19.50	
	Heathkit Scope Demodulator Probe Kit No. 337 (1 lb.)	4.50	
	Heathkit T.V. Alignment Generator Kit—Model TS-2 (20 lbs.)	39.50	
	Heathkit Q Meter Kit—Model QM-1 (12 lbs.)	39.50	
	Heathkit Grid Dip Meter Kit—Model GD-1 (4 lbs.)	19.50	
	Heathkit VTVM Kit—Model V-6 (7 lbs.)	24.50	
	Heathkit RF Probe Kit No. 309 (1 lb.)	5.50	
	Heathkit HV Probe Kit No. 336 (2 lbs.)	5.50	
	Heathkit Peak-to-Peak Volt. Probe Kit No. 338 (2 lbs.)	6.50	
	Heathkit Visual-Aural Signal Tracer Kit—Model T-3 (8 lbs.)	22.50	
	Heathkit Condenser Checker Kit—Model C-3 (7 lbs.)	19.50	
	Heathkit RF Signal Generator Kit—Model SG-7 (7 lbs.)	19.50	
	Heathkit Tube Checker Kit—Model TC-1 (12 lbs.)	29.50	
	Heathkit T.V. Tube Adapter No. 355 (1 lb.)	4.50	
	Heathkit Battery Eliminator Kit—Model BE-3 (20 lbs.)	24.50	
	Heathkit Vibrator Tester Kit—Model VT-1 (7 lbs.)	14.50	
	Heathkit Audio Generator Kit—Model AG-8 (16 lbs.)	29.50	
	Heathkit Audio Oscillator Kit—Model AO-1 (14 lbs.)	24.50	
	Heathkit Audio Frequency Meter Kit—Model AF-1 (15 lbs.)	34.50	

QUANTITY	ITEM	PRICE	
	Heathkit Square Wave Gen. Kit—Model SQ-1 (14 lbs.)	$29.50	
	Heathkit AC VTVM Kit—Model AV-2 (5 lbs.)	29.50	
	Heathkit Intermodulation Analyzer Kit—Model IM-1 (18 lbs.)	39.50	
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	Heathkit Decade Resistance Kit—Model DR-1 (4 lbs.)	19.50	
	Heathkit Decade Condenser Kit—Model DC-1 (4 lbs.)	16.50	
	Heathkit Impedance Bridge Kit—Model IB-1B (15 lbs.)	69.50	
	Heathkit Battery Tester Kit—Model BT-1 (3 lbs.)	7.50	
	Heathkit Resistance Substitution Box Kit—Model RS-1 (3 lbs.)	5.50	
	Heathkit F.M. Tuner Kit—Model FM-2 (9 lbs.)	22.50	
	Heathkit Broadcast Receiver Kit—Model BR-1 (11 lbs.)	19.50	
	Heathkit Three Band Receiver Kit—Model AR-1 (11 lbs.)	23.50	
	Heathkit Amplifier Kit—Model A-7 (10 lbs.)	14.50	
	Heathkit Amplifier Kit—Model A-7A (10 lbs.)	16.50	
	Heathkit Amplifier Kit—Model A-8 (19 lbs.)	33.50	
	Heathkit Amplifier Kit—Model A-8A (19 lbs.)	35.50	
	Williamson Type Amplifier Kit (Type:) Shipped express only		
	WA-P1 Preamplifier Kit (7 lbs.) (Shipped exp. or p.p.)	19.75	

*Please ship C.O.D. ☐ Postage enclosed for ____________ lbs. Enclosed find ☐ Check ☐ Money Order for ____________

THE ROTALYZER

The Rotalyzer is a new instrument for measuring speed and speed variations. It may be used with any rotating shaft. First the Rotalyzer converts the rotation to a.c. If the shaft speed is uniform, the a.c. will be unmodulated. There will be only one frequency as in Fig. 1-a. If the speed varies, the a.c. frequency will also vary. It will rise and fall about the average as in Fig. 1-b. This frequency variation is common, ordinary FM. It can be detected by a discriminator.

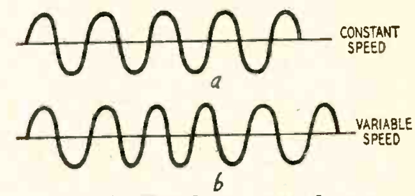

Fig. 1—Rotalyzer waveforms.

Fig. 2 shows the block diagram of the Rotalyzer. The tachometer is a tiny generator coupled to the rotating shaft. It contains a number of fixed magnetic poles and a coil wound on the rotating armature. (In some types the coil is fixed and the magnets are mounted on the armature.) When the generator rotates with the shaft of the device being checked, magnetic lines of force cut across the coil and generate a.c. The equation for the generator frequency is

$$F = \frac{\text{shaft RPM} \times \text{poles}}{120}$$

As long as the shaft rotates at constant speed the frequency also remains constant. If the shaft speeds up, the armature turns faster and the frequency increases. If the shaft slows down, the frequency decreases.

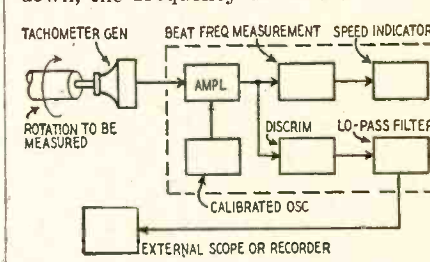

Fig. 2—Average speed is found by beat method. Discriminator shows variations.

For most purposes, an average a.c. of between 5 kc and 30 kc is convenient. For slow shaft speeds, we need a large number of poles to reach these frequencies. Some Rotalyzers have as many as 600 poles within a 2-inch tachometer.

Tachometer output is amplified. The average frequency is compared with a standard oscillator by the best method. The answer gives us the average speed.

The amplified a.c. is also impressed across an FM discriminator. This detects only the FM component. It is passed through a filter which rejects the high frequencies, leaving only the slow variations due to wow and flutter of the shaft. The variations may be recorded or observed on a scope.

The Rotalyzer can show speed changes as small as 0.1%. Average speeds of from 50 r.p.m. to 20,000 r.p.m. are easily measured. END

Why pick 'em blind?

Buying capacitors by rating without also specifying brand is like buying neckties blindfolded. You just don't know what you're getting. When it comes to capacitors, don't buy blind . . . don't trust to luck . . .

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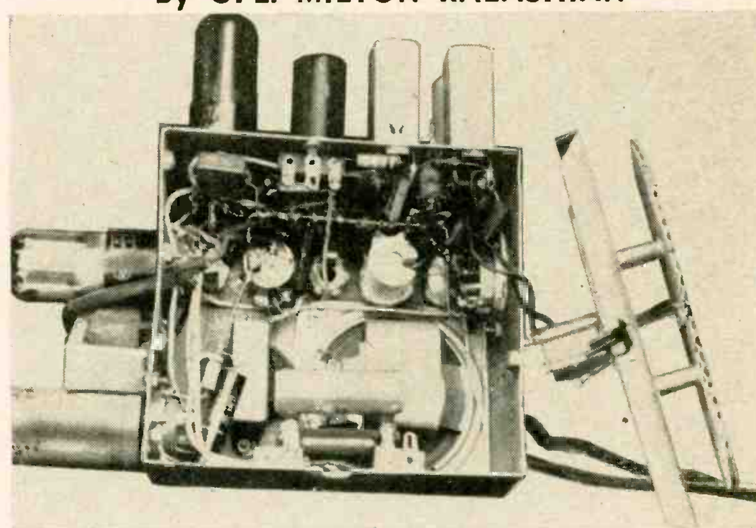
ROK RECEIVER

By CPL. MILTON KALASHIAN



Inside the receiver. The loop antenna is mounted on the open cover at the right.

KOREA isn't quite so bad if you're a "ham" and part of a Signal Corps outfit. You're not allowed to operate a rig of your own, but when things are quiet, you may have time to do some experimenting with whatever parts you can salvage.

A big morale builder here is the good music broadcast on 1320 kc by AFRS (Armed Forces Radio Station) *Troubadour*—running a revamped BC-610. The broadcast receiver situation here was so critical, we decided to beat the shortage by building one. As a Signal Corps outfit we had 110-volt a.c. most of the time, so an a.c.-d.c. hookup (Fig. 1) took care of that. It's only a simple 5-tube superhet, loop antenna and all, with some minor changes. The only thing *really different* about this set is the way it's constructed. It had to be rugged so it could withstand a lot of abuse.

Since the only tubes on hand were the 300-ma heater types, we had to use the 130-ohm voltage-dropping resistor. This resistor is an advantage here in winter, with the temperature always well below zero. It produces quite a bit of heat and keeps the inside of the set dry. In summer the cabinet gets quite hot, but this hasn't done any damage yet. (If the same tube lineup is used on normal *117-volt* lines, this resistor should have a value of 160 ohms, 20 watts. This is a standard value in resistor-type line cords and ballast tubes. If 150-ma heater tubes—12BE6, 12BA6, 12AV6, 50C5, 35W4, or their metal equivalents—are used, the dropping resistor is not needed.—*Editor*)

The loop antenna feeds a conventional 6BE6 pentagrid converter, which in turn feeds the 6BA6 i.f. amplifier through the first i.f. transformer. The second i.f. transformer drives the diode

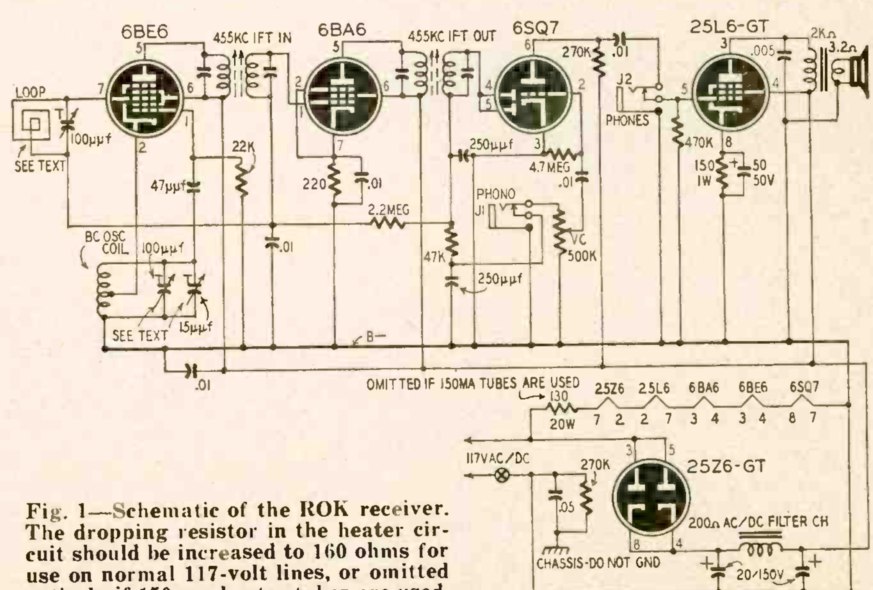
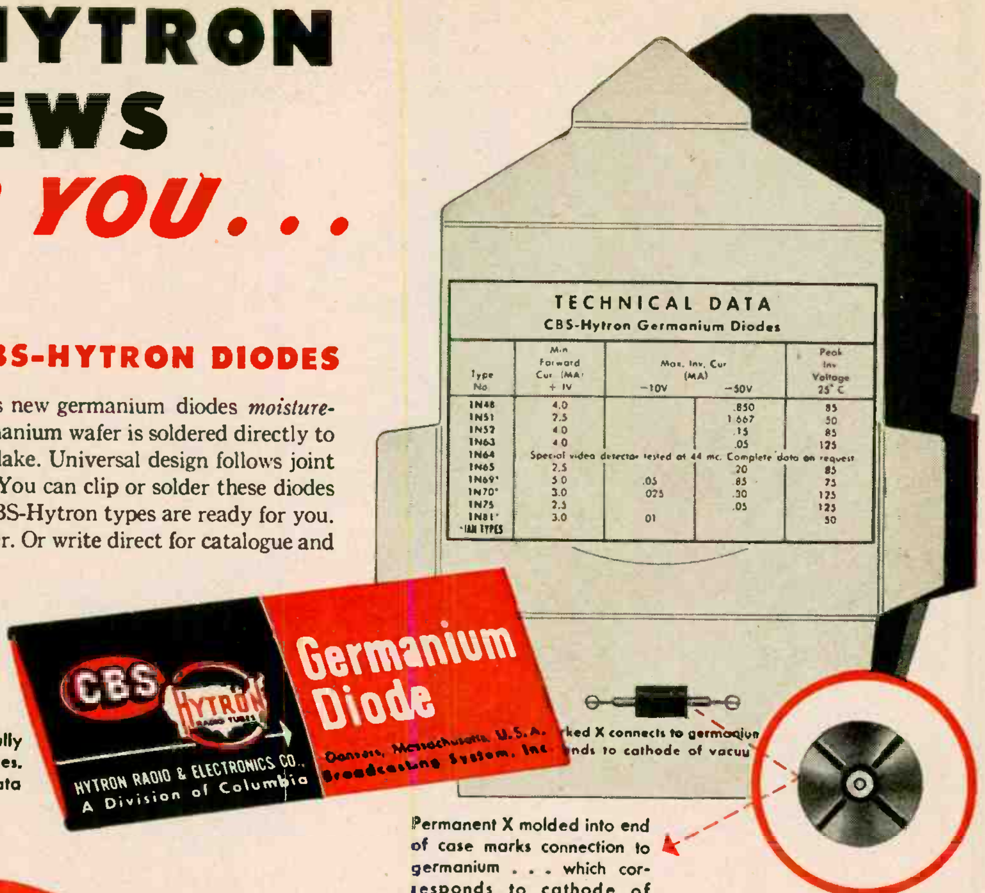


Fig. 1—Schematic of the ROK receiver. The dropping resistor in the heater circuit should be increased to 160 ohms for use on normal 117-volt lines, or omitted entirely if 150-ma heater tubes are used.

CBS-HYTRON NEWS *FOR YOU . . .*

ABOUT NEW CBS-HYTRON DIODES

CBS-Hytron guarantees its new germanium diodes *moisture-proof* . . . trouble-free. Germanium wafer is soldered directly to the base . . . no plating to flake. Universal design follows joint Army-Navy specifications. You can clip or solder these diodes into circuit. Ten popular CBS-Hytron types are ready for you. See your CBS-Hytron jobber. Or write direct for catalogue and interchangeability chart.



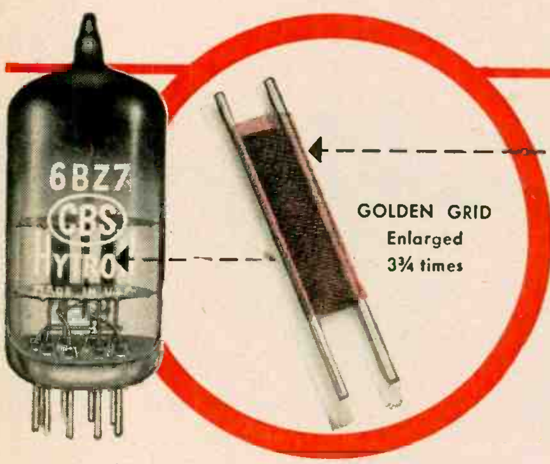
TECHNICAL DATA
CBS-Hytron Germanium Diodes

Type No	Min Forward Cur (MA) + 1V	Max. Inv. Cur (MA) −10V	Max. Inv. Cur (MA) −50V	Peak Inv Voltage 25° C
1N48	4.0		.850	85
1N51	2.5		1.667	50
1N52	4.0		.15	85
1N63	4.0		.05	125
1N64	Special video detector tested at 44 mc. Complete data on request			
1N65	2.5		.20	85
1N69*	5.0	.05	.85	75
1N70*	3.0	.025	.30	125
1N75	2.5		.05	125
1N81*	3.0	.01		50

*JAN TYPES

New, attractive tuck-away carton fully protects CBS-Hytron germanium diodes. Note unbent leads and convenient data on inside cover.

Permanent X molded into end of case marks connection to germanium . . . which corresponds to cathode of vacuum tube.



GOLDEN GRID
Enlarged
3¾ times

ABOUT CBS-HYTRON GOLDEN GRIDS

Hidden gold in CBS-Hytron tubes? Yes, since 1944. CBS-Hytron first used gold-plated grids in the 6AK5. Later in many transmitting types: 2E25A, 2E30, 3B4, 5516, etc. Now you will find them also in the 6BZ7, 6BQ6GT, 12A4, 12BY7, etc.

Why? Gold kills unwanted emission. Even mounted very close to a hot cathode, a CBS-Hytron gold-plated grid does not give *primary* emission. Like a sponge the gold also soaks up stray electrons. Wipes out *secondary* emission too. And foreign material vaporized onto the grid during exhaust is absorbed harmlessly by the gold plating.

Such deluxe processing costs money. But it gives you better tubes. That is why CBS-Hytron has ignored the cost. Has specified gold-plated grids for years.

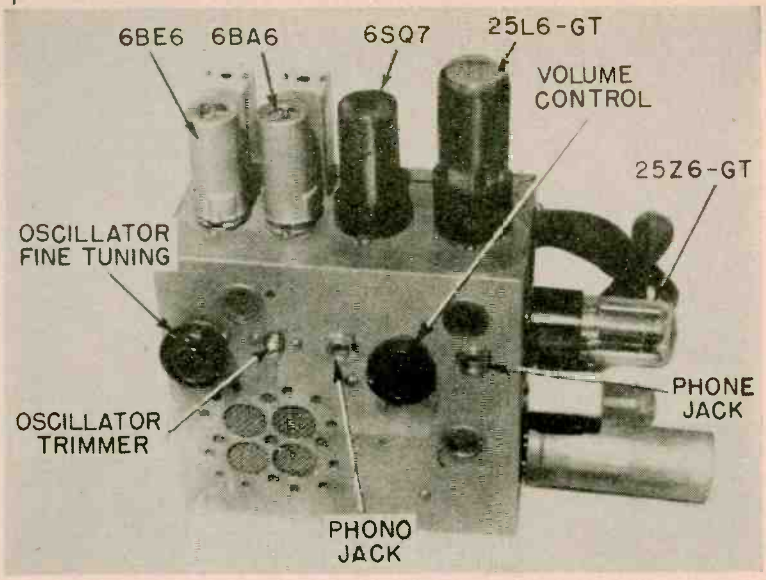
ABOUT NEW, FREE CBS-HYTRON TV GUIDE

Like the popular CBS-Hytron Miniature Guide, the new CBS-Hytron Reference Guide for Television Picture Tubes is *complete*. Gives all important data . . . as well as basing diagrams . . . for 164 types. Includes *all* magnetically deflected picture tubes . . . regardless of make. Also shows electrical interchangeability of similar types.

You need this complete . . . accurate . . . helpful Guide. Keep abreast of today's confusing variety of TV picture tubes. Get the new CBS-Hytron TV Guide now. It's *free*. At your CBS-Hytron jobber's. Or write direct today.

MANUFACTURERS OF RECEIVING TUBES SINCE 1921
HYTRON RADIO AND ELECTRONICS CO.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

DANVERS, MASSACHUSETTS



The ROK's layout was a forced blend of commercial parts and military salvage.

detector in the 6SQ7, which also furnishes a.v.c. voltage to the converter and the i.f. amplifier. The triode section of the 6SQ7 drives the 25L6 audio power amplifier. The rectifier is a 25Z6 with both sections tied together, and a choke is used rather than a resistor for better filtering. A closed-circuit jack (J1) was installed just in case we found a phonograph lying around. Another closed-circuit phone jack (J2) was wired in the grid circuit of the 25L6 for listening in with just a pair of high-impedance phones.

The combination chassis and cabinet was made from a salvaged 6 x 6 x 3-inch dynamotor box. As many parts as possible were mounted inside, including the 3-inch speaker. Since the B-minus bus goes to one side of the power line, *it was not connected directly to the metal chassis;* but is grounded for r.f. and audio through a .05-μf capacitor. The 270,000-ohm resistor across the capacitor allows the chassis to be used as a ground for voltage measurements with a v.t.v.m.

Since *Troubadour* was the only station that could be picked up 24 hours a day, the usual ganged tuning capacitor was replaced by two air trimmers—making it practically a one-station receiver. A 15-μμf air trimmer with a front-panel control knob was connected across the main oscillator-tuning capacitor to compensate for drift.

Materials for receiver

Resistors: 1—4.7 megohms, 1—2.2 megohms, 1—470,000 ohms, 2—270,000 ohms, 1—47,000 ohms, 1—22,000 ohms, 1—220 ohms, ½ watt; 1—150 ohms, 1 watt; 1—130 ohms, 20 watt (see text); 1—500,000-ohm potentiometer with on-off switch.

Capacitors: (Electrolytic) 2—20 μf, 150 volts, 1—50 μf, 50 volts. (Paper) 1—.05 μf, 1—.005 μf, 600 volts; 5—01 μf, 400 volts. (Mica or ceramic) 2—250, 1—47 μμf, 500 volts. (variable) 2— 100 μμf, 1—15 μμf.

Transformers: 1—2,000 ohms to 3.2 ohms a.f. output transformer; 1—455-kc input i.f. transformer, 1—455-kc output i.f. transformer; 1 broadcast type oscillator coil for 455-kc i.f.; 1 broadcast type loop antenna; 1—80 ma, 200-ohm, filter choke.

Miscellaneous: 1—3-inch PM speaker; 1—6BE6, 1—6BA6, 1—6SQ7, 1—25L6, 1—25Z6, or equivolent types (see text); 2—closed-circuit phone jacks; chassis; cabinet; 5 sockets to suit tubes; line cord, knobs, terminals, wire, solder, hardware.

(The 100-μμf trimmers are too small to reach the lower broadcast frequencies with a standard loop antenna and oscillator coil. If you want to be able to cover the whole broadcast band, use a standard 2-gang r.f.-oscillator tuning capacitor.—*Editor*)

The loop and its trimmer were mounted on the back cover, with the loop on the outside, supported by two 1-inch insulating spacers. END

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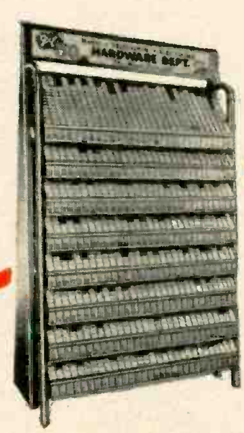

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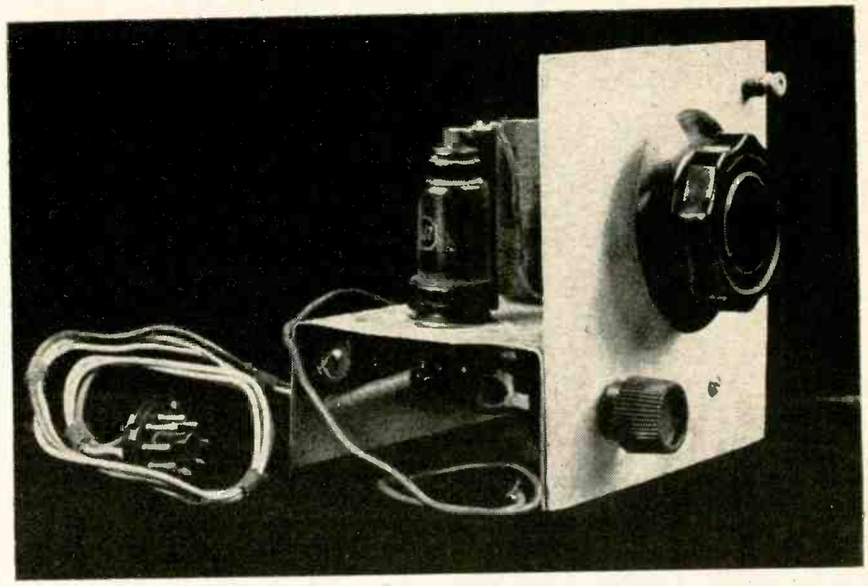

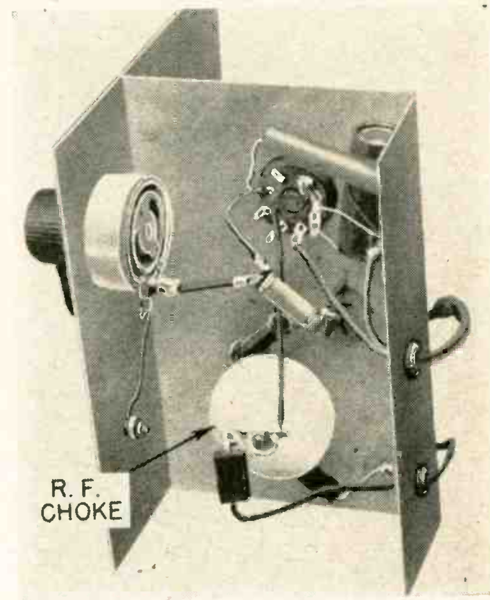

By JAMES L. FUGATE (W8UFF)

Top—The completed r.f. amplifier. The antenna coil is on top of the chassis, behind the tube. Cable and plug connect to power-supply socket on the receiver.
Right—Plenty of room underneath the amplifier chassis. The gain-control potentiometer and the r.f. choke are a bit oversize, but they both do the job very nicely.

DRIVEN to a lower frequency by TVI like many other class-B amateurs, I took one last, long, fond look at ten-meter phone, and headed for the tall masts and long wires of 160.

The r.f. section of my transmitter consists of an 807 final, driven by a 6L6 harmonic-crystal oscillator. The oscillator plate-tuning capacitor is 140 μμf. Having a 1¼-inch coil form and some No. 24 enameled wire in the shack, I wound 70 close-wound turns for a 160-meter plate coil. Since the oscillator plate current (not counting screen current) is only about 25 ma at resonance, with the oscillator loaded, I was able to use No. 24 wire and had ample room for the necessary number of turns.

The final stage presented more of a problem. The plate-capacitor tuning is only 50 μμf, which gave the right L-C ratio on the higher-frequency bands, but exactly the reverse of what I needed on 160. After considering the possibility of mounting an extra capacitor on the already overcrowded chassis, I finally decided on an outboard arrangement. The result was a 140-μμf tuning capacitor and a coil mounted on a piece of ¼-inch masonite and connected to the transmitter output-coil socket by an 18-inch length of 300-ohm ribbon line. The ribbon was soldered to the prongs of a discarded tube base. See Fig. 1. This combination worked so well that I gave up the idea of building a new output tank into the rig. Since I have had no complaints as far as TVI is concerned I saw no reason to shield it, and I eventually rebuilt it on a small chassis with the antenna coupler used for 160 and 80. The 160-meter final coil has 50 turns of No. 20 enameled wire close-wound on a 1½-inch form. The output link consists of 4 turns of No. 20 insulated wire over the cold end of the final coil. Whenever I decide to risk TVI on the high frequencies, I just unplug the outboard circuit, plug in the original coils, and away I go.

For a while it was fun just chewing the rag around town on the 1875–1900 kc band. Then I decided I wanted to work out-of-town stations too. After all, I moved down to the lower band to get away from the locals. With the rig tuned up, and the antenna loaded just fine, I was in business again.

The fellows I worked gave me fair reports for the power and antenna I was using, but I soon found out that my receiver, which is fine on the higher frequencies, was a very sad disappointment on this band.

Checking with other fellows locally and out of town, I found this was a common complaint on 160 meters, especially with medium- and low-price receivers. Most of these have a single r.f. stage or feed the antenna right into the mixer grid coil.

Most of the local fellows whose receivers had 2 r.f. stages seemed to be hearing and working stations consistently that I could find only with my b.f.o. turned on. With my eye on the high price of a new and better receiver, *versus* the low trade-in value of my 1947 model S-40, and my XYL's eye on the cost of groceries, I decided to give my receiver an r.f. stage.

After inventorying the junk around the shack, I found one 6K7 tube, one octal socket, ½-watt and 1-watt resistors of various values, a few bypass capacitors, one midget 100-μμf variable, and a 10,000-ohm wire-wound volume control. I also found a fiber coil form 1¼ inches in diameter, and an army surplus r.f. choke. Since I had only one tuning capacitor I decided to tune the amplifier grid and put the r.f. choke in the plate circuit. See Fig. 2.

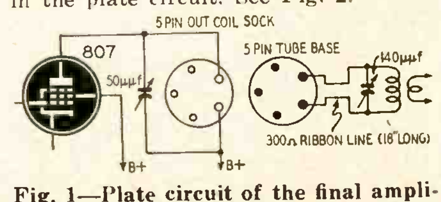

Fig. 1—Plate circuit of the final amplifier showing the outboard tank circuit.

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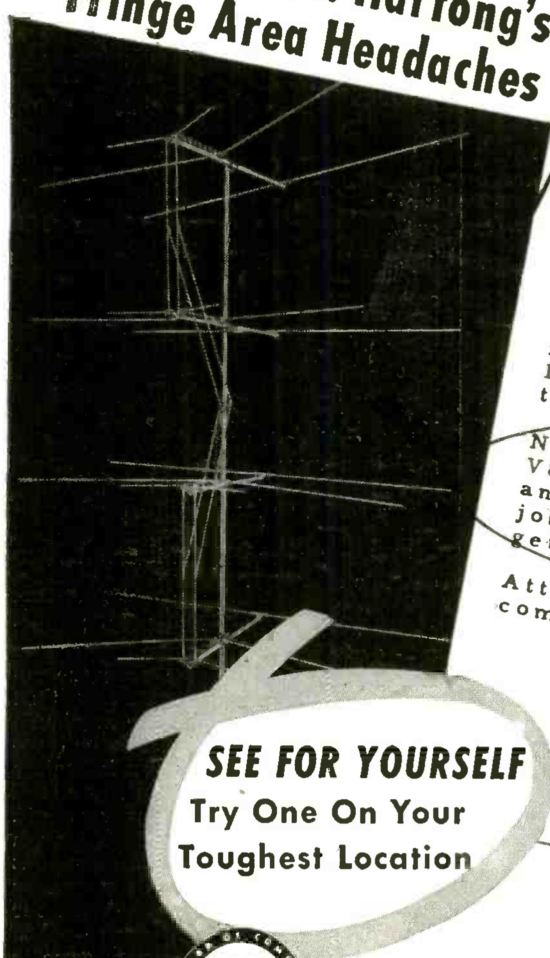
Now, we have finally found the answer in your V8 antenna. Servicemen tell us its the best antenna we have ever had. It really does the job because it pulls in stations we could not get before.

Here's How the new RADIART TELEVISION V★8 ANTENNA Solved Mr. Hartong's Fringe Area Headaches



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October 7, 1952

Dear Bill,

Just a word to let you know how we feel about your new V8 antenna.

As you know, our reception problem down here is difficult because of the fringe area position. Believe me, when I tell you almost everything that has come along has been tried.

Now, we have finally found the answer in your V8 antenna. Servicemen tell us its the best antenna we have ever had. It really does the job because it pulls in stations we could not get before.

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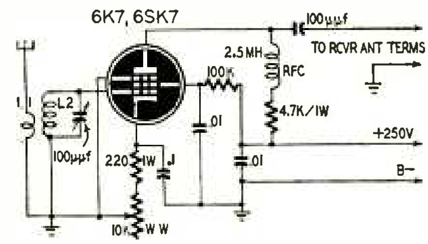
The antenna coil can be varied to change the selectivity and sensitivity. The number of turns and spacing of the grid winding are not critical as to frequency, but will change the coupling to the antenna.

The power supply in the receiver, if not already too heavily loaded, can supply the voltages for the outboard's r.f. stage. My receiver has a plug and socket for battery operation, which I rewired to bring out the voltages.

With only the receiver on, and with r.f. and audio gain all the way up, I tuned in a fixed station 40 miles away. He was talking to several mobile stations and was just barely loud enough to read.

Then I turned on the outboard stage, and with the same antenna, I could hear him the same with the receiver audio gain about half open. One mobile station was now perfectly readable with the audio ¾ open, where before I could just barely hear his carrier with the b.f.o. on and full audio gain.



L2=72T N°22 ENAM 1-1/4" DIA; L1=20T N°22 ENAM 1/2" BELOW L2
BOTH CLOSE WOUND

Fig. 2—The circuit of the simple r.f. amplifier stage for low-price receivers.

The r.f. stage provided much more gain than expected, so I didn't attempt tuning in the plate circuit. The increased gain is more noticeable in the daytime than at night.

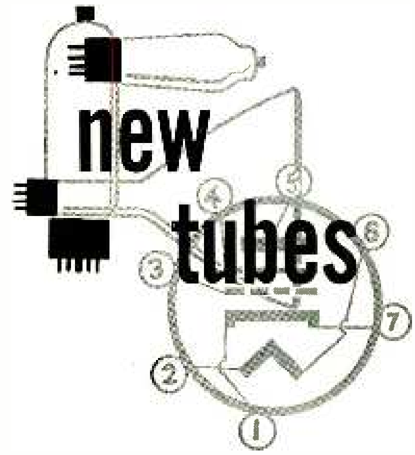
The potentiometer in the cathode circuit was originally provided to control regeneration if a tuned plate circuit was added, and the r.f. stage started oscillating. Although it doesn't mean much as an r.f. volume control, turning it down reduces heterodynes.

The grid coil, tuning capacitor, and grid lead were kept above the chassis, and all plate-circuit components below. There would be more gain with a small amount of coupling between plate and grid circuits, but I found it ample without this feedback.

Tuning is not critical. As a matter of fact, the tuning control can be just a 2- or 3-inch knob. I found no reason to calibrate it. I merely tune the receiver to the station first, and then adjust the r.f. tuning for maximum signal. When listening for a call the noise level can be used as an indication of resonance. Although the noise level is high, the signal gain is way over it.

Having just been transferred from a daytime job to an evening shift, this added stage enables me to hear stations in daylight which were too weak for profitable contacts before.

The higher-frequency bands seem to be good enough on my present receiver, so I haven't tried them with the r.f. stage, although I don't see why it couldn't be used with plug-in coils on any band. END



MINIATURE versions of high-transconductance metal pentodes are especially valuable as single-stage video amplifiers. With the same power ratings as their larger prototypes, the miniatures have smaller input and output capacitances, which can be used to extend the high-frequency response, increase the stage gain, or both. In addition, their smaller size and lower manufacturing cost make them ideal for TV-receiver applications.

The first of these was the 6AH6, a 7-pin miniature equivalent of the metal 6AC7. It has been used in many commercial TV sets, not only as a video amplifier, but also in i.f., sync, and horizontal a.f.c. circuits.

As a pentode, the 6AH6 has the following typical operating characteristics: Plate voltage, 300; suppressor voltage, 0; screen voltage, 150; cathode resistor, 150 ohms; plate resistance, 0.5 megohm (approx.); transconductance, 9,000 μmhos; plate current, 10 ma; screen current, 2.5 ma; grid 1 voltage for plate current of 10 μamp, -7 (approx.).

As a triode (suppressor and screen connected to plate): Plate voltage and cathode resistor same as for pentode operation; amplification factor, 40; plate resistance, 3,600 ohms (approx.); transconductance, 11,000 μmhos; plate current 12.5 ma. Basing of the 6AH6 is shown on the following page.

Two of the new miniature high-transconductance nine-pin pentodes.

One of the most recent, the RCA 6CL6, is a 9-pin miniature version of the 6AG7. This tube can give a voltage gain of 40 to 45, with peak-to-peak output of 132 volts, in a 4-mc-bandwidth video amplifier. The control grid and screen grid are each brought out to two base connections. This helps in laying out the chassis wiring for minimum stray input capacitance, and the shortest possible signal leads. The cathode and suppressor have separate pin connections. This allows the suppressor to be grounded in circuits where an unbypassed cathode resistor is used for degeneration. (If the suppressor and cathode were connected internally, the

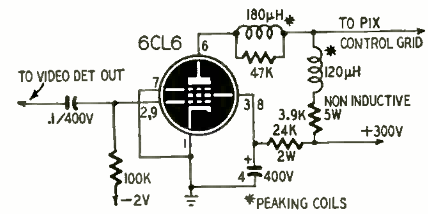


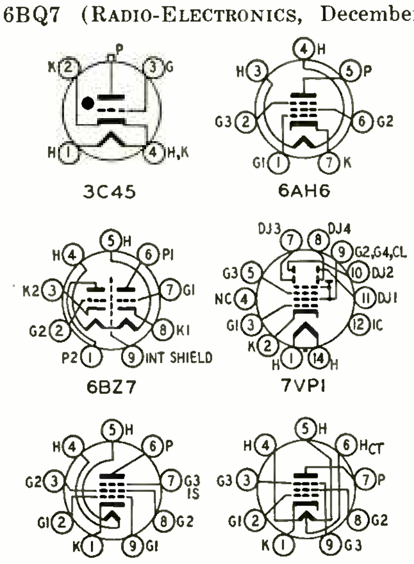
Fig. 1—A 4-mc 6CL6 video amplifier.

capacitance between plate and suppressor might feed a large fraction of the output signal back to the ungrounded cathode and set up oscillations.)

A typical 4-mc-bandwidth video-amplifier circuit suggested by RCA for the 6CL6 is given in Fig. 1. At the operating voltages shown, the zero-signal plate current is 30 ma, screen current 7 ma, input signal 3 v, and output signal 132 v, peak-to-peak. Heater rating is 6.3 v and 0.65 amp.

Another recently introduced 9-pin miniature, high G_m pentode is the CBS-Hytron 12BY7, used in some of the new Du Mont 17- and 21-inch receivers. Operating characteristics of the 12BY7 are: Plate voltage, 250; suppressor, connected to pin 1 at socket; screen voltage, 180; cathode resistor, 100 ohms; plate resistance, 110,000 ohms; transconductance, 12,000 µmhos; plate current, 24 ma; screen current, 5 ma; grid voltage for plate current of 20 µamp, -8. Base connections are given in the accompanying diagram.

The 6BZ7, a product of the Lansdale Tube Company, Lansdale, Pennsylvania, is a low-noise twin triode, designed specifically for cascode-amplifier service, and is used in recent Westinghouse receivers, and in the Philco "Golden-Grid" tuner. This tube is similar to the 6BQ7 (Radio-Electronics, December,



Basing diagrams of six new tube types.

1951) except for a higher transconductance of 8,000 μmhos. The 6BZ7 has a 6.3-volt, 0.4-amp heater, and each triode section has the following typical characteristics in class A operation: Plate voltage, 150; plate current, 10 ma; plate resistance, 5,600 ohms; transconductance, 6,000 μmhos; *cascode* transconductance, 8,000 μmhos; cathode resistor, 220 ohms; amplification factor, 38. Basing is shown in the accompanying diagram.

The new RCA 5726 twin diode is a "premium" version of the 6AL5, with a special vibration-proof internal structure for mobile and aircraft service. The especially rugged, pure tungsten heaters are connected in series, so that failure of either section will put both diodes out of operation. The 5726 also has slightly higher peak-voltage ratings than the 6AL5, but their general operating characteristics and basing are identical.

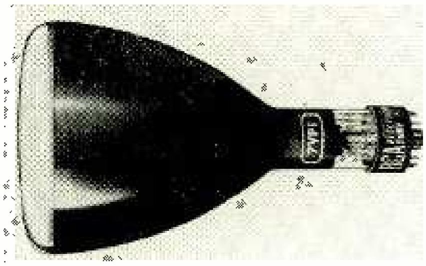
RCA has also announced the 12AX4-GT, a television damper tube with a 12.6-volt, 0.6-amp heater, for use in receivers with series-connected heater strings. Except for heater ratings, the 12AX4 is identical with the 6AX4 described in last month's RADIO-ELECTRONICS.

New oscilloscope tube

The RCA 7VP1 is a high-resolution, 7-inch cathode-ray tube with a medium-persistence green phosphor. Replacing the earlier 7JP1 (except for a lower ultor rating of 4,000 volts maximum), the new tube is designed to give an extremely fine, sharply focused trace for precision oscilloscope use. An improved gun design maintains constant focus over a wide range of brightness settings. Following are typical operating conditions for the 7VP1: Ultor voltage, 3,000; grid 3 (focus) voltage, 800 to 1,200; grid 1 voltage for extinction of undeflected focused spot, -84; deflection factors: DJ_1 and DJ_2, 93 to 123 volts d.c. per inch; DJ_3 and DJ_4, 75 to 102 volts d.c. per inch. Connections to the medium-shell diheptal base are shown in the accompanying diagram.

Transmitting tubes

The *Eimac* (Eitel-McCullough) 4W20000A is a radial-beam power tetrode suited for power-amplifier service up to 250 mc. As a class B linear amplifier in the output stage of a v.h.f. television transmitter, the 4W20000A can deliver a peak (sync-level) output of 20.1 kw at 216 mc. The coaxial structure of the tube, with radial contact fingers forming the connections to the internal elements, allows it to be used in resonant-cavity tank circuits. The thoriated-tungsten cathode is heated by *electron bombardment* from an internal filament. (The cathode and

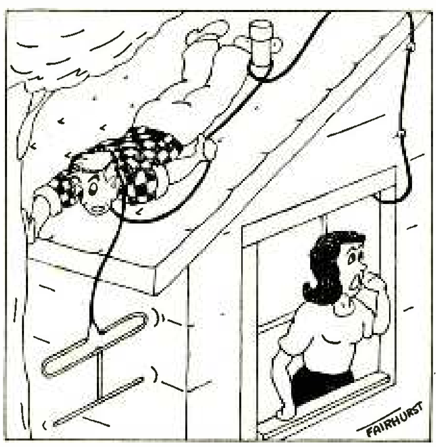


filament form a diode, with the cathode approximately 1,600 volts positive to the filament.) The anode has intake and outlet fittings for connection to the required water-cooling system. Control-grid, screen-grid, cathode, and filament contact areas require forced-air cooling.

Typical operating conditions for the 4W20000A as a class B linear amplifier in TV service, with a 5-mc bandwidth at 216 mc: Load impedance, 400 ohms; effective length of plate line, ¼ wave; plate voltage, 5,500; screen voltage, 1,200; grid voltage, -240; plate current, 7.1 amps; screen current (approx.) 500 ma; grid current (approx.) 140 ma; peak r.f. grid voltage, 430; driving power 1,500 watts (approx.); plate power input, 39.1 kw; plate dissipation, 16.5 kw; useful plate power output, 20.1 kw.

The RCA 3C45 is a hot-cathode, three-electrode hydrogen thyratron for pulsing u.h.f. oscillators at high repetition rates (radar service). At 2,000 ½-μsec pulses per second, the 3C45 can deliver a peak power output of 43,000 watts per pulse.

The 3C45 has a peak anode-voltage rating of 3,000 and a special slow-heating 6.3-volt, 2.3-amp indirectly heated cathode. END

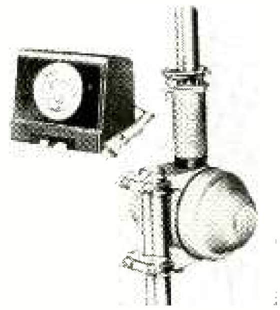


"Perfect, honey—leave it right there."

New Devices

CDR ROTOR

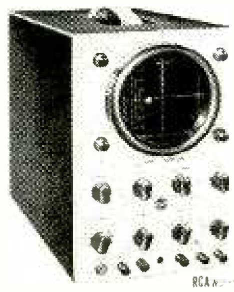
The Radiart Corp., 3571 W. 62nd St., Cleveland, Ohio, has designed a general-purpose antenna rotator, the CDR, which includes a modern cabinet with meter control dial and finger-tip control lever using 4-wire cable.



The motor features high torque, instant locking, and instantaneous reversal. It will fit all standard towers and take antenna masts up to 1½ inches outside diameter. It is marketed as model TR-11.

5-INCH SCOPE

The Tube Department of the RCA Victor Division, Radio Corp. of America, Harrison, N. J., has designed a 5-inch oscilloscope, the WO-88A. Included is a 10-megohm probe with an input capacitance of less than 10 μμf. The instrument provides virtually perfect square-wave response up to 50 kc. Controls for push-pull balance and astigmatism adjustment are outside the cabinet for operating convenience.

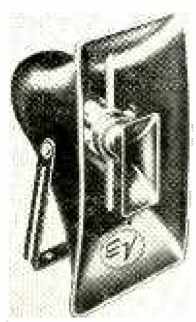


Engineering features include plus and minus sync; 60-cycle sweep and phasing; a shield around the C-R tube gun to minimize hum pickup; push-pull circuitry in both stages of the vertical amplifier to minimize line-bounce, and direct coupling to provide quick recovery time and a frequency response flat down to d.c.

The deflection sensitivity is 25 r.m.s. millivolts or better per inch; the unit has frequency response flat from d.c. to 500 kc within minus 3 db and within minus 10 db at 1 mc; and a sweep-circuit frequency of 15 c.p.s. to 30 kc in four ranges.

SPEAKER SYSTEM

Electro-Voice, Inc., Buchanan, Mich., has announced a new public-address speaker system, the CDP (compound diffraction projector), which uses two coaxially mounted diffraction horns working from both sides of a single diaphragm. Each projector is designed for optimum air loading and

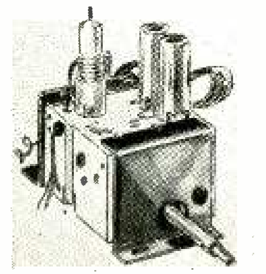


reproduction within its own range, to provide peak-free response ± 5db to 11,000 c.p.s. Low end response is augmented by 100-c.p.s. horn taper which insures at least one-half octave added bass over that possible from larger, conventional re-entrant-type projectors. Polar distribution pattern exceeds 120 degrees at all frequencies up to 10,000 cycles.

The model 848 CDP loudspeaker system is rated at 25 watts. Impedance is 16 ohms. Finished in gunmetal gray, it has two mounting positions for the hang-up bracket, and can be installed horizontally or vertically for augmented dispersion. The unit is 10½ inches wide at mouth, 20½ inches high at mouth, and 20 inches deep over-all.

TUNER BRACKETS

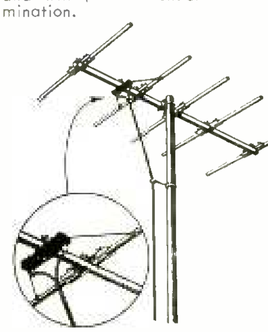
Vidaire Electronics Manufacturing Co., Lynbrook, L. I., N. Y., has added to its line bracket sets for Philco and



RCA TV tuners. The sets are cadmium plated. Electrical and mechanical installation instructions are included with each pair.

LOW-COST YAGIS

The LaPointe-Plascomold Corp., Rockville, Conn., has announced the new *Delta* line of low-cost five-, eight-, and twelve-element Yagis which incorporate a delta matching system. This delta match will replace the standard driven element of the Vee-D-X JC Yagi and will provide exact 300-ohm termination.

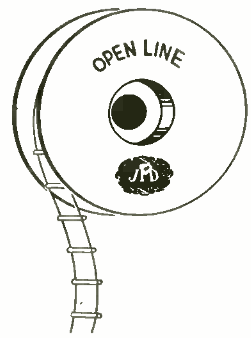


The Vee-D-X *Long John* and *Long Long John* Yagis will also be made with the delta match to lower the cost of these high-gain fringe-area antennas.

COPPER WIRE LEAD-IN

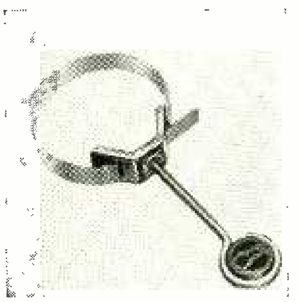
JFD Manufacturing Co., 6101 16th Ave., Brooklyn 4, N. Y., has introduced an all copper open-line lead-in wire with *Formvar* enamel for eliminating oxidation and corrosion from atmospheric conditions.

With polystrene insulators spaced at 6-inch intervals it cuts line loss to ⅙ the usual drop experienced with 300-ohm ribbon.



TV LEAD-IN INSULATOR

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 60, N. Y., is distributing a new mast standoff insulator with stainless steel strapping. The strapping is joined to the buckle with a stainless-steel rivet.



RMS has assigned model Nos. MC-3S and MC-7S to the new units, which are 3½ inches and 7 inches long respectively. Models DMC-3S and DMC-7S are dual type standoff insulators.

ANTENNA SELECTOR

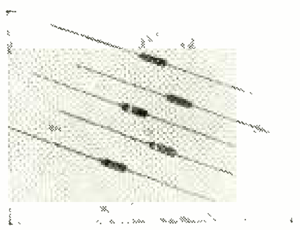
Technical Appliance Corp., Sherburne, N. Y., have designed a low-loss triple-circuit antenna switch for selection at the receiver of signals from any one of three antennas.

The unit is packaged ready for installation. It may also be used as a receiver selector in a television showroom by switching the signals from the antenna to any one of three receivers.

MOLDED CAPACITORS

International Resistance Co., 401 North Broad St., Philadelphia 8, Pa. is now producing a low value molded capacitor, type CAS. Designed to provide small values of capacitance with exceptionally high Q for its range, the capacitor is 13/32 inches long by 1/8 inch in diameter. It is being manufactured in standard values from 0.22 μμf to 2.2 μμf, ± 20% standard tolerance.

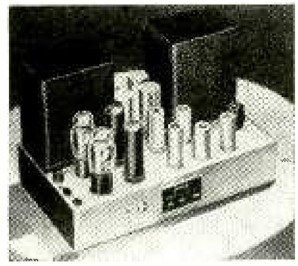
Molded in thermosetting material, and protected for applications requiring an insulated capacitor, the CAS meets JAN C-20A specifications for temperature coefficient and humidity.



HI-FI AMPLIFIER

Fisher Radio Corp., 41 E. 47th St., New York, N. Y., is the manufacturer of the new model 50-A laboratory-standard amplifier which features high output with extremely low distortion (.05% at 5 watts, .08% at 10 watts, and 0.3 at 40 watts). Intermodulation distortion—measured with 40 and 12,000 cycles at 4 to 1—is below 0.4% at 10 watts and less than 2.0% at 40 watts. Response is within 0.1 db from 20 to 20,000 cycles and within 1 db from 5 to 100,000 cycles. Hum and noise are better than 92 db below full output. Damping factor is 31 at the 16-ohm tap. Efficiency is better than 55% at full output as compared to 25-30% in typical class A amplifier circuits.

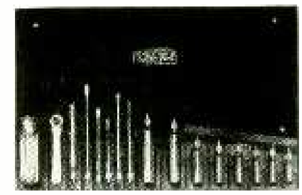
The model 50-A measures 8 x 14½ x 9 inches. It uses three 12AU7, two 6S4, two 1614, and two 5V4-G tubes. A meter jack and variable bias control are provided for balancing the plate currents of the output tubes.



TOOL KIT

Tele-Scopic Products Inc., 111 W. 42nd St., New York 36, N. Y., has announced a 17-unit radio-TV service-tool kit featuring slip-on deep-wall socket wrenches in eight sizes ranging from ¼-inch to 9/16-inch, enabling the service technician to remove nuts from volume controls with long shafts and screws with long studs.

The *Tele-Tool Kit* also features a ratchet wrench and an extension shaft for reaching screws and nuts in normally inaccessible places. Screwdriver blades and a handle are also provided.



MINIATURE MIKE

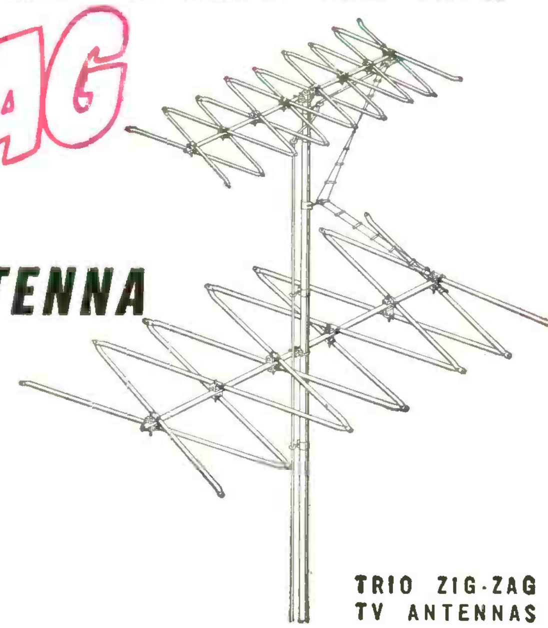
The Astatic Corp., Conneaut, Ohio, has released a miniature crystal microphone, model 54M3. The unit has an output of –51 db below 1 volt per microbar, and is nondirectional when mounted in its base. Recommended for

recorder, PA, conference, and other uses, its response (30 to 10,000 cycles) is flat to 1,000, rising gradually to 6,000 cycles. It is furnished with five feet of rubber-covered, single-conductor shielded cable and protector sleeve at microphone.

TERRIFIC ACCEPTANCE GREETS THE NEW TRIO ZIG-ZAG TV ANTENNA

SMASH HIT!

(Patent Pending)



The sensational new TRIO ZIG-ZAG TV ANTENNA has already proven its superiority in the field. Thousands of installations have given a new high in TV reception, especially in ultra-fringe areas. Word of mouth has done the rest. TRIO'S plant capacity, taxed to the limit in an effort to supply the amazing demand for the ZIG-ZAG ANTENNA series, is being greatly expanded. Very soon now, your ZIG-ZAG ANTENNA will be supplied, and it's well worth waiting for.

ZIG-ZAG ANTENNAS have replaced every known type of installation and TRIO is proud to report that in EVERY instance the ZIG-ZAG ANTENNA has out-performed them all, even the tried and true TRIO dual-channel yagi.

TV listeners are finding that with a ZIG-ZAG ANTENNA they are no longer tied down to just one or two channels, but are getting excellent reception on channels never seen before. ZIG-ZAG ANTENNA is truly HOT on all VHF channels.

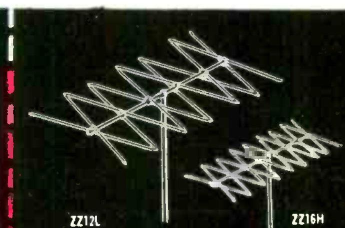
TRIO ZIG-ZAG TV ANTENNAS available in 8 different models, provide a new high in all-channel performance for any area, from metropolitan to ultra-fringe. Tremendous gain, sharp directivity, excellent match to 300 ohm line, sturdy vibration-proof construction and fast, easy installation tells the rest of the TRIO ZIG-ZAG ANTENNA story.

SEE THEM at your JOBBERS. WRITE for CATALOG.

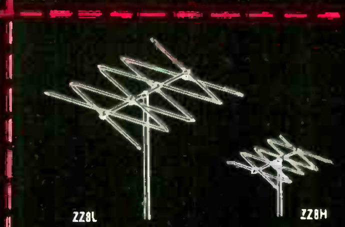
TRIO ROTATOR

A worthy companion to the ZIG-ZAG ANTENNA. Tested and proven under every conceivable condition of load, weather, strain and stress. Two motors, one for each rotation direction. Positive electrical stops prevent damage of over-rotation. Positive brake action, no drift even when supporting heavy arrays in 80 MPH winds. Precision built of finest materials and UNCONDITIONALLY GUARANTEED by TRIO for TWO YEARS. SMARTLY STYLED DIRECTION INDICATOR has easy to read dial face and easy to use finger touch control. A beautiful instrument you'll be proud to own.

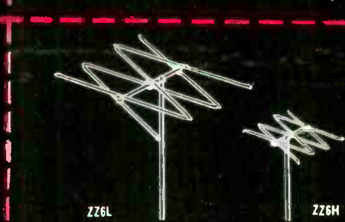
These ZIG-ZAG ANTENNAS provide the ultimate in extreme fringe area reception. ZZ12L provides 12-14 db. gain on Channels 2 thru 6. ZZ16H has a gain of 14 db. on Channels 7 thru 13. These antennas have very narrow forward lobe, high front to back ratio, provide high rejection in areas with co-channel interference.



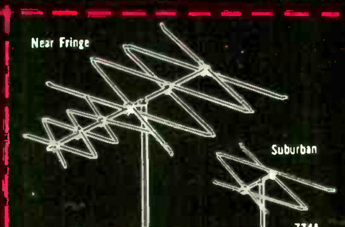
Where maximum gain is not necessary these normal fringe model ZIG-ZAG ANTENNAS are ideal. Model ZZ8L has a gain of 9 db. average on Channels 2 thru 6. The ZZ8H provides an 11 db. gain on Channels 7 thru 13. Forward lobe patterns comparable to good multi-element single channel yagi.



For near fringe area reception these ZIG-ZAG ANTENNA models provide 8-9 db. gains on all Channels 2 thru 13. ZZ6L covers Channels 2 thru 6 and Model ZZ5H covers Channels 7 thru 13. Both models have patterns similar to those of cut to channel yagis.



These ZIG-ZAG ANTENNAS provide ALL CHANNEL reception with only ONE antenna bay. Model ZZ6A is designed for near fringe area reception of all Channels 2 thru 13, with an average gain of 9 db. Model ZZ4A is for use in suburban areas, providing an average gain of 6 db. on all Channels 2 thru 13.

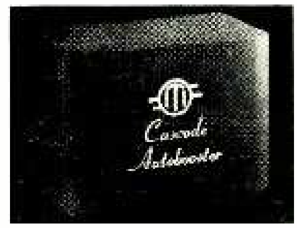


TRIO

TRIO MANUFACTURING COMPANY • GRIGGSVILLE, ILLINOIS

TV FRINGE BOOSTER

Industrial Televisión, Inc., 369 Lexington Ave., Clifton, N. J., has announced a new sub-fringe TV booster, the IT-90AB cascode autobooster, successor to the IT-90A. The unit provides a uniform gain of 26 db on the high band and 34 db on the low band. Noise factor is 7 db.

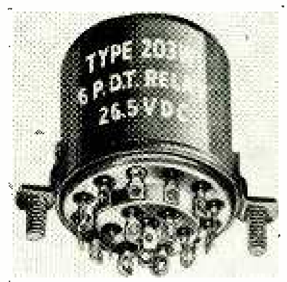


The IT-90AB has wide-band automatic tuning, on-off relay, separate high- and low-band inputs, independent gain controls for each band, and bypass switch.

D.C. RELAY

RCA Tube Department, Harrison, N. J., has announced a miniaturized d.c. relay for general use throughout the electrical systems of military aircraft. Hermetically sealed, this new type RCA-203W1 relay is a 6-pole, double-throw unit operating on 26.5 volts.

The miniaturized-type design features sturdy and compact construction, palladium contacts, moisture-free gas filling, and long operating life. It is designed to meet U.S. Air Force specification MIL-R-5757 and is engineered to provide long service under extremes of temperature, humidity, shock, vibration, and voltage variations. The relay weighs 3 ounces and can be operated in any position.

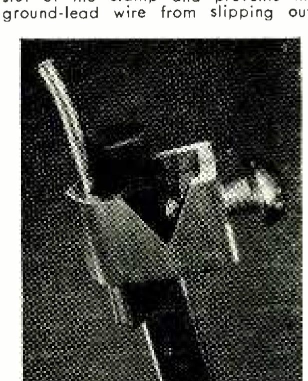


Its 6-pole, double-throw construction features palladium contacts rated to handle 2 amperes with a resistive load at 26.5 volts d.c., and 1 ampere with an inductive load at the same voltage. Contacts are arranged in a break-before-make sequence.

WIRE CLAMP

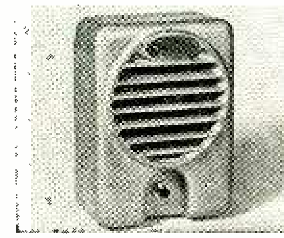
South River Metal Products Co., 377-399 Turnpike, South River, N. J., has announced a new ground rod with a special extruded aluminum wire clamp which will accommodate all ground-lead wire from No. 3 to No. 20 gauge.

The screw and nut fastening feature forces the wire to nest in the grooved slot of the clamp and prevents the ground-lead wire from slipping out.



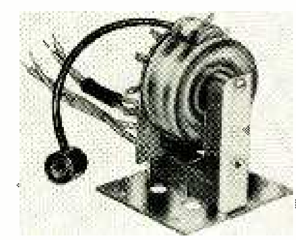
WEATHERPROOF INTERCOM

Cleveland Electronics, Inc., 6612 Euclid Ave., Cleveland 3, Ohio, has announced a weatherproof intercom station engineered for industrial users. Built around a 4-inch weatherproof speaker with a 45-ohm dustproof aluminum voice coil, the unit includes a talk-listen switch for two-way communication. The stations can be used with a suitable a.f. amplifier to form a complete intercom system. The unit is 4 inches by 6 inches by 4½ inches deep and weighs 2 pounds 2 ounces.



GREEN BAND LINE

Todd-Tran Corp., Mt. Vernon, N. Y., has announced the new *Green Band* line of cosine deflection yokes and flyback transformers. The deflection yokes

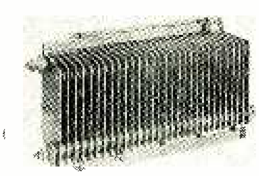


feature nylon segments for inter-coil insulation, high deflection sensitivity, good line and corner focus, coil balance to within one turn, compensated cosine design to minimize pincushioning, and ferrite cores.

Flyback transformers are constructed with the coil windings and connecting terminals completely vacuum-encased in a cast plastic dielectric so as to withstand very high voltages without flashover, corona, or breakdown. These transformers are particularly adaptable to large picture tubes requiring wide sweeps and high voltage.

SELENIUM RECTIFIER

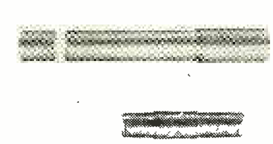
Federal Telephone and Radio Corp., Clifton, N. J., has developed a new selenium rectifier cell rated at 36 volts r.m.s. Because the individual cells are rated at 36 volts, a rectifier



stack made up of these cells not only will withstand a higher reverse voltage, but will require fewer cells for the same voltage output. Losses are proportionately less and the efficiency of the stack is considerably increased.

MAST SECTIONS

Snyder Manufacturing Co., 22nd and Ontario Sts., Philadelphia, Pa., has



added antenna-mast sections to their line. The MIO-X masts are self-coupling and rustproof. Each section is 10 feet long. END

All specifications given on these pages are from manufacturers' data.

CERTIFICATION PLAN

The National Alliance of Television and Electronic Service Associations (NATESA) has presented to all its members and correspondents a plan intended to create confidence in TV set owners. In brief, the plan would include inspection of any shops requesting such service and issuing certificates and emblems to those qualifying as approved by the industry.

The inspection committee would be selected from the local service association, distributors' organizations and the Better Business Bureau. They would consider such points as shop space and office facilities, test equipment, service data, parts stocks, insurance coverage, credit record, complaint record with the BBB and distributors, and manpower.

It was not indicated what weight was to be given to shop space and office facilities. Some bills introduced to regulate servicing have indicated that the framers considered shop space a positive factor and sought to impose a minimum. On the other hand, experience with bankruptcies in the worst days of the TV contract era indicated that financial stability and quality of service tended to drop with increases in shop and office size.

A plan was also proposed for training technicians, which would include refresher courses, clinics, and final certification for technicians who qualify. The entire industry, says NATESA, would be expected to publicize the course and recommend that only certified personnel be used by certified shops.

CHILDREN GET TV

A projector-type TV receiver and two new antennas were presented to the San Diego (California) Children's Convalescent Hospital by the San Diego Electronic Association. Members of the Association, which is composed of more than one hundred professional technicians in the electronic field, have made a long-term project of their assistance to crippled children. In addition to the new equipment, they have pledged complete installation and servicing of all television and radio sets for the entertainment of the handicapped youngsters.

THE NATESA CODE

A new service code of 16 items has been promulgated by NATESA. The text follows:

1. Employ qualified personnel to assure proper service. No student shall be passed off as a technician.
2. Make proper arrangements for the protection of reserve funds on contracts.
3. Carry adequate insurance coverage.
4. Avoid trick advertising which offers to service or deliver materials under conditions which are questionable or unfair to the set owner or your fellow members.
5. Employ approved methods of doing installations and maintenance.
6. Issue a standard guarantee.
7. Have available sufficient and proper test equipment to assure a good job.

8. Maintain an adequate service data library.
9. Render service no later than 24 hours.
10. Install only such parts and tubes as are really necessary. Use only new parts and tubes of a quality at least equal to original equipment.
11. Leave with or return to customer all parts and tubes replaced (except where impractical).
12. Issue an itemized bill.
13. Give estimates before major work is performed.
14. Service sets in home if possible.
15. Be honest, courteous, and treat each client in a professional manner.
16. Observe the Golden Rule.

NEW CEILINGS ON REPAIRS

The Radio-TV Service Industry Advisory Committee to the Office of Price Stabilization approved a proposed OPS order clamping stricter controls on service charges. When adopted, it will supplement regulation CPR 34. Ceiling-price lists filed with the local OPS office will have to be carried on all outside calls as well as posted conspicuously in the shop. Bills will have to show separate charges for materials and labor and list any used or second-grade parts used in the repair.

The heads of both national service associations, Max Liebowitz of NETSDA and Frank Moch of NATESA, are on the Committee. According to OPS, some committee members feel the new order is still not tough enough to weed out all service chiselers.

ARTSNY TRIES NEW PLAN

A contract of co-operation between The Associated Radio-Television Servicemen of New York (City) and Transvision, Incorporated, was signed at a meeting of the membership October 16.

Under the provisions of the contract, Transvision accepts the Code of Ethics of ARTSNY as its own, will assist in publicizing ARTSNY by advertising and in its mailings to service technicians, will offer Transvision distributorships in the New York metropolitan area to ARTSNY members exclusively. Transvision will submit all its new test-instrument designs to ARTSNY for test, and will carry the ARTSNY seal on all approved instruments.

In return, ARTSNY will assist Transvision in furthering its distributorship plan, and will supply Transvision with its membership lists to help circulate information on the plan. The Association will also publicize the plan among its members, at meetings and otherwise, and will report to affiliated and other service associations on the progress and status of co-operative action with Transvision. It will also assist Transvision in its relations with manufacturers and suppliers of parts.

The meeting, which was attended by approximately 100 members, was addressed by Herbert Suesholtz, Dave Gnessin, Elmer Andrews, and Jerry Williams of Transvision. The Transvision symposium covered organizational prospects and problems, test equipment, and service techniques. END

Watch for our Annual Television Issue, on the stands Dec. 26. Prospects and problems of the TV service technician in new TV areas will be discussed in articles by famous writers. U.h.f. articles and circuitry will be featured in the issue, as well as articles on many phases of TV and TV servicing, and directories of TV receivers, antennas, picture tubes, and components.
Don't fail to reserve your copy early!

LEARN PRACTICAL RADIO AT HOME!

COMPLETE, FOR ONLY $19^{95}

Build 15 Radios

Build a Professional Signal Tracer
Build a Code Oscillator
and Learn Code!

PROGRESSIVE

FREE! • ELECTRICAL AND RADIO TESTER • RADIO TELEVISION SERVICING LESSONS • BOOK ON TELEVISION • MEMBERSHIP IN RADIO-TELEVISION CLUB • ELECTRIC SOLDERING IRON • CONSULTATION SERVICE • QUIZZES

10-DAY MONEY BACK GUARANTEE

ABSOLUTELY NO PREVIOUS TRAINING NEEDED • FREE TOOLS • NO ADDITIONAL PARTS REQUIRED
YOU KEEP ALL PARTS, TOOLS, INSTRUCTIONS • AN EXCELLENT BACKGROUND FOR TELEVISION

LEARN TROUBLE SHOOTING . . . THEORY . . . WIRING . . . CODE!

WHAT THE NEW IMPROVED 1953 PROGRESSIVE RADIO "EDU-KIT" OFFERS YOU

The Progressive Radio "Edu-Kit" offers you a home study course at a rock bottom price. Our kit is designed to train Radio Technicians, with the basic facts of Radio Theory and Construction Practice expressed simply and clearly. You will gain a knowledge of basic Radio Principles involved in Radio Reception, Radio Transmission and Audio Amplification.

You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio circuit schematics; how to mount various radio parts; how to wire and solder in a professional manner. You will learn how to operate Receivers, Transmitters, and Audio Amplifiers. You will learn how to service and trouble-shoot radios. In brief, you will receive a basic education in Radio exactly like the kind you would expect to receive in a Radio Course costing several hundreds of dollars.

THE KIT FOR EVERYONE

The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The Kit has been used successfully by young and old in all parts of the world. It is not necessary that you have even the slightest background in science or radio.

The Progressive Radio "Edu-Kit" is used by many Radio Schools and Clubs in this country and abroad. It is used by the Veterans Administration for Vocational Guidance and Training.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. All parts are individually boxed. and identified by name, photograph and diagram. Every step involved in building these sets is carefully explained. You cannot make a mistake.

THE PROGRESSIVE RADIO "EDU-KIT" IS COMPLETE

You will receive every part necessary to build 15 different radio sets. This includes tubes, tube sockets, variable condensers, electrolytic condensers, mica condensers, paper condensers, resistors, tie strips, coils, tubing, hardware, etc. Every part that you need is included. In addition these parts are individually packaged, so that you can easily identify every item.

TROUBLE-SHOOTING LESSONS

Trouble-shooting and servicing lessons are included. You will be taught to recognize and repair troubles. While You are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge fees which will far exceed the cost of the Kit. Here is an opportunity for you to learn radio and have others pay for it. You build a professional Signal Tracer which alone, is worth more than the price of the complete Kit.

THE PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" comes complete with instructions. These instructions are arranged in a clear, simple and progressive manner. The theory of Radio Transmission, Radio Reception, Audio Amplification and Servicing by Signal Tracing is clearly explained. Every part is identified by photograph and diagram; you will learn the function and theory of every part used.

The Progressive Radio "Edu-Kit" uses the principle of "Learn By Doing." Therefore you will build radios to illustrate the principles which you learn. These radios are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced radio sets, and doing work like a professional Radio Technician. Altogether you will build fifteen radios, including Receivers, Amplifiers, Transmitters, Code Oscillator & Signal Tracer.

THE PUBLIC APPROVES!

COMMENTS FROM SATISFIED USERS OF THE PROGRESSIVE RADIO "EDU-KIT"

VETERANS ADMINISTRATION,
PHYSICAL MEDICINE REHABILITATION SERVICE,
WASHINGTON, D. C.

"This morning I was showing the Progressive Radio 'Edu-Kit' to one of our representatives from our Branch Office in Richmond, and already he wants me to purchase some for his hospitals . . . As indicated in previous correspondence. I took the Progressive Radio 'Edu-Kit' to our Veterans Administration Hospital at Fort Thomas, Kentucky. Both instructors and patients worked them, and they proved quite satisfactory."

ROBERT L. SHUFF,
1534 Monroe Ave., Huntington, W. Va.

"Thought I would drop you a few lines to say that I have bought a Progressive Radio 'Edu-Kit' and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and radio-phonographs. Friends were really surprised to see me get into the swing of it so quickly. The trouble-shooting tester that came with the kit is really swell, and finds the trouble if there is any to be found. Everything you say about your kit is true."

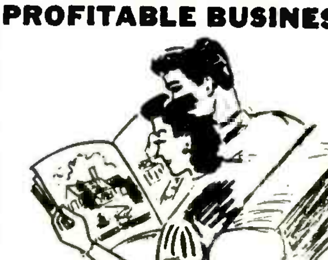
DOMINICK STRACUZZA,
111 Clarence St., London, Ontario.

"I am very satisfied with the Progressive Radio 'Edu-Kit' which I bought from you. I did not know anything about radio, but now I feel as though I have been in the radio business for years. Your kit is simple and educational. I enjoy working with it."

BECOME A RADIO AMATEUR

GET A WELL-PAYING JOB

GO INTO A PROFITABLE BUSINESS



Order your Progressive Radio "EDU-KIT" Today, or send for further information.
Postage prepaid on cash orders—C.O.D. orders accepted in U. S. A.

PROGRESSIVE ELECTRONICS CO.
497 UNION AVE., DEPT. RE-66 BROOKLYN 11, N. Y.

New Patents

SUBSCRIPTION TELEVISION

Patent No. 2,601,505
Alexander Ellett, River Forest, Ill.
(Assigned to Zenith Radio Corp.)

This TV system garbles film programs to prevent their being enjoyed by unauthorized persons. A decoding signal printed on the film is sent along an auxiliary channel, such as a telephone wire. Subscribers are linked to the transmitter by both channels. They alone receive normal pictures. The TV transmitter uses conventional circuits.

Some of the frames in the film are inverted. The received image is unrecognizable unless these upside-down frames are again inverted in some way.

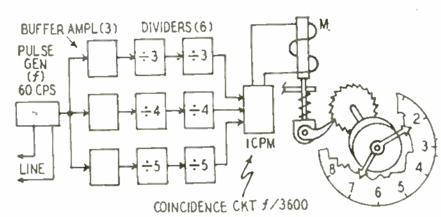
A decoding tone along the side of the film indicates an inverted frame. The tone is separated from its corresponding frame by an intermediate frame. For example, the first frame in the film carries the tone. It indicates that the third frame is upside down. Frame 3 also carries a tone, indicating that frame 5 will be inverted.

The decoding signal controls the vertical sweep at the receiver. Normally the sweep operates from the top of the picture to the bottom. In the presence of a decoding tone, the sweep voltage is reversed. It sweeps from bottom to top, inverting the inverted image so that the subscriber sees a normal picture.

FREQUENCY DIVIDER

Patent No. 2,602,140
Lyman R. Fink, Syracuse, N. Y.
(Assigned to General Electric Co.)

This system provides very large frequency stepdown ratios. For example, a 3,600 r.p.m. motor, using this divider, can drive the hour hand of a clock. This is a stepdown of 216,000:1. A quartz crystal can control a slow-moving mechanism like a stepping relay.



As shown, pulses of a given frequency (f) feed buffers in parallel. Each buffer is associated with a series of conventional frequency dividers, which may be multivibrators. In the example shown, the upper channel divides by 9, the middle channel by 16, and the lower channel by 25. These numbers are *prime* to each other. (None is divisible by either of the others.) For that reason, 9 x 16 x 25 (3600) pulses are delivered by the pulse generator before all three channels provide pulses which coincide. Only when 3 pulses arrive *simultaneously* does the coincidence circuit trip. Thus the coincidence circuit has a frequency f/3,600.

When the coincidence circuit trips, it energizes magnet M and a gear wheel is advanced by one tooth. If there are 60 teeth, an hour hand can be driven directly.

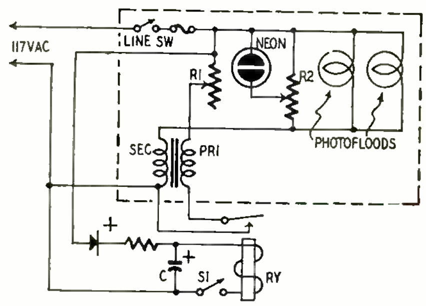
Note these important requirements. Each channel stepdown ratio must be *prime* to the others. Pulses taken from the channels must be sufficiently sharp so they do not coincide with the others except at the final pulse.

PHOTOFLOOD LIGHTING

Patent No. 2,609,523
Robert A. Stein and Lee S. Wasserman
(Assigned to Globe Industries, Inc., Dayton, Ohio)

Photoflood lamps are popular light sources for amateur and professional photography. They provide much light and have a life of several hours. Ordinarily, they are plugged into line sockets and turned on ahead of time. Thus the scene is properly lit when the picture is snapped. These lamps provide so much light that they may annoy the photographer and his subject during the preparatory stage. Besides, lamp life is shortened needlessly and there is considerable current drain (several amperes for each).

This invention avoids the above difficulties by preheating the lamps at low voltage. Thus the scene is illuminated normally while the subject is modeled. On opening the shutter, a supernormal voltage is applied simultaneously across the photofloods. In about .01 second the lamps reach peak brightness which is maintained for about 1/25 second. The lamps are energized briefly so lamp life is extended. Because of the supernormal voltage, very high illumination is obtained.



The camera shutter is synchronized with switch S1. When they are operated, the charge on C energizes the relay and the contacts are closed. Now line current flows through the primary and a high voltage is induced across the secondary of the transformer. The added power flashes the lamps briefly. As C discharges, the relay reopens and the lamps cool again.

Variable resistor R1 adjusts the high voltage across the lamps to the desired value. Tapped resistor R2 is adjusted so that the neon lamp may indicate when the voltage across the lamp equals the predetermined value.

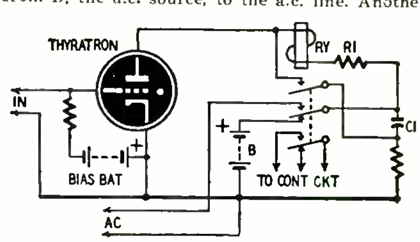
PULSE COUNTER

Patent No. 2,607,022
Paul N. Martin, Penn Township, Pa.
(Assigned to Westinghouse Air Brake Co.)

This thyratron counter operates from pulses of any width, where the pulse interval is relatively long. For example, trains can be counted or timed as they pass. The pulse width equals the time required for the train to pass a given point. A pulse is generated by a photocell (or other device) and fed into the counter each time a train passes. The counter registers *once* for each train passing a given point.

Conventional thyratron counters, using a.c. as the plate supply, are not suitable for this type of counting. When triggered by a very narrow pulse, the tube may conduct for less than 1/20 of a second. This is because the tube de-ionizes when its plates supply goes negative. This interval is too short to operate a mechanical indicator. On the other hand, a wide pulse turns the tube on and off 60 times a second, so the count may be incorrect.

This new circuit (see diagram) normally operates with d.c. on the thyratron plate. C1 is charged to the full supply voltage. When a pulse fires the tube, the plate relay picks up its 3 sets of contacts. One set switches the plate supply from B, the d.c. source, to the a.c. line. Another



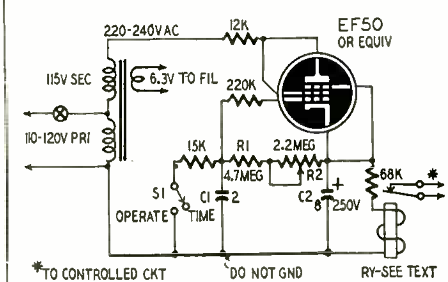
shunts C1 across both R1 and the relay. If the a.c. line makes the plate negative at the instant that the relay pulls in, the tube cuts off. C1 discharges through the relay and R1 so the relay will remain pulled in for a period somewhat longer than 1/60 of a second. When the plate becomes positive, the tube conducts. During conduction, C1 recharges to a value nearly equal to the peak a.c. line voltage, so it can again take over control of the relay during the next negative half-cycle of the a.c. line.

When the trigger pulse is removed from the grid, the grid bias takes control and the tube does not conduct during the next positive half-cycle. The relay remains pulled in until the discharge current of C1 drops to such a low value that the relay releases the armature. At this point, the back contacts reset the circuit for the next trigger pulse.

END

NOVEL ELECTRONIC TIMER

The average electronic timer described in this and other magazines usually has a maximum timing range of a little over 2 minutes. Longer-timed intervals are often desirable when the equipment is used to control electric motors, heat lamps, and other appliances. One timer designed for long periods was described in the article "Long-Period Radio Timer" in the August issue. Another circuit of this general type but of different design is reprinted here from *Radio Constructor* (London, England).



The original circuit uses a EF50 tube, but a 6AC7 or similar pentode may be used. To operate the timer, throw S1 to OPERATE and close the line switch. After the tube has warmed up, throw S1 to TIME. The tube operates as a half-wave rectifier which charges C2. As the voltage across C2 increases, a current flows through R1 and R2 to charge C1. The charge on C1 makes the grid more negative with respect to the cathode. This bias reduces the current through the tube and thereby reduces the charging rate of C2. The current through the relay increases as the charge on C2 increases. The contacts close when the relay current is slightly more than 1 ma.

The timing circuit consists of C1, R1, and R2. The values shown provide for a maximum time cycle of 5 minutes. The time can be increased to 15 minutes or more by using larger values for R1. R2 is the vernier time control. Its dial may be calibrated in minutes and fractions thereof. To cover a range of time cycles, R1 may be replaced by a tap switch and several fixed values offer selection to give the required range to R2. A telephone-type relay with a 40,000-ohm coil and contacts which close at about 1 ma was used in the original model. If you use a relay having a lower resistance but equal sensitivity, compensate for the lower resistance by increasing the value of the series resistor.

The unit is powered by a half-wave power transformer with the primary and high-voltage secondary connected in series aiding to give approximately 220–240 volts. C2 should be an oil-filled paper capacitor selected for a high internal resistance.

VIDEO COMPENSATOR

Simple combinations of resistance and capacitance can be used to improve picture detail in TV receivers which do not pass the higher video frequencies. However, it is quite a problem for the average service technician to find the right R-C combination.

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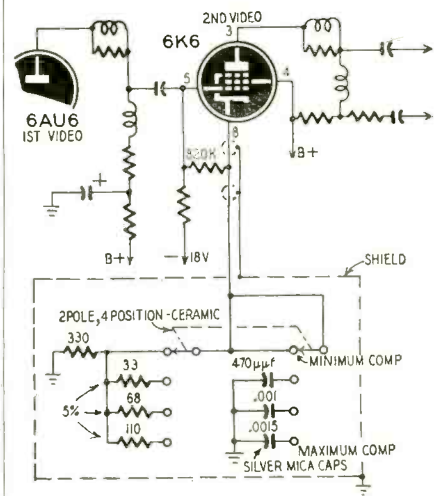
The schematic shows how a four-step video compensator can be added to the 630 and similar receivers. The ceramic rotary switch and all components must be shielded and located as close as possible to the video output stage to reduce stray circuit capacitance.

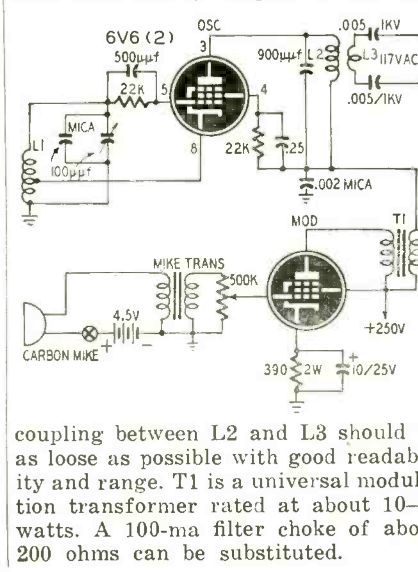


If the receiver to which compensation is to be added has the contrast control in the cathode of the video output stage, try switching different values of capacitance across it. The results will probably provide a pleasing surprise.—*Wilbur Hantz*

CARRIER-CURRENT RIG

This carrier-current transmitter is easy to construct and provides excellent communication within a radius of two or three blocks from the station. The transmitter uses a 6V6 variable-frequency oscillator modulated by a 6V6 driven from a carbon microphone. If greater output is required, use a 6L6 in the oscillator stage and raise the voltage to about 300.

L1 is a standard 2.5-mh r.f. choke tapped one-fourth the way up from the ground end. Plate coil L2 is 185 turns of No. 28 wire closewound on a ½-inch form. The plate circuit is fixed-tuned with a 900-μμf mica capacitor. L3 is 20 turns of No. 28 wire closewound on a ½-inch form loosely coupled to L2. The



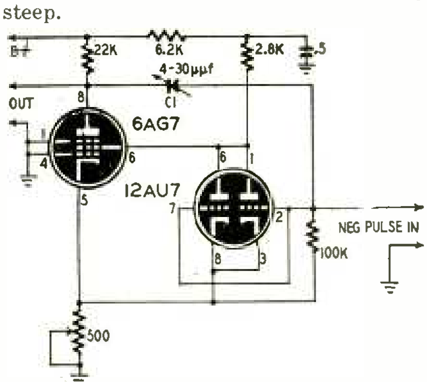
coupling between L2 and L3 should be as loose as possible with good readability and range. T1 is a universal modulation transformer rated at about 10–15 watts. A 100-ma filter choke of about 200 ohms can be substituted.

The transmitter operates at about 190 kc. We use Hallicrafters S-22R receivers for reception. The antenna terminals are connected to the power line through .005-μf, 1,000-volt transmitting-type mica capacitors.—*George R. Anglado*

[If the Hallicrafters S-22R receivers are not available for reception, you will probably find suitable substitutes on the surplus market. There are a number of marine, navigation, and aircraft receivers which cover the desired tuning range. Among these are: the BC-1206 (195 to 420 kc), the Navy's ADF model (15 to 1750 kc), Navy type ARB (195 kc to 9 mc), ARC-429A (200 to 400 and 2500 to 4700 kc), and the R-2/ARN-7 (200 to 1750 kc).—*Editor*]

SQUARE-WAVE DEVICE

This new multivibrator-type square-wave generator, described in U. S. patent No. 2,605,403 issued to Lawrence H. Crandon, provides output pulses whose amplitude is substantially equal to the supply voltage and whose rise and decay characteristics are very steep.

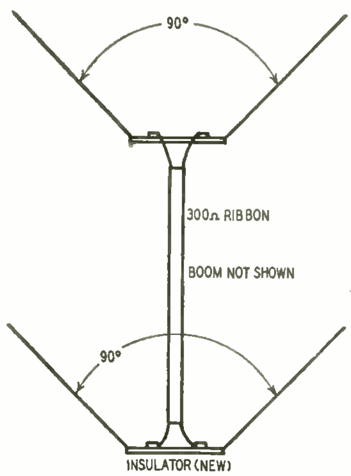


The diagram shows a practical circuit based on the patent. The 6AG7 is normally cut off and the triode is normally conducting. A negative pulse applied to the input terminal reduces the 12AU7 plate current and causes the plate voltage to rise. The decrease in plate current reduces the voltage drop across the cathode biasing resistor common to both tubes. The decrease in cathode bias makes the 6AG7 control and suppressor grids more positive (less negative) with respect to the cathode. At the same time, the increase in 12AU7 plate voltage has made the 6AG7 screen voltage more positive with respect to the cathode. The abrupt change in 6AG7 potentials causes it to conduct suddenly. Its plate current rises and makes the triode grid still more negative. This action is cumulative until the triode cuts off and the pentode is conducting heavily.

Coupling capacitor C1 begins to charge through the 100,000-ohm resistor, and the 12AU7 grid becomes more *positive*. This action continues until the triode again conducts. The triode plate current increases the drop across the cathode resistor and makes the 6AG7 control and suppressor grids more negative. Simultaneously, the drop in triode plate voltage makes the 6AG7 screen less positive. These changes continue until the 12AU7 is again fully conducting and the 6AG7 cut off. END

TV ANTENNA MODIFICATION

A great many of the older TV antennas consist of a dipole and reflector cut for channel 4 or 5. The bandwidth and the gain on the high channels can be greatly increased by converting them to double-vee types which provide a good match to 72- or 300-ohm transmission lines. You can use this same trick to improve some conicals.



Bend the radiator dipole forward so there is a 90° angle between the ¼-wavelength elements. The reflector is usually one solid length of tubing or two pieces joined by a metallic block. In the latter case, replace the metal block with a piece of heavy plastic or fiber of the same size. If solid tubing is used, cut it in the center and mount the two pieces on a block of insulating material with the two inside ends 2–3 inches apart. Bend the reflector elements forward so they form a 90° angle. Now, connect the reflector and radiator together with a piece of 300-ohm transmission line as shown in the drawing.

The lead-in can be connected to either member of the antenna. Better try both connections if you are troubled with ghosts.—*Hyman Herman*

MINIATURE PLUG-IN COIL FORMS

Miniature polystyrene plug-in coils are useful and efficient in u.h.f. circuits. Unfortunately, coils are hard to assemble on these forms because heat from a soldering iron softens the plastic and distorts the pin mountings before sufficient heat can be applied to form a good joint. You can make low-loss forms which solve the problem of soldering and are less expensive than commercial forms.

Obtain a length of ⅝-inch inside-diameter polystyrene tubing and cut it to the desired length. Fit an Amphenol miniature 4-prong chassis plug into one end of the tubing and use coil cement or screws to hold it in place. The plug-in coil form thus made fits a 4-contact miniature socket. Using bakelite in the base and socket causes slightly higher r.f. losses than an all-polystyrene form and socket, but does simplify soldering problems.—*I. Queen*

BANDSWITCHING COILS

Many experimenters and constructors claim that it is impossible to construct an efficient bandswitching superhet with homemade coils, without using a Q meter, grid-dip oscillator, and other laboratory type equipment. However, I find that almost anyone can do a good job of winding coils that track properly without using special equipment if he has the time and patience.

To avoid the seemingly endless job of soldering and unsoldering circuit leads each time I want to change the number of turns on a coil, I rig up a temporary plug-in circuit on the receiver. Sockets for plug-in coils are mounted on standoffs above the chassis, and five small holes are drilled in the chassis for leads.

When my experiments show that I have the correct number of turns and spacing for good tracking, I wind duplicate coils on forms of the same diameter and wire them permanently into the circuit. The coils are mounted in space reserved for them near the bandswitch. Completing the coils for all bands, I remove the coil sockets, leaving only a few small holes that are hardly noticeable when the job is completed. —*B. W. Welz*

NEAT PANEL MARKINGS

One of the most difficult problems in the construction of instruments and apparatus is providing neat, legible markings for controls. An excellent way of simulating expensive silk-screen printing, even on wrinkle-finish cabinets, is as follows:

Pencil in the desired legend; then carefully letter over this with photographic-album inks in white, yellow, etc. Allow the lettering to dry and then go over it as many times as necessary to get full rich colors. Shake the ink often to keep the solid pigments in solution. When finished, apply a coat of colorless fingernail polish or lacquer (thin coil cement will do) over the lettering.—*H. Zave*

(If your hand is as shaky and your lettering as poor as ours, you will be able to do a much better job of labeling a panel with Millen Panel Marking Transfers or Tekni-Cals marking decals.—*Editor*)

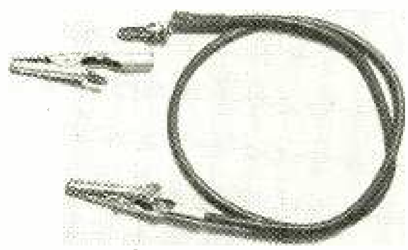
MORE HINTS ON WELLER IRONS

Weller and other similar quick-heating soldering irons are handy for removing metallic filings and chips from radio chassis.

When using irons of this type for *any* purpose, take care not to bring the tip too close to the magnets in meters, headphones, and other delicate instruments. There is a strong magnetic field around the tip of these irons when they are on. Failure to observe these precautions may demagnetize the magnets and affect the calibration and sensitivity of magnetic measuring instruments.—*O. C. Vidden*

HANDY CONNECTORS

Several pairs of connectors like those in the photo are handy for making experimental hookups, connections to test instruments, and temporarily substituting a good part in place of a defective one. A 2-inch alligator clip is placed on one end of a length of test lead wire



and a banana plug is placed on the other. This will plug into the end of another alligator clip or will fit banana jacks on test equipment. The size and types of jack and plugs and the length and color of test lead wire can be selected to meet individual requirements. —*R. Sandretto*

TV FRONT-END ALIGNMENT

Be careful when applying coil dope or other cements to lock adjustments of the front-end tuning slugs or capacitor screws. Leave the scope, sweep generator, and set operating when applying dope. Allow dope to dry before removing scope and the balance of the test equipment. Some cements contract slightly on drying and may alter the setting of the tuning slug or may run between the plates of the capacitor. The scope and sweep generator will show the slightest change in alignment as the dope dries so you can compensate for it before the settings are sealed tight.—*John Crouch*

MOUNTING TRANSFORMERS

When assembling radio and electronic equipment, it is common practice to mount half-shell and full-shell power transformers with the core and top shell above the chassis. This practice often increases the above-chassis height of the instrument and makes it necessary to use an unusually high cabinet.

To reduce above-chassis height, try mounting the transformer so its core is below the chassis and the top shell is above it. This reduces the above-chassis height of the transformer by the thickness of its core.

If the chassis is heavy steel, this method of mounting may eliminate some of the difficulties caused by the magnetic field around the core. The chassis serves as a shield which keeps the magnetic field below it so there is less likelihood of hum being induced in input transformers, cathode-ray tubes, and other hum-sensitive components.—

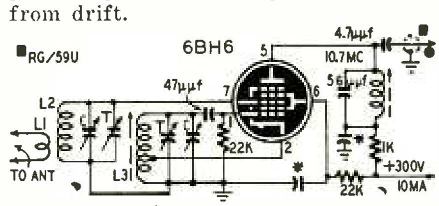
If the magnetic fields around the power transformer or filter choke cause hum voltages to be induced into sensitive circuits, try rotating the troublesome component to find the position where hum is minimized before mounting it permanently in position.—*John Sareda*

END

30-50 MEGACYCLE CONVERTER

? *Please print a diagram of a simple 30–50-mc front end that I can use ahead of a 10.7-mc i.f. strip.—E. J. U., Cleveland, Ohio*

A. The circuit of a 1-tube converter is shown. Its oscillator operates on the low side of the signal frequency to provide greater stability and freedom from drift.



C=25μμf; T=8-50μμf; *.01 DISC CERAMIC; ●TO 1ST IF AMPL GRID

A grid-dip meter should be used in adjusting the coils to cover the desired range. The oscillator tunes from 19 to 39.6 mc. The antenna circuit should tune from 29.7 to about 50.3 mc. L1 consists of 3 turns of No. 22 d.s.c. wire wound around the bottom end of L2. If you use a whip type antenna, omit L1 and use the R'9er type antenna input circuit shown in the converter described in the Question Box of the April, 1951, issue.

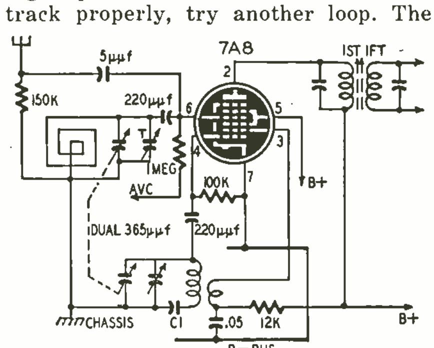
L2 consists of approximately 12 turns from a B & W type 3007 Miniductor. Cut it to about 16 turns and use a grid-dip meter to prune it to cover the desired range. L3 consists of 12 turns of No. 22 enameled wire wound on a National XR-50 or equivalent slug-tuned form and tapped 4 turns from the ground end.

Operating voltage for the converter can be obtained from the receiver or i.f. strip. The antenna and oscillator tuning capacitors may be a ganged 25-μμf unit if you have the equipment and patience to adjust the coils for good tracking. Otherwise, you can use separate controls with a vernier tuning dial on the oscillator control. The antenna tuning capacitor can then be used for peaking the signal.

PHILCO 49-901 CONVERSION

? *I have a Philco model 49-901 receiver that I would like to convert from push-bar to variable-capacitor tuning. If this is practical, please print a diagram showing the changes which must be made.—V. T., No address.*

A. The diagram shows the circuit of the converter stage arranged for continuous tuning. We are not sure that you will be able to use the present loop antenna with a standard 365-μμf tuning capacitor. If the circuit does not track properly, try another loop. The



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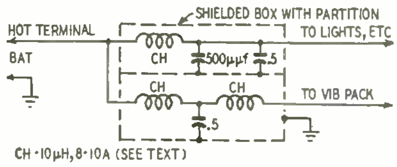
oscillator coil is a standard broadcast tuning unit designed for use with a 365-μμf tuning capacitor. The padder capacitor (C1) should be the value specified by the coil manufacturer.

The 100,000-ohm oscillator grid resistor seems a little high. If the oscillator blocks or does not function properly, change the grid resistor to about 50,000 ohms.

HASH IN POWER SUPPLY

? *My 10-watt marine radiotelephone unit is powered with a vibrator-type power supply delivering 350 volts at 200 ma. There is a lot of hash in the output. Will I have much trouble converting to a dynamotor-type supply? Will I have to add filters or can I use a Genemotor without alterations?—E. D. S., Scio, Ohio.*

A. Hash from vibrators and whine from dynamotors are two problems which must be licked in all battery-powered receiver, transmitter, and amplifier installations. If the equipment is not properly grounded and shielded, you are likely to have trouble regardless of the efficiency of the filters.



CH -10μH, 8-10A (SEE TEXT)

Your trouble may be caused by a defective rectifier tube or vibrator, or the buffer capacitor may be leaky or may have changed its value. Our suggestion is to give the vibrator pack and the radiotelephone unit a good overhauling before deciding to replace it with a dynamotor. You may find that the trouble is caused by a faulty component in the pack or the receiver or transmitter. If the batteries are used for lighting, ignition, or other purposes, you may find that a couple of simple filters will eliminate your trouble. The drawing shows the construction of the filters. The chokes should have an inductance of approximately 10 microhenries and should be rated at 8–10 amperes. The J. W. Miller type 5551 will do for lines where the drain does not exceed 8 amperes. The filter sections may be mounted in a metal box with a shield partition between them as shown, or they may be in separate shield cans. The shields should be well grounded.

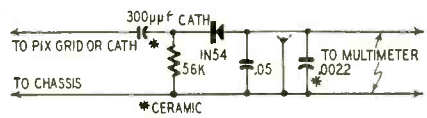
Some dynamotors now on the market are available without any form of filtering. Others have B supply filters but no filters in the low-voltage supply circuit. Others are completely shielded and filtered so that they can be used with almost any existing equipment without modifications. A unit that is shielded and fully filtered is probably the best bet unless the transmitter-receiver unit has a good built-in filter network.

TV ANTENNA MODIFICATIONS

? *TV station WSAZ-TV in Huntington, West Virginia has been shifted from channel 5 to channel 3. How can*

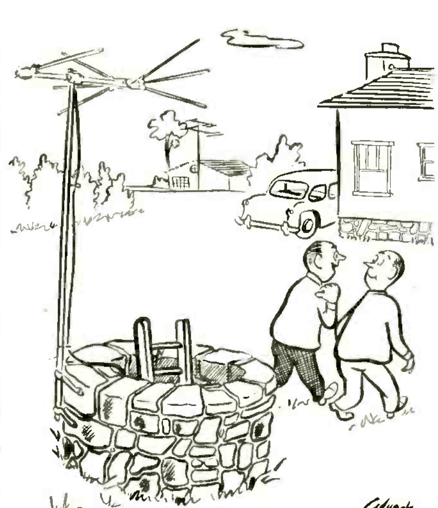
I modify a channel-5 Yagi to work on the new frequency?—E. J. Burdine, Ky.

A. If your antenna is one of the broad-band Yagis, it may perform satisfactorily on channel 3. If it is a single-channel job, its elements should be lengthened. You can use short lengths of aluminum tubing which slip into or over the ends of the present elements. The folded dipole can be lengthened by cutting off the ends and inserting extensions made from tight-fitting aluminum plugs or tubing into the sections of the dipole. The new lengths of the reflector, radiator, and first, second, and third directors (in inches) may be found by dividing 5,208, 5,256, 5,304, 5,544, and 5,880, respectively, by the frequency of the low end of the TV channel to be received. For channel 3, divide by 60 mc.



The bandwidth, gain, front-to-back ratio, and impedance of a Yagi depend on the lengths of the individual elements and the spacing between them. The antenna will probably work satisfactorily with the present interelement spacing. However, if you want to perform some interesting experiments, you can lengthen the boom (crosspiece) and experiment with the spacing and length of the elements.

For extensive experiments, you should have some form of field-strength meter to indicate the effect of minor changes in the antenna. If you have a multimeter which reads 50 or 100 μa full scale—most 20,000-ohms-per-volt multimeters do—you can use it with the adapter shown in the diagram. The meter reads the video signal applied to the grid or cathode of the picture tube. Do not connect the adapter to a receiver which has a hot chassis. Use a large 600-volt blocking capacitor in series with the lead which connects to the chassis. END



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6AG5	.64	.59
6AG7M	1.24	1.19
6AH6	.99	.94
6AK5	.89	.84
6AL5	.49	.39
6AQ5	.49	.44
6AQ6	.69	.64
6AR5	.59	.59
6AR6	2.49	2.29
6AS5	.69	.64
6AT6	.49	.39
6AU6	.49	.44
6AV6	.49	.39
6AX4GT	.69	.64
6AX5GT	.79	.74
6BA6	.49	.44
6BC5	.69	.64
6BD5GT	1.19	1.09
6BD6	.59	.54
6BE6	.49	.44
6BF5	.69	.64

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6BJ6	.69	.59
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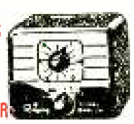
6BL7GT	1.19	1.09
6BN6	1.19	1.09
6BQ6GT	.89	.79
6BQ7	.99	.89
6C4	.49	.39
6C5GT	.49	.44
6C6	.49	.44
6CB6	.54	.49
6CD6G	1.59	1.49
6E5	.79	.74
6F6GT	.64	.59
6H6	.69	.59
6J5GT	.49	.44
6J6	.69	.64
6K6GT	.64	.59
6L6G	1.29	1.19
6L6GA	1.29	1.19
6S4	.49	.44
6S8GT	.89	.79
6SA7GT	.69	.64
6SC7	.99	.89

	Each, lots of 1 to 24	Each, lots of 25 and up
6SD7GT	.79	.74
6SG7	.89	.84
6SH7	.79	.74
6SJ7GT	.69	.64
6SK7GT	.59	.49
6SL7GT	.69	.64
6SN7GT	.59	.54
6SQ7GT	.69	.59
6SR7	.79	.69
6T8	.79	.74
6U4GT	.69	.59
6U5	.79	.69
6U8	.89	.79
6V3	1.59	1.49
6V6GT	.49	.44
6W4GT	.49	.44
6W6GT	.79	.74
6X4	.49	.39
6X5GT	.49	.44
6Y6G	.89	.79
7A4	.69	.64
7A8	.89	.84
7B6	.59	.54
7B7	.89	.84
7C6	.89	.84

	Each, lots of 1 to 24	Each, lots of 25 and up
7C7	.89	.84
7L7	.99	.94
7N7	.79	.74
7X7	.79	.74
12A8GT	.49	.44
12AL5	.49	.44
12AT6	.49	.44
12AT7	.79	.69
12AU6	.49	.44
12AU7	.59	.54
12AV6	.59	.54
12AV7	.69	.64
12AX4GT	.69	.64
12AX7	.59	.54
12AZ7	1.09	1.04
12BA6	.49	.44
12BA7	.99	.89
12BD6	.59	.54
12BE6	.49	.44
12BH7	.79	.74
12J5GT	.59	.54
12Q7GT	.69	.64
12SA7GT	.79	.74
12SK7GT	.79	.69
12SN7GT	.79	.74

	Each, lots of 1 to 24	Each, lots of 25 and up
12SQ7GT	.69	.64
12S8GT	.49	.44
14A7	.99	.94
14B6	.79	.74
14Q7	.99	.99
19BG6G	1.39	1.29
19T8	.99	.89
25BQ6GT	.79	.74
25L6GT	.59	.49
25W4GT	.59	.49
25Z5	.49	.44
25Z6GT	.69	.64
35B5	.54	.49
35C5	.54	.49
35L6GT	.69	.69
35W4	.49	.39
35Y4	.74	.69
35Z5GT	.49	.44
50B5	.54	.49
50C5	.54	.49
50L6GT	.59	.54
80	.59	.54
117L7GT	1.29	1.19
117Z3	.49	.39
807	1.79	1.69
FM-1000	.89	.84



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Model DB-410

While present stocks last! **$14.95**

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Exact repl. for L72A, 82A ... **$1.95**

CRYSTAL PICKUPS

Complete

Webster N-7 ... **$1.95**
Astatic L71A ... **$2.60**
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Famous Make Vol. Controls Reduced

Flat shaft, SPST switch, indiv. boxed. 5M, 10M, 100M, 250M. Your Choice, each ...... 35¢

Kit of 4 controls, 1 each of above **$1.25**

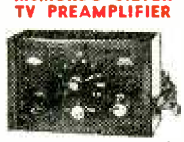
TV VARIABLE CONTROLS

Pix & Sound, 10M ohms, 1 Meg W/SPST switch ..$.79

Vert. & Horiz.

50M ohms, 1 Meg **$.69**
Focus & Bright, 50M ohms, 2250 Ohms.. **$.59**
Kit of 3 (1 ea.)... **$1.98**
Kit of 6 (2 ea.)... **$3.89**

McMURDO SILVER TV PREAMPLIFIER



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All PM speakers have Alnico V slugs.

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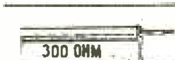
4" PM 1.0 oz.	1.39
5" PM 1.0 oz.	1.39
6" PM 1.0 oz.	1.79
4"x6" PM 1 oz. ...	1.49
5"x7" PM 1.47 oz.	1.89
6"x9" PM 3.16 oz. with heavy duty output transformer	2.99
8" PM 2.15 oz. ...	3.69
10" PM 6.8 oz. (extra heavy) ..	5.95
12" PM 3.2 oz. ...	4.95
AUTO RADIO SPEAKER 7¼" PM	3.95



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$ 1.49 per C ft.

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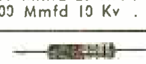
Unit price in lots of ten or more assorted, shown.

Mfd	WVDC	Each
16	150	$.29
24	150	.35
30	150	.35
40	150	.39
20X20	150	.39
20X40	150	.39
30X30	150	.44
40X40	150	.45
50X30	150	.45
8	450	.29
8X8	450	.49
16	450	.39
30	450	.44
40	450	.49

TUBULAR ELECTROLYTIC KITS

Fine assortment, popular types for radio, TV service.
10 condensers.... $1.49
25 condensers.... $3.69

"DOOR-KNOB" CERAMIC
Hi-Voltage
500 Mmfd 20 Kv. . .59
500 Mmfd 10 Kv . .29



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¼ & ½ Watt, Kit of 100 Asstd..... $2.25
½ Watt A-B & IRC, separated, in plastic container, 20 popular sizes **$4.85**

CAN TYPE CONDENSERS

Separate Leads. 450 V. Working.

Mfd	Size	Net
8	1⅜x3	.59
12	1⅜x3	.65
16	1⅜x3	.69
20	1⅜x3	.79
30	1⅜x3	.89
40	1⅜x3	1.05
8-8	1⅜x4	.75
8-16	1⅜x4	.89
16-16	1½x4	1.05
20-20	1½x4	1.19
8-8-8	1½x4	1.05

5% off, lots of 50 asstd.

TUBULAR PAPER BYPASS CONDENSER KITS

100 Asstd, 400 WV **$4.95**
100 Asstd, 600 WV **$5.95**

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63° RCA 205D1 .. **$ .99**
70° Type 206D1 .. **2.99**
60° Type 201D1 .. **2.49**

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Permanent Magnets.
Single, 203D1 .. **$.39**
Double, 203D3 .. **$.69**

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TRANS., for 16", 17" Pix Tubes **$2.99**

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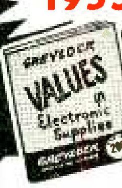
Famous Make, all BRAND NEW, FRESH STOCK. 130 V DC Input.

Ma.	Net.
75	.64
100	.69
150	.79
200	1.25
250	1.25
350	1.59
450	1.79

GERMANIUM CRYSTAL DIODE
Sylvania 1N34A .... 79¢

GREYLOCK 1953 CATALOG



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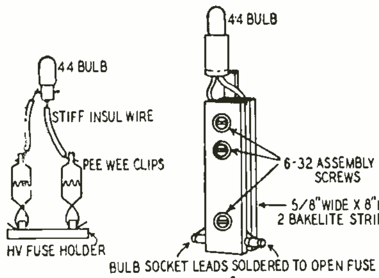
WATCH FOR OUR JANUARY TELEVISION NUMBER

TV LINEARITY ADJUSTMENT

Service manuals on recent Sentinel TV sets state that horizontal linearity can be adjusted accurately and rapidly without relying on a bar generator or a station test pattern. Simply replace the fuse in the high-voltage cage with a 150-ma d.c. meter and adjust the linearity control until *minimum* current is obtained.



a *b*

A recent *Sentinel Service Bulletin* describes a modification of this method used by Marvin Miller, of Springfield, Ohio. Mr. Miller uses a No. 44 pilot lamp and two clip leads assembled as shown at *a* in the drawing. The lamp substitutes for the meter in the original system.

The linearity control is adjusted for *minimum* glow. The drawing at *b* shows an adaptation of this device recommended by Sentinel. This tool snaps into the fuse holder. It is made from two 8 x ⅝-inch strips of bakelite with a pilot lamp holder at one end and an open fuse at the other. This raises the lamp above the edge of the cage for easier viewing.

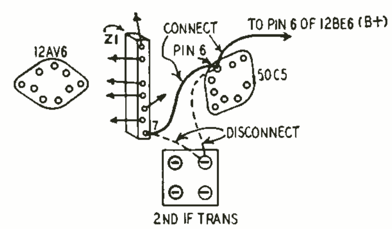
REPLACING BROKEN C-R TUBE BASES

When it is necessary to replace a broken base on the picture tube proceed as follows:

1. Remove the broken base by unsoldering all the pins, being careful not to damage the wires.
2. Straighten and form the wires so the new base can be easily placed on them.
3. Apply a coat of speaker cement to the glass neck of the tube and to the inside of the new base.
4. Place the new base on the tube, making certain that each wire is inside its proper pin. Hold the socket in place until the cement dries sufficiently hard to permit soldering the pins.—*Crosley Service Dept.*

WESTINGHOUSE V-2157-5 CHASSIS

Motorboating in the H-355T5 and H-356T5 models may be eliminated by a slight rearrangement of the wiring. The dashed lines in the diagram show leads to be disconnected and the heavy solid lines show the leads after modification. To make the change proceed as follows:



1. Remove the wire between pin 6 of the 50C5 and the second i.f. transformer. 2. Disconnect lead 7 of the capacitor-resistor assembly Z1 from the i.f. transformer and connect it to pin 6 on the socket of the 50C5. 3. Connect an insulated lead between pin 6 of the 50C5 socket and pin 6 of the 12BE6 socket.

These changes have been made in later production runs of these models.
—*Westinghouse Service Notes*

CHEVROLET MODEL 986515

These sets are often very difficult to remove from the car because they are mounted so close to the air-flow heater and its controls. Sometimes service technicians have to remove the heater leg to get the set out.

I have discovered that by dropping the set down just enough to permit removal of the dial escutcheon, dial pointer, and dial-lamp holder, the set can then be pulled with ease. The dial parts are held in place by six No. 8 hex screws. Removing these parts does not constitute unnecessary work because they must be removed before any bench work can be done on this particular set.
—*Richard D. J. Lytwyn*

AUTO-RADIO SERVICE HINTS

Very often we find capacitors, resistors, and other components which have broken loose because of vibration. After making the repair, we use Scotch tape to secure the new part to the chassis or other component. This prevents vibration from causing future failures of this nature.—*Floyd A. Roberts* END

AMPERITE

Studio Microphones at P.A. Prices

Ideal for BROADCASTING RECORDING PUBLIC ADDRESS

"The ultimate in microphone quality," says Evan Rushing, sound engineer of the Hotel New Yorker.

- *Shout right into the new Amperite Microphone—or stand 2 feet away—reproduction is always perfect.*
- *Not affected by any climatic conditions.*
- *Guaranteed to withstand severe "knocking around."*

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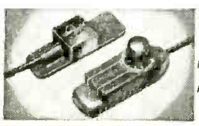
RBHG—Hi-imp.
List $42.00



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Model KKH, list $18.00

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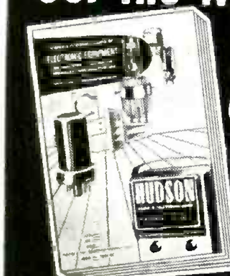

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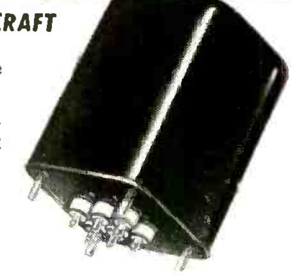

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The HP3-140 unit is just one of the many "specials" in the CHICAGO New Equipment Line in stock at HUDSON. The complete range of CHICAGO Sealed-in-Steel Transformers for every modern circuit application always in stock at Hudson for prompt delivery.

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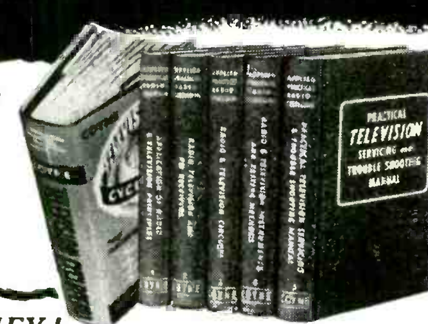

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People

Julius Haber, director of advertising and sales promotion for RCA technical products, was advanced to the position of director of public relations for the RCA Victor Division. Haber, associated with RCA since 1922, has devoted his entire business career to public relations, publicity, and advertising activities in electronics.


J. Haber

L. E. Cotsen was appointed manager of renewal sales for TUNG-SOL ELECTRIC, INC., Newark, N. J. He was formerly manager of the Eastern Division sales office. Walter R. Ohlsen, previously a salesman in the Eastern Division, was advanced to the post vacated by Cotsen.


L. E. Cotsen

Richard A. Norman was appointed manager of manufacturing for the GENERAL ELECTRIC Cathode-Ray Tube operations at Electronics Park, Syracuse, N. Y. He was formerly superintendent of subminiature tube manufacturing at the G-E Owensboro, Ky., tube works.


R. A. Norman

Thomas H. Moss joined the TURNER Co., Cedar Rapids, Iowa, as assistant sales manager. He comes to the company from the Harper Brush Works where he was sales and advertising manager. Moss will assist sales manager H. M. Murdock in all phases of the recently expanded sales program on Turner microphones and TV boosters.


T. H. Moss

John H. Adams was appointed assistant sales manager of the ROLA CO., INC., a division of the Muter Co., Cleveland. Adams has had wide experience in engineering in the radio field and has handled both Rola and Muter products since 1946 as a direct factory man. In his new position he will discontinue all activity for the Muter Co. and concentrate his efforts exclusively on products of the Rola division.


J. H. Adams

Personnel Notes

. . . **Dr. E. F. W. Alexanderson**, noted radio pioneer, who retired recently from the General Electric Co., which he joined in 1902, has been appointed consultant for the RADIO CORPORATION OF AMERICA. He had previously served as chief engineer of RCA from 1920 to 1924. Dr. Alexanderson, who received the IRE Medal of Honor in 1919 for his invention of the Alexanderson alternator, is a Fellow and former president of the IRE, a Fellow of the American Institute of Electrical Engineers, and has been awarded many other scientific and academic honors for his contributions to electricity, radio, and electronics.

Dr. E. F. W. Alexanderson

. . . **Earl Kirk** was promoted to the position of distributor sales manager of I.D.E.A., INC., Indianapolis, manufacturer of Regency boosters and converters; and Edward Sheridan, formerly with the RCA Victor Engineering Products Division, joined the company as industrial sales manager.

. . . **Donald MacGregor**, formerly a vice-president with Zenith Radio, joined WEBSTER-CHICAGO as president, succeeding R. F. Blash, who was elected chairman of the board.

. . . **Victor Welge** joined P. R. MALLORY & Co., INC., Indianapolis, as associate director of engineering. He was formerly with Consolidated Vultee Aircraft Corp.

. . . **William M. Jones** was named division manager of the Electronics Division of THOMPSON PRODUCTS, INC., Cleveland. F. J. Weihmiller is sales manager.

. . . **R. J. Yeranko**, MAGNAVOX Co., was reappointed chairman of the RTMA Service Committee.

. . . **Dr. Sidney J. Stein** was promoted to director of research for the INTERNATIONAL RESISTANCE Co., Philadelphia. He was also appointed to the company's Operating Committee.

. . . **Henry Taylor** was promoted to assistant to the director of research for AEROVOX CORP., New Bedford, Mass. Peter P. Grad, formerly with the Borden Co., joined Aerovox as technical director, and Rex Nicholson, previously with Sangamo Electric Co., joined the company as research engineer.

. . . **Anton C. Fisher** was appointed sales and advertising manager for "Fretline" TV antennas, chimney mounts, and towers manufactured by FRETCO, INC., Pittsburgh.

. . . **Mort Leslie** was promoted to assistant sales manager of the JFD MANUFACTURING Co., Brooklyn, N. Y.

. . . **A. H. Schenkel** continues as director and president of UTAH RADIO PRODUCTS Co., Huntington, Ind., and vice-president of Newport Steel, after a recent company election. Other members of the Board of Directors of Utah Radio Products include: F. S. Gibson, Jr., chairman; B. A. Mitchell, William J. Mericka, and George H. Roderick. END

THE FUND'S RISE ENCOURAGING

HELP-FREDDIE-WALK FUND

It is most heartening to record the continued response to our appeal for contributions to "help Freddie walk." Freddie, as most of our readers now know, is the four-year-old son of Herschel Thomason, radio technician of Magnolia, Arkansas, and he has been without arms and legs since birth. Through the generosity of hundreds of readers, individually and in groups, the Help-Freddie-Walk Fund has grown to over $10,000, and it is this aid which has helped make it possible for doctors to fit little Freddie with artificial legs, thus starting him on the way to becoming a useful and contributing citizen.

We would like to take this opportunity to make special mention of the following donations:

$31.00 from the military, civilian, and contractor-technician personnel of the Communications and Electronics Engineering Division, Far East Air Logistic Force, Japan.

$16.00 from the Purchasing Department of the United Motor Service division of General Motors Corp., Detroit, Michigan.

$20.00 from John Abney and G. P. Handytin, Beirut, Lebanon.

$1.21 from De Marco's Radio Shop, New Haven, Connecticut.

$15.00 from the Staff, Committee on Electronics, Research and Development Board, Washington, D. C.

$1.00 from Roscoe D. Conklin, Rahway, New Jersey, whose father is paralyzed and bedridden, whose brother is seriously ill with cancer of the jaw, and who knows "what heartaches are."

But our work is just beginning, for it is obvious that before Freddie reaches full maturity the mechanical appliances upon which he will always depend will have to be altered or changed completely time and time again.

Donations to this worthy cause are therefore urgently requested; no amount is too small to receive an acknowledgment and the sincere thanks of both RADIO-ELECTRONICS and Mr. and Mrs. Thomason. *Make all checks, money orders, etc., payable to Herschel Thomason.* Address all letters to:

HELP-FREDDIE-WALK FUND
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New York 7, N. Y.

FAMILY CIRCLE CONTRIBUTIONS

Balance as of September 19, 1952	$ 561.50
Edith Trainor, West Hempstead, L. I., N. Y.	10.00
FAMILY CIRCLE Contributions as of October 20, 1952	$ 571.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of September 19, 1952	$ 9,443.26
A. C., Los Angeles, California	1.00
John Abney and G. P. Handytin, Beirut, Lebanon	20.00
Anonymous, Juneau, Alaska	10.00
Anonymous, Lafayette, Indiana	1.00

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Staff, Committee on Electronics, Research and Development Board, Washington, D. C.	15.00
RADIO-ELECTRONICS Contributions as of October 20, 1952	$ 9,571.47
FAMILY CIRCLE Contributions ...	571.50
TOTAL CONTRIBUTIONS as of October 20, 1952	$10,142.97

MINE DETECTOR, M.D.

Mine detector outdoes X-ray. According to an item in the Montreal *Daily Star*, hospital X-rays failed to find a piece of metal imbedded in a man's arm. The injured man, Charles Hooper of Yorkton, Saskatchewan, turned to friends in the City Works Dept., who pinpointed the fragment with a mine detector used for locating buried sewer connections. Subsequent X-rays proved the mine detector right.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

December 1918 ELECTRICAL EXPERIMENTER

Wireless Around the World, by H. Gernsback
Harvard Hails the Naval Radio Man
A Rotary Quenched Spark Gap, by Francis R. Pray
A High Note Buzzer, by George F. Harrington
Radio Around the World
A Clever Wireless Practice Set, by T. G. Grantham
A Perforated Tape Code Teacher, by A. E. Hersee
An Imitation "Stage" Radio, by G. B. Pennebaker

END

SCHOLARSHIPS HELP, TOO

Dear Editor:

I read your comment on Mr. Richards' letter in the October issue with considerable amazement, and wonder if you have considered *scholarships*. I studied in the "expensive" East—at Amherst—and tuition, room, board, books, and fees ran to around $1,100 to $1,200 a year. Scholarships that pay up to $600 a year are available. I suppose an engineering school like M.I.T. costs more, but anyone who can maintain a B average and really needs the money should be able to qualify for enough scholarship funds to keep the cost down to $1,000 a year.

If you are interested in a scholarship, apply as early as possible to the school itself, or see your high-school principal, your minister, your local newspaper (if you ever had a paper route), or any of the large fraternal organizations like the American Legion, Masons, or Odd Fellows. They may either have scholarships available, or know where you can apply for them.

IRVING L. CHIDSEY

Aberdeen, Md.

(According to the American Schools & Colleges Association, the current cost of a full school year at Massachusetts Institute of Technology is $1,775. This includes tuition, books, fees, room and board, and insurance. In addition to the private organizations mentioned in Mr. Chidsey's letter, many states offer full or partial scholarships, based on either your school record or competitive examinations. *Editor*)

WHAT'S YOUR IDEA?

Dear Editor:

My item "Unusual Servicing Problem" on page 79 of the August issue posed the question: "How can a bad tube produce sounds and symptoms exactly like those created by a worn volume control, with these sounds audible only when the volume control slider is moved?" The volume control in this case was *not* defective.

Mr. Milton M. Schuman of Baltimore, a service technician since the "'20's," writes me that he has found this condition at times, and that it was caused by a loose tube element—usually the

"Are you sure it's a radar set we've had installed?"

OPPORTUNITY AD-LETS

control grid. When the loose grid touches the screen "you get an awful racket," says my correspondent. This is usually started by vibrations from the speaker at high volume levels.

It sounds logical. And coming from an older, wiser, more experienced technician than myself, I'm inclined to accept this explanation. Does anyone have a better answer?

J. D. AMOROSE

Richmond, Va.

Mr. Amorose's Tech-Note in the August issue concerning a defective tube that gave the effect of a bad volume control reminded me of a similar experience. Turning the control past the first third of the arc would cause a muffled scraping sound, with a thump and an erratic shift in volume at full rotation. There was also too much hum.

The volume control was replaced, but with absolutely no change in results. A rather elaborate three-circuit compensator of the feedback type had been connected to the high end of the control. When this was disconnected, the noise disappeared and the hum level went down.

After many unsuccessful attempts to cure the trouble, the entire compensator unit was finally placed in a shield can with the leads brought out through shielded wire. All shielding was grounded, of course. No certain explanation was ever figured out, but this cured the trouble completely, even when the original volume control was re-installed.

R. C. SANDISON

Denver, Colo.

I read with a great deal of interest Joseph Ambrose's mystery problem "Unusual Servicing Trouble" in the August issue. It appears to me that he had a gassy 6F5, which was making the grid go positive. The gas current flowing in the grid circuit shifted the bias and varied the volume erratically from high to low.

GEORGE P. OBERTO

Richmond, Va.

"H'lo—Acme Distributors—say about that booster I called in for yesterday.—"

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. All literature offers void after six months.

VIBRATOR DATA

A guide giving the type number of James Vibrapowr vibrators designed for direct replacement in approximately 70 different models of mobile communications receivers and transmitters made by 13 of the leading communications equipment manufacturers. Also available is a 4-page bulletin, *Using Your Oscilloscope in Vibrator Maintenance.* It gives details on adjusting the scope, setting up the vibrator for testing, and on analyzing waveforms to determine the condition of the vibrator.

Available free of charge from The James Vibrapowr Co., 4036 N. Rockwell St., Chicago 18, Ill.

NEW CAPACITOR CATALOG

Catalog No. 1117 is a 7-page bulletin describing the *Stabelex-D* capacitors made by Industrial Condenser Corp. The new capacitor type is characterized by extremely high insulation resistance and Q, very low dielectric absorption, losses, and power factor, and low temperature coefficient. The long time-constant (200 days for a 10-μf capacitor) makes these units highly applicable for use in computing and timing devices where information must be stored for extended periods.

Copies of catalog 1117 can be obtained without charge from Industrial Condenser Corp., 3243 N. California Ave., Chicago 18, Ill.

HIGH-FIDELITY BROCHURE

A 20-page booklet with sections on selecting loudspeakers, how to lister to a loudspeaker demonstration, selecting enclosures, and similar valuable information for the layman has been released by Jensen Mfg. Co. The catalog pages consolidate Jensen's high-fidelity speakers, 2-way system components and cabinets. New items of interest include a triplex 3-way complete reproducer in a back-loading folded-horn cabinet, 3-way system components, and a 12-inch compression-driver coaxial.

Request brochure 1020 from the Jensen Manufacturing Co., 6601 S. Laramie, Chicago, Ill.

DATA BOOK AND CATALOG

The new 42 page 1952 edition of the *Wheelco Data Book and Catalog* is now available. It contains prices, application recommendations and pertinent information concerning instrument sensing units and associated accessories.

Special items are resistance bulbs and wells, radiation (heat) detectors, special thermocouples for plastic injection and extrusion machines, and a molten metal thermocouple for ferrous metals. Essential data pertaining to thermocouples, wire sizes and resistances, and temperature-millivolt curves make this manual useful in applying indicating, controlling, and recording instruments.

Copies of Bulletin TC 9 gratis upon request from Wheelco Instruments Division, Barber-Colman Co., Rockford, Ill.

CAPACITOR CATALOGS

Pyramid Electric Co., manufacturer of capacitors, announces the publication of four new catalogs. Specifications, construction and engineering data, sizes, and prices are featured.

Catalog PG-1 lists miniature Glasseal capacitor types PGH, PGM, and PGX. These tubular paper units function at temperatures ranging from −55° to + 125° C.

Catalog IMP-1 describes molded-plastic tubular capacitors, impervious to moisture and withstanding a temperature of 100° C.

Catalog MP-2 gives detailed information on ultra-compact metallized-paper types. Minimum size and weight and self-healing qualities are characteristic of these units.

Catalog J-7 is a 32-page compilation of paper, electrolytic, oil-paper, and metallized paper capacitors.

Free copies are available on letterhead request to Pyramid Electric Co., 1445 Hudson Blvd., N. Bergen, N. J.

TACO ANTENNA CATALOGS

Three new catalogs have just been issued on the Taco line of antennas and accessories. Catalog No. 37 is a 6-page bulletin illustrating and describing unidirectional and omnidirectional FM antennas and all-band noise-reducing and master antenna systems for AM and FM.

Catalog No. 38 covers the complete line of Taco TV antennas, boosters, and hardware. Catalog No. 39 covers the Tacoplex amplified distribution systems for apartment-house, community, and store installations. Included are channel converters which change a high-band signal to a low-band frequency to reduce circuit losses, signal separators for isolating low-band signals and feeding them to separate r.f. amplifier strips or boosters, mixer units, hardware, and accessories.

Copies of these catalogs can be obtained free of charge by writing to Technical Appliance Corp., Sherburne, N. Y. In Canada, write to Stromberg Carlson Ltd., Toronto 4, Ont.

HAMMARLUND CAPACITORS

Hammarlund's new catalog No. 52 describes the firm's present line of variable capacitors for amateur, commercial, and industrial applications. Each type of capacitor is illustrated by photographs and detailed engineering drawings.

Available free of charge from Hammarlund Manufacturing Co., Inc., 460 W. 34th St., New York, N. Y. END

RADIO ASTRONOMY, by Bernard Lovell and J. A. Clegg. Published by John Wiley & Sons, Ltd., 440 Fourth Ave., New York, N. Y. 5½ x 7½ inches, 238 pages. Price $4.00.

Professor Lovell is already known to readers of this magazine through his article, "Radar Tracks Shooting Stars" in the July, 1951, issue. Five chapters of this book are devoted to the study of meteors by radio-echo techniques. The velocity of a number of meteor groups has been verified, at least two new daylight meteor showers have been discovered, and important studies on the orbits of meteor streams have done much to solve the question as to whether they are of solar-system or interstellar origin.

Other important work described by Professor Lovell includes the study of radio waves from the sun, from our own star system, and from points outside it. Four chapters are devoted to the signals received from our galaxy.

The aurora borealis, the moon, planets, and the zodiacal light are all discussed in connection with radio (and in some cases radar) investigations, and the possible results to be gained are estimated.

To make reading easier for the person who is neither an astronomer nor a radio technician, there are introductory chapters on fundamental astronomy and the transmission and reception of electromagnetic waves. Though an amateur astronomer may have some trouble comprehending the chapter on radio transmission and reception, the electronic technician will have little trouble with those on elementary astronomy, and will be able to follow the radio and radar techniques without any difficulty at all.—*FS*

RAPID TROUBLE SHOOTING AND ALIGNMENT by Harry G. Cisin. Published by H. G. Cisin, 200 Clinton St., Brooklyn 2, N. Y. 8½ x 11 inches, 69 pages. Price $2.00.

This practical book can aid TV service in many ways. Section 1 lists many troubles and shows possible causes. They are given on a combined picture-raster-sound basis. For example, certain troubles may cause abnormalities in all of these. Therefore we have three different clues to help localize the defect.

Each condition of picture, raster, and sound is given a symbol. These are combined in three-symbol *codes*, as in the author's earlier *Radio Doctor*. To discover a trouble, the technician looks up the symbol for each of the conditions, combines them into a code, and turns to the section under that code heading.

Section 2 gives useful data on rapid alignment. It contains hints on the use and connection of scopes, VTVM's and sweep generators. Section 3 includes a short description of the installation and service of u.h.f antennas and tuners. Section 4 is especially valuable. It shows how to make many rapid checks. For example, there is information on testing for relative sensitivity, sync signal strength, damper potentials, crystal diodes, and others.—*IQ*

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY
Page 129

Radio-Electronics does not assume responsibility for any errors appearing in above Index.

MOST-OFTEN-NEEDED 1952 RADIO DIAGRAMS AND SERVICING INFORMATION (Volume 12), compiled by M. N. Beitman. Published by Supreme Publications, 3727 W. 13th St., Chicago, Ill. $8\frac{1}{4}$ x $10\frac{1}{2}$ inches, 168 pages. Price $2.50.

Diagrams, detailed alignment procedures, parts lists, socket-voltage and resistance tables, trouble-shooting hints, and other pertinent servicing data is supplied on nearly 500 different auto radios, AM and FM receivers, record changers and players, and intercom units made by 34 manufacturers during 1952. In addition to the obvious usefulness to radio service technicians, the books in the Most-Often-Needed series are useful references for students and engineers interested in studying and comparing circuits of modern receivers and allied equipment.—*RFS*

END

STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) of RADIO-ELECTRONICS, published monthly at Philadelphia, Pa., for October 1, 1952.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Gernsback Publications, Inc., 25 West Broadway, New York 7, N. Y.; Editor, Hugo Gernsback, 25 West Broadway, New York 7, N. Y.; Managing Editor, Fred Shunaman, 25 West Broadway, New York 7, N. Y. Business Manager, none.

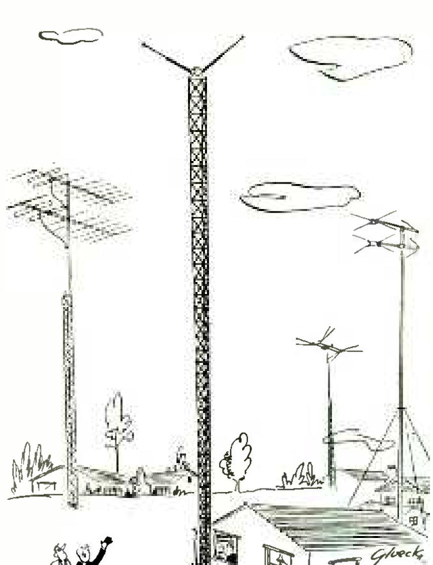
2. The owner is: Gernsback Publications, Inc., 25 West Broadway, New York 7, N. Y.; H. Gernsback, 25 West Broadway, New York 7, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

H. GERNSBACK, Publisher.

Sworn to and subscribed before me this 1st day of October, 1952. [Seal] Maurice Coyne, Notary Public. (My commission expires March 30, 1954.)



"He set out to prove he'd get reception with his little indoor antenna."

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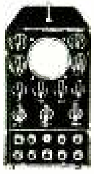

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Resistors, 1/2 & 1W. to 2 Megs **100 for 3.98**
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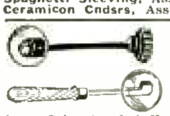

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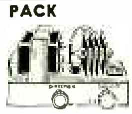

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4	.40	.45	.79	2	95.00
150wvdc		1	.90	15000wvdc	
1-1-3-5	.98	2	1.69	.0016	9.08
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1.2	.25	.25	1.29	AC RATED	
400wvdc		.5	1.39	220vac/600dc	
.1	.49	1500wvdc			
.5	.59	.5	1.49	2	.69
1	.69	.75	1.69	4	.89
4	1.69	1	1.79	5	1.29
6	2.29	5	3.49	225vac/630dc	
8	2.49	6	3.98		
10	1.00	2000wvdc		3.3	.79
2x1	.75	.1	1.49	230vac/630dc	
2x.5	.94	2x.1	1.69		
3x.1	.91	1	1.89	5	1.29
3x.25	.99	2	2.98	330vac/1000dc	
600wvdc		3	3.69		
.1	.35	8	9.49	1.25	.63
.25	.37	2500wvdc		1.5	.89
.5	.40	.25	2.29	1.75	.98
1	.50	3000wvdc		2	.33
2	.60	.1	2.49	2.5	1.09
3	1.08	.5	2.98	2.8	1.15
4	1.89	2	4.49	3	1.19
5	1.50	4	7.98	4	1.29
6	2.69	4000wvdc		5	1.49
7	2.89	2	8.98	15	3.98
10	3.29	5000wvdc		25	6.49
2x.1	.79	2	4.49	405vac/1200dc	
2x.25	.89	1	10.98		
2x.5	.98	4	19.98	.15	1.29
2x1	1.19	7000wvdc		600vac/1800dc	
2x2	1.39	.002	1.69		
2x8	3.29	.0075	1.98	16	6.98
3x.05	.89	.1	4.98	660vac/2000dc	
3x.22	.98	7500wvdc			
3x.25	1.09	.03	2.98	5	4.49
700wvdc		.05	3.49	6	4.98
4	1.50	10000wvdc		10	6.98
800wvdc					
.1	.69	.03	3.49	16	7.98

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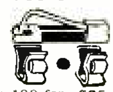

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3 for..**$1.00**; 20 for..**$5.98**; 100 for..**$25.**
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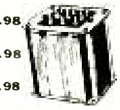

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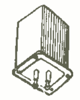
1320V&375VCT /110ma, 5V/3A, 2.5V/3.25A; 6.3V/2.75A Hsld Hvins **8.98**
1000VCT/200MA, 18V/.55A, 6.3V/5A, 5V/6A .....**6.98; 2 for 12.98**
1000VCT/45MA, 795vct/80ma, 360vct/55ma, 3x5V/3A, 6.3vct/1A, 6.3vct/.3A csd Hvins can be used 2x rating Raytheon Hypersil Core **4.98**
950VCT/100MA, 5V/5A, 5V/2.5A, 45V/1A, 10V/1.5A **5.49**
900V/35MA, 2x2.5V/2A, xclnt 1800-V'dblr two 2x2 fil. windgs hsld ... **3.49**
840VCT/110MA, 530vct/21ma, 2x5V/3A, 6.3vct/1A, 6.3vct/.3A **4.98**
770VCT/85MA, 5V/2A, 6.3V/3.5A.. **3.98**
750VCT/200MA, 6.3V/5A, 5V/4amp **6.49**
700VCT/120MA, 2x6.3V/3A, 6.3V/1A ....**$3.98; 2 for $7.50**
650VCT/150MA, 5V/3A, 6.3V/2.1A . **2.98**
550VCT/150MADC, 5V/3A, 6.3V/5A **3.49**
500VCT/60MA, 6.3V/4A Hsld **2.98**
420VCT/90MA, 6.3V/1.9A, with INPTS 6, 12, 24, 115VDC & 115 230VAC Vibrator Trans **1.98**

FILTER CHOKES



Dual 30 Hy/60ma Csd ...**$ .98**
15Hy/40ma AC/DC sets 3 for **.98**
12Hy/80ma/H'Sld/3KVins **2.25**
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12HY/300ma, Hmsld 5KVins **4.95**
Dual 2HY/300ma, USN ..**1.25**; 2 for **1.98**
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FILAMENT TRANSFORMERS

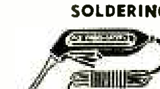
6.3vct/4A (gud 6.5A) H'Sld HVins...**$2.69**
6.3vct/1.5A .. **1.05**; **6.3v/.6A** **1.98**
2.5v/2A .**2 for 1.49**; **7.5vct/12A 15Kvins** **10.98**
24v/6a csd .. **4.98**; **24v/1.25A** csd. **1.98**
2.5vct/10Amp 5 Kvins ... **3.59**; **2x12V/2A** ... **3.89**
5V/2A, 6V/3A 2.25; **6V/6A** **2.95**
5V/60A .....**13.98**; **5V/115A** **16.95**

NOVICE XMITTER KIT
Power input 24 watts. 2 band oper. 3.7 to 3.75 mc and 26.96 to 27.23 mc inclds all parts to build xmitter & pwr supply. W/2 xtals, key & tubes **$29.95**

FUSES & HOLDERS

3AG: 1/8, 1/4, 1/2 Amp. Ea. **5¢**; 100 for **3.98**
3AG: 1, 1 1/2, 2, 3, 4, 15, 20 Amp. Ea. **3¢** ....100 for **2.49**
3AG: Slo-Blo; 10, 20 Amp. Ea. **7¢**..........100 for **5.98**
4AB: **BUSS** 10 Amp. Ea. **7¢**;...100 for **5.98**
4AG: 1/4, 1/2 Amp. Ea. **7¢**;...100 for **5.98**
4AG: 3, 5, 10, 15 Amp. Ea. **5¢**; 100 for **3.98**
4AG: **Slo-Blo**; 3, 10, 15, 20 Amp. Ea. **9¢** ....100 for **7.98**
5AB: **BUSS**, Littelfuse, 5 Amp. Ea. **4¢** ....100 for **3.00**
5AG: 35, 80 Amp. Ea. **5¢**;...100 for **3.98**
7AG: 0.2 Amp. Ea. **9¢**;.....100 for **7.98**
8AG: 1/32, 2/10, 1/2 Amp. 100 for **6.98**
HOLDER 1075 Littelfuse **20¢**;..10 for **1.75**

SOLDERING IRON GUN



SENSATIONAL VALUE, lightweight heavy duty soldering gun, with removable alloy tip—will not corrode, tip is flat. "TAB" Special—**$7.49**
2 for $14.49

NEW THRIFT-LITE LIFETIME PHOTO-FLASH

Not a kit. Incl. Pwr pck. Life gtd Lamp, Rflctr & 15' cord flash every 7 Sec. True daylight color. Usable all cameras oper 115VAC w/lite Gun Type AC40.
Delivered U.S.A. ..**$38.00**
Complete Outfit for AC & Battery opr. Incl. AC40 & BP25 portopak & all accssrs for KODAK & COMPUR shutters.
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AD15 Intensifier, Doubles Light Output of Basic Unit. Dlvd U.S.A. **$15.85**
AC-45F 115V/60cy Flash Unit. Features Selective Time Delay. Up to 30 Milisecond. Complete W/Lifetime Flash-Bulb.
Delivered U.S.A. **$49.00**
Write for Complete "THRIFTLITE" Data Boosterpacks, Ext lites, Units for Focal plane shutters & accessories.

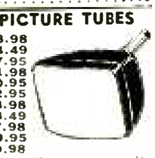
TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max.	Each
U5W	FT105	100	5.98
U10	GE FT114	100	$7.25
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
53GT	GE FT 403	500	13.50
VA	SYLV. 4330	200	9.98
23MT	FT 214	250	9.98
22ST	FT 110	200	9.98
353GTQ	FT 503	5000	49.98
V4X4	X400	200	10.98
DX	SPRG FA100	150	9.00

PHOTOFLASH CAPACITORS

2x.36MFD Total .72MFD Per Unit. 20 Units 21.6MFD 1800VDC/38.8 W. Sec. **$4.98**
30 Units 21.6MFD/3000VDC 64.8 W. Sec. ....**$6.98; 60 units $12.98**
Save on Replacements. Write for Details
15MFD/330VAC/1500VDC Intermit't.**$3.98**
25MFD/330VAC/1500VDC Intermit't. **6.49**
16MFD/600VAC/2800VDC Intermit't. **6.95**
16MFD/660VAC/3000VDC Intermit't. **7.95**
32MFD/1.2KVDC/23W. Sec. **7.49**
27MFD/460VAC/2KVDC Int. **54W. Sec. 8.95**
4.5MFD/660VAC/3KVDC Intermittent 20 W. Sec......**$4.25; 4 for $15.00**
26MFD/330VAC/1.5KVDC Int. **29W. Sec.** ....**$6.98; 2 for $11.95**
2X.44MFD, Total .88MFD Per Unit. 25 Units Equals **22MFD/660VAC/3KVDC** Intermittent **99W. Sec**..............**7.49**

ONE YEAR GTD PICTURE TUBES



10 BP4	$13.98
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12" Glass	17.95
12" Metal	21.98
14" Rectangular	20.95
16" Glass	22.95
16" Metal	23.98
17" Rectangular	23.49
19" Round	27.98
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Your old pict. tube is worth money, write for trade-in allowance on RMA coded and dated tubes with one year guarantee. Ship your defective picture tubes prepaid only. When ordering metal tube, defective metal tube is required.

866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cyc.... Input, outpt 2.5vct, 10A/Hvinsul ..**$6.98**

DIODE PROBE TUBE

Unexcelled for **No-Loss VHF** testing. Ultra-sensitive subminiature-envelope. New, w/data VR92 ....**25¢; 5 for $1.00**

PARTS CABINET

50 Draw Hvy Steel 34 1/2"H/18"W/9"L/65 lbs Draws 3"W/2 1/2"H/8"L **$40.00**
100 Draws as above 135 lbs **$65.00**
27 Draw Hvy Steel 37"H/30 3/4"W/14 1/4"L/120 lbs. Draws 3"H/9"W/12"L ..**$39.95**

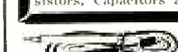
AUDIO AMPLIFIERS READY TO GO

Model 600AA 10 Watt Hi-Fidelity Ampl. in the Low Price Range. Features Mike & Phono Inpts, w/Separate Gain Cntrls. Uses Inverse Feedback for Base Boost, W/Tone Cntrl. Chassis is Finished in Hammered Bronze Enamel. Complete W/6 Tubes **$24.98**
Model 305MP 5 Watt Ampl, as Pictured Above Features Mike & Phono Inpts. W Sep. Gain Cntrls. Latest Compensated Tone Cntrl Design. Complete W/3 Tubes **$14.98**
Model 200MO Mike OSC. Broadcasts Through Your Radio with No Direct Connection. W/Tubes **$6.98**
Model 100PO Phono OSC. Phonograph Broadcasts Through Your Radio. No Direct Hookup. W/Tube **$4.98**
Model 302PA 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph. W/Tubes **$4.98**

SOUND POWERED PHONES

US Navy Mike, as illustrated. Push to Talk **$1.25**
RCA Head & Chest Set. Sound Pwr. No Batteries Needed. Ideal for TV Antenna Installation. New. Ea. ....**2 for $28.50**
P-20 Recvrs w/Band & Cord. 24K ohms **$4.98; 2 for $9**
HS-18, 2 Recvrs Cord w/PL54 less/HD Band ....**98¢; 4 for $3.25**

INFRARED SNOOPERSCOPE
Image Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—Resolution up to 350 line/in. Complete data & tube, ea. **$4.98; 2 for $9.49**
SNOOPERSCOPE PWR SUPPLY
1800VDC/35MA, Using Doubler Crkt, Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram.**$6.98**



Precision Feeler Gauge TL147 Ideal Teletype & Relay Work Setting Cont. Pts. Spark Gap, Individ Removable Gauges .012/.018/.025/.035/.037/.055" NEW orig Container ....**98¢; 6 for $5.00**
Test Leads as illustrated, 4 foot long, high quality ....**59¢; 2 for 98¢**

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***From This Special List We Ship $10.00 and Up Tube Orders At Our Expense (Post-paid) Within Continental Limits of U.S.A. 90 Day Guarantee Tubes.**

0A2	.95	6BY5G	1.45	12BY7	1.35	CK539DX	1.98
0A3/VR75	1.04	6CB6	.69	12BZ7	1.25	CK541DX	1.98
0B2	1.37	6CD6G	1.69	12SA7GT	.69	CK542DX	.98
0B3/VR90	1.09	6D4	2.70	12SC7	.80	CK543DX	.98
0C3/VR105	1.19	6J4	6.66	12SF5GT	.72	CK544DX	.98
0D3/VR150	1.05	6J5GT	.47	12SF7GT	.49	CK546DX	1.98
1R3/8016	.81	6J6	.63	12SG7	.83	CK547DX	1.98
5R4GY	1.60	6K4A	6.45	12SH7	.63	CK571AX	
5R4GYW	1.75	6L6	2.09	12SJ7GT	.59	5886	4.98
6AG5	.79	6L6G	1.35	12SK7	.72	CK573AX	4.45
6AG7	1.39	6L6GA	1.35	12SL7GT	.65	CK1005	.85
6AH5G	1.49	6L6GAY	2.29	12SN7GT	.75	CK1027	3.35
6AH6	1.22	6SA7GT	.63	12SQ7GT	.63	CK1028	9.98
6AJ5	1.40	6SA7GTY	3.37	19T8	1.09	CK1089	2.98
6AK5	.74	6SB7Y	1.19	19V8	1.62	CK1090	2.98
6AK5W	1.49	6SC7	.90	25BQ6GT	1.19	CK5672	2.29
6AK6	1.05	6SD7GT	.80	25L6GT	.69	CK5676	2.29
6AL5	.54	6SF5	.77	25Z5	.79	CK5678	2.45
6AL7GT	1.29	6SF7	.73	25Z6GT	.99	5687	5.75
6AN5	2.90	6SG7	.72	28D7	1.95	CK5702	7.45
6AQ5	.55	6SH7	.61	35Z5GT	.59	CK5703	.98
6AQ5W	3.98	6SJ7	.70	50L6GT	.69	Xtal Diodes	
6AQ6	.81	6SK7GT	.69	80	.69	1N21A	1.55
6AQ7GT	1.29	6SL7GT	.69	81	1.69	1N21B	3.00
6AR5	.79	6SN7GT	.70	82	1.19	1N21C	21.50
6AR6	2.98	6SN7WGT	2.25	82V	1.30	1N22	1.25
6AS5	.79	6SQ7GT	.63	83	1.45	1N23	1.35
6AS6	2.43	6SR7	.65	83V	[illegible]	1N23A	2.35
6AS7G	4.14	6SS7	.75	84/6Z4	.99	1N23B	3.49
6AT6	.63	6ST7	.98	117L M7GT	1.59	1N25	4.98
6AU5GT	1.10	6SU7GTY	2.69	117N7GT	1.79	1N26	8.75
6AU6	.59	6V6	1.39	117P7GT	1.39	1N27	1.55
6AV5GT	1.29	6V6GT	.57	117Z6GT	1.19	1N29	3.50
6AV6	.49	6W4GT	.57	117Z7GT	1.49	1N32	23.75
6AW6	1.89	12AH7GT	1.45	CK501X	1.26	1N34	.64
6BA6	1.23	12AK5	1.98	CK501AX	1.26	1N34A	.90
6BA6	.63	12AK5W	2.98	CL502A	1.79	1N35	1.65
6BA7	1.27	12AL5	.75	CK502AX	1.79	1N38	1.43
6BC5	.63	12AT6	.52	CK503AX	1.79	1N39	4.15
6BC7	1.23	12AT7	.81	CK505AX	1.79	1N44	1.21
6BD5GT	1.65	12AU6	.72	CK506AX	1.79	1N45	1.39
6BD6	.83	12AU7	.63	CK509AX	1.26	1N47	5.49
6BE6	.59	12AV6	.49	CK512AX	3.15	1N48	.59
6BF5	.98	12AV7	.98	CK522AX	2.49	1N51	.45
6BF6	.65	12AW6	1.79	CK525AX	3.15	1N52	1.85
6BF7	2.55	12AX4GT	1.20	CK526AX	3.95	1N54	.89
6BG6G	1.39	12AX7	.79	CK528AX	2.39	1N56	.89
6BG7	1.98	12AY7	2.95	CK529AX	2.98	1N57	.89
6BH6	.63	12AZ7	1.49	CK531DX	1.98	1N58	1.19
6BJ6	.69	12BA6	.59	CK532DX	1.98	1N60	.60
6BK7	2.15	12BA7	.79	CK533AX	1.39	1N61	2.10
6BL7GT	1.45	12BD6	1.23	CK534AX	.89	1N63/K63	2.49
6BN6	1.49	12BE6	.59	CK536AX	.89	1N64	.69
6BN7	1.69	12BF6	.85	CK537AX	4.98	1N67	1.95
6BQ6GT	1.20	12BH7	1.29	CK538DX	.89	1N69	1.98
6BQ7	2.15						

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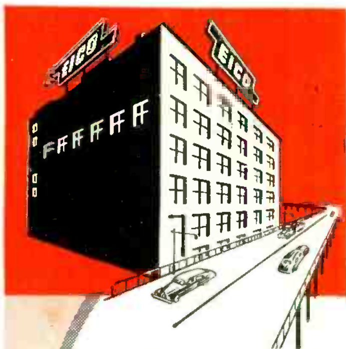

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EICO New Model 536—1000 Ohms/Volt Multimeter Wired $14.90. KIT $12.90.

- 31 full scale ranges!
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- DC/AC Current: 0-1 ma, 10 ma; 0.1 A, 1 Amp.
- Ohms: 0-500, 100K, 1 meg.
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- Ohms: 0-2000, 200K, 20 meg.
- 5 DB Ranges: −12 to +55.
- Large 4½" 50 ua meter movement.
- High-impact Bakelite case. 6¾ x 5¼ x 3".

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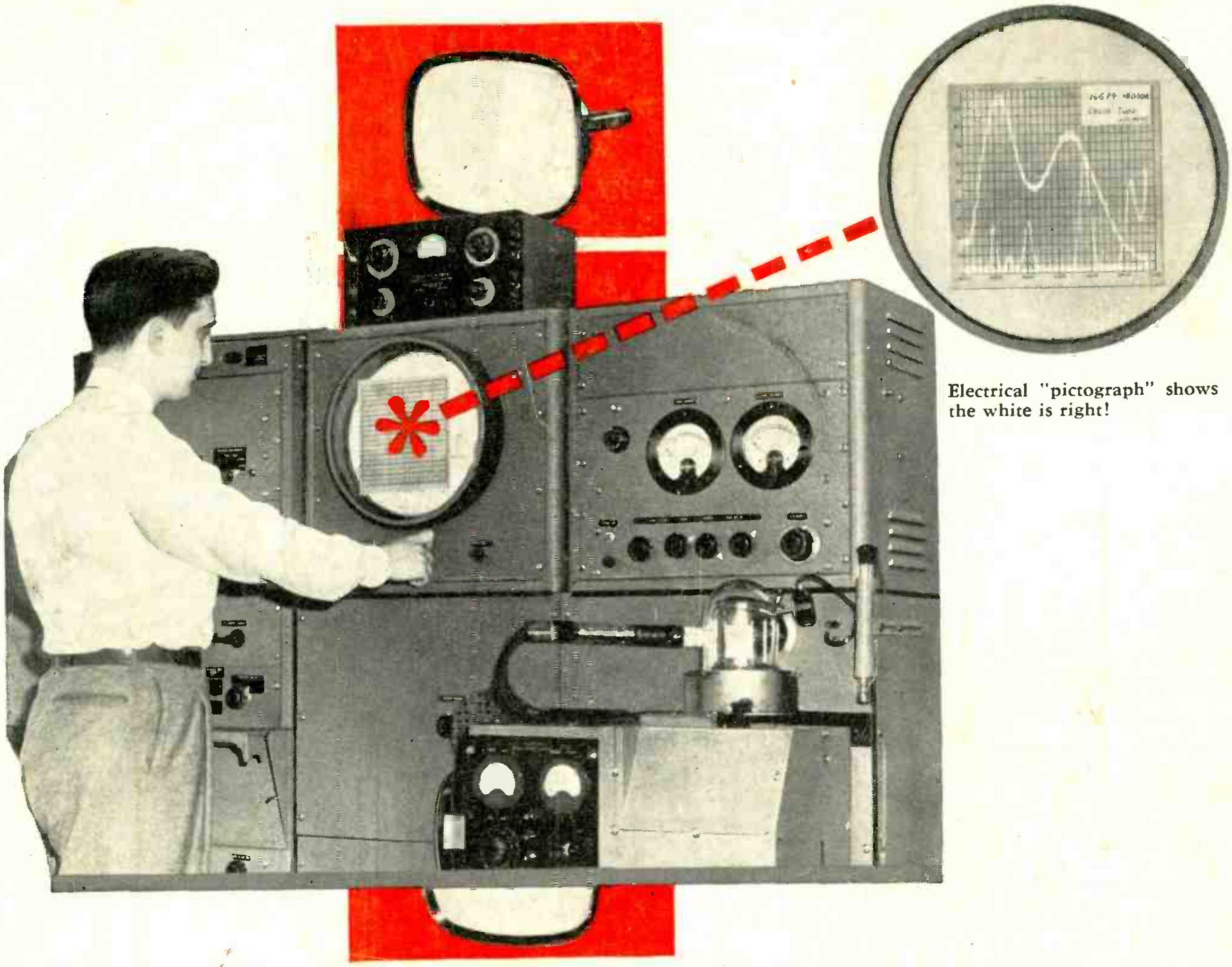

Electrical "pictograph" shows the white is right!

How we get *white* that's just right

for RCA picture-tube screens

MIX BLUE AND YELLOW paint and you get green. But mix "blue" and "yellow" phosphors and you get *white* . . . or what appears white to the eye. So it is that the fluorescent screen of a picture tube consists of about two billion tiny "blue" and "yellow" luminescent crystals. By the principle of *color addition*, the colored light from the individual crystals stimulates the eye to give the *impression* of white light.

The problem is you can get white that is yellowish, or white that is bluish . . . depending on the blend of the "blue" and "yellow" phosphors. Getting a white that's *just right* for picture-tube screens is no easy trick. It calls for extremely precise *color control* of the phosphor.

RCA does it with a *spectroradiometer*. This instrument permits very accurate measurement of the *shade* of the "blue" and "yellow" phosphors. Based on this information, batches of "blue" and "yellow" phosphors are selected and blended to give the desired shade of white. Each blend is tested in a pilot run of picture tubes, and these tubes are also measured on the spectroradiometer. Only when a pilot run shows the desired white is a blend approved for production use. Result: *"Off-color" picture tubes never reach your shop.*

RCA's constant vigilance at all stages of manufacture is your assurance that only top-quality RCA Kinescopes leave the factory. In this way, RCA closely guards its own reputation . . . *and yours as well.*

With RCA Receiving Tubes, as well as RCA Kinescopes, TOP-QUALITY CONTROL makes the difference.

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