LATEST IN TELEVISION • SERVICING • AUDIO

NEW CIRCUITS IN 1951 TV RECEIVERS

TELEVISION SERVICE CLINIC

CHRISTMAS PACKAGE FOR FUTURE HAMS — SEE AMATEUR SECTION
**TEN WAYS BETTER!**

1. Directly measures complex waves from 0.2 volt to 1400 volts, peak-to-peak.
2. Has an over-all accuracy for dc measurements of ±3% of full scale.
3. Measures dc voltages from 0.02 volt to 1500 volts.
4. Measures rms values of sine-wave voltages from 0.1 volt to 1200 volts.
5. Has 7 non-skip ranges for both resistance and voltage.
6. All full-scale voltage points increase in a uniform "3-to-1" ratio.
7. Frequency response flat from 30 cps to approximately 3 Mc.
8. Negative-feedback circuit provides better over-all stability.
10. More convenient to use because of smaller size and new slip-on probes.

The WV-97A measures peak-to-peak voltages directly. Hence, it quickly provides information essential for servicing TV receivers with their pulse-type waveforms.

**SPECIFICATIONS**

**DC Voltmeter:**
- Seven continuous ranges: 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts
- Input resistance (including 1 megohm in dc probe): 11 megohms
- All ranges: ±3% of full scale

**AC Voltmeter:**
- Fourteen continuous ranges: 0 to 4, 14, 40, 143, 400, 1400, 4000 volts
- Peak-to-peak ranges: 1400, 4000 volts
- RMS ranges (for sine waves): 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts

**Input Resistance and Capacitance with WG-218 Direct Probe and Cable:**
- 1.5, 5, 15, 50, 150-volt ranges: 0.83 megohms shunted by 85 µµf
- 1000-volt range: 0.83 megohms shunted by 85 µµf
- Overall Accuracy:
  - Input: ±3% of full scale
  - Output: ±3% of full scale
- Frequency Response (with WG-218 Direct Probe and Cable):
  - 1.5, 5, 15, 50, 150, 500, 1500-volt ranges flat from 30 cps to 3 Mc for voltage source having 100-ohm impedance

**Dimensions:**
- 7¼" high; 5¼" wide; 3½" deep

**Available Accessories:**
- WG-264 Crystal Diode Probe. Ends range at 350 Mc. ($7.75 suggested user price)
- WG-289 High-Voltage Probe and WG-206 Resistor to extend range to 35,000 volts. ($19.95 suggested user price)

---

The WV-97A has a range of usefulness extending beyond that of any other instrument in the field. Its quality, dependability, and accuracy make it a true laboratory instrument; it is exactly what is needed for television in the design laboratory, factory, and service shop.

The new Senior VoltOhmyst measures dc voltages in high-impedance circuits, even with ac present. It reads the rms values of sine waves and the peak-to-peak values of complex waves or recurrent pulses, even in the presence of dc. Its electronic ohmmeter has a range of ten billion to one.

Like all RCA VoltOhmysts, it features high input resistance, electronic protection from meter burn-out, zero-center scale for discriminator alignment, molded-plastic meter case, a 1-megohm isolating resistor in the dc probe, and sturdy metal case for good rf shielding.

An outstanding feature is its usefulness as a television signal tracer ... made possible by its high input resistance, wide frequency range, and direct reading of peak-to-peak voltages.

For complete information on the new RCA WV-97A Senior VoltOhmyst, see your RCA Test Equipment Distributor, or write RCA, Commercial Engineering, Section L49X, Harrison, New Jersey.

You Practice COMMUNICATIONS
I Send You Parts To Build
This Transmitter

As part of my Communications Course you build this low-power broadcasting transmitter. Learn how to put a station "on the air," perform procedures demanded of Broadcast Station operators, make many tests.

This Tester with parts I send early in my servicing course helps you fix neighbors' Radios and EARN EXTRA MONEY in spare time.

YOU BUILD Vacuum Tube Power Pack as part of my Communications Course; get experience with parts of many kinds. Learn how to correct Power Pack troubles.

YOU BUILD this A.M. Signal Generator as part of my Servicing Course. It provides amplitude-modulated signals for many tests and experiments.

I TRAINED THESE MEN

"I have been operating my own Servicing business. In two years I net $4,000 worth of business not profit. AM. Have one full-time employee, an N.R.I. student."-Phillip C. Brogan, Louisville, Ky.

"Four years ago, I was a bookkeeper with a hand-to-mouth salary. Now I am a Radio Serviceman with a key station of the American Broadcasting Company network."-Norman M. Ward, Highland Park, I. J.

"Went halfway thru the N.R.I. course. I made 38 in a 48-voice test at my school. Am now doing well. Am using N.R.I. course to advance my trade."-E. S. Strickler, New Boston, Ohio.

"The best job I ever had was as a radio operator with KDB. Obtained my job thru my graduate course. Dep., I am now Chief Engineer of Police Radio Station, WLO.

Send for Information to address N.R.I."-T. S. Norton, St. Louis, G.

You Practice Radio SERVICING
On This Modern Radio You Build With Parts I Send

As part of my Servicing Course, I send you the speaker, tubes, chassis, transformer, loop antennas, EVERYTHING you need to build this modern, powerful Radio Receiver! I also send you parts to build other Radio circuits, see below. You use for practical experience and earn EXTRA money in spare time.

Learn Servicing or Communications by Practicing in Spare Time with KITS OF RADIO PARTS I Send

Do you want good pay, a job with a bright future and security? Would you like to have a profitable shop or store of your own? If so, find out how you can realize your ambition in the fast growing, prosperous RADIO TELEVISION industry. Even without Television, the industry is bigger than ever before. At million home and auto radios, 2,700 Broadcasting Stations, expanding use of Aviation and Police Radio, Micro-wave Relay, Two-way Radio for boats, taxis, etc., are making opportunities for Servicing and Communications Technicians and FCC-Licensed Operators.

Many Soon Make $10 Extra a Week

Keep your job while training. Hundreds of successful RADIO TELEVISION TECHNICIANS I trained had no previous experience, some only a grammar school education. Learn Radio-Television principles from illustrated lessons. Get PRACTICAL EXPERIENCE—build valuable multimeter—experiment with circuits common to Radio and Television. Keep all equipment. Many students make $2, $10 extra a week fixing neighbors' Radios in spare time. SPECIAL BOOKLETS start teaching you the day you enroll.

Send Now For 2 Books FREE—Mail Coupon

Send now for my FREE DOUBLE OFFER. You get actual Servicing lesson to show you how you learn at home. Also my 64-page book, "How to Be a Success in Radio-Television." Readers, who are graduates, are doing, earning; see equipment you practice with at home. Send coupon in envelope or paste on postal. J. E. Smith, President, Dept. ONX, National Radio Institute, Washington, D.C. Our 37th Year.

Good for Both—FREE

Mail Coupon Now!
CONTENTS
DECEMBER, 1950

Editorial (Page 21) ........................................ Hugo Gernsback, Editor-in-Chief 21

Choleric Color TV ........................................ Hugo Gernsback 21

Servicing—Test Instruments (Pages 22-26) ............... by Hugo Gernsback 21

Radio Set & Service Review (Improved Circuits in Du Mont's 1951 Receivers) ............... by Ricardo Muniz 22

Fundamentals of Radio Servicing, Part XXI............. by John T. Frye 25

Television (Pages 27-31) ....................................
Television DX Reports ....................................... 27
Television Service Clinic .................................... 27
Time Base Circuits .......................................... 30
FCC Picks CBS Color ....................................... 31

Electronics (Pages 32-37) ....................................
Electric Space Ships, Part I ................................ 32
Relays Do Simple Arithmetic, Part III.................. 35
by Edmund C. Berkeley and Robert A. Jensen 35

Audio (Pages 38-44) ........................................
Electronics and Music, Part VI ............................ 38
PA Gets Prolificity .......................................... 40
Audio Feedback Design, Part III ......................... 42
by George Fletcher Cooper 42

Amateur (Pages 46-48) ......................................
Christmas Package for Future Hams (Cover Feature) by Larry Le Kashman, W2IOP 46
40-Meter M Antenna .......................................... 48
by Jerome Moszkowski, WBLKM 48

Hi-Fi AM Tuner and Amplifier, Part II ................. 50
by D. R. R. Drenner 50

High-Efficiency Crystal Receiver ......................... 52
by Robert E. Kelley 52

3-Tube Receiver for Wired Radio ......................... 57
by Rufus P. Turner 57

New Design (Page 62) ......................................
New Tubes of the Month .................................... 62

Dezpartments ................................................
The Radio Month .......................................... 78
Radio Business ............................................ 82
New Devices ................................................ 84
New Patents ................................................ 86
Radio-Electronic Circuits ................................ 88
Question Box ............................................... 91

ON THE COVER: ...........................................
Larry Le Kashman and his daughter Patricia 95
in a Christmas scene at his station W2IOP.
Redchome by Avery Slack.

WATCH FOR THE JANUARY ANNUAL TELEVISION NUMBER
Learn RADIO

TELEVISION, ELECTRONICS

by

SHOP METHOD HOME TRAINING

Let NATIONAL SCHOOLS, of Los Angeles, a practical Technical Resident Trade School for almost 50 years, train you for today's unlimited opportunities.

GOOD JOBS AWAIT THE TRAINED RADIO TECHNICIAN

You are needed in the great modern Radio, Television and Electronics industry! Trained technicians are in constant and growing demand at excellent pay—in Broadcasting, Communications, Television, Radar, Research Laboratories, Home Radio Service, etc. National Schools Master Shop Method Home Study Course, with newly added lessons and equipment, can train you in your spare time, right in your own home, for these exciting opportunities. Our method has been proved by the remarkable success of National Schools-trained men all over the world.

You Learn by Building Equipment with

Standard Radio Parts We Send You

Your National Schools Course includes not only basic theory, but practical training as well—you learn by doing. We send you complete standard equipment of professional quality for building various experimental and test units. You advance step by step until you are able to build the modern superheterodyne receiver shown above, which is yours to keep and enjoy. You perform more than 100 experiments—build many types of circuits, signal generator, low-power radio transmitter, audio oscillator, and other units. The Free Books shown above tell you more about it—send for them today!

NOW! NEW PROFESSIONAL MULTITESTER INCLUDED

This versatile testing instrument is portable and complete with test leads. Simple to operate, accurate and dependable. You will be able to quickly locate trouble and adjust the most delicate circuits. You can use the Multitester at home or on service calls. It is designed to measure AC and DC volts, current resistance and decibels. You will be proud to own and use this valuable professional instrument.

GET THE DETAILS—SEND THE COUPON

DECEMBER, 1950

www.americanradiohistory.com
The one millionth Teletron recently rolled off the production line. It was all in a day's work for DuMont's vast Allwood plant geared to over a million TV picture tubes a year. Yet that tube established a unique record, because it represented the one millionth BIG TUBE. No other manufacturer has made that many BIG TUBES.

Ever since 1939 when Du Mont introduced the first commercial television set with its 14" Teletron, Du Mont has pioneered BIG TV TUBES. While others were offering 7" and 10" tubes, Du Mont was satisfied producing less than 12". Even as early as 1939, Du Mont was producing 7" Teletrons. Since then the public has followed the Du Mont lead, but the industry is rapidly catching up with still larger tubes now available shortly.

IN BIG TUBES

THE BIG NAME IS

DU MONT

First with the Finest in Television

ALLEN B. DU MONT LABORATORIES, INC.
TUBE DIVISION - CLIFTON, N. J.

RADIO-ELECTRONICS
Are You Preparing for a Good Paying Job in TV-Electronics?

Whether you're headed for Essential Industry—or the Armed Services—CREI Technical Training qualifies you for more interesting jobs at better pay!

CREI Home Study can help you step ahead!

By E. H. Rietzke
President CREI

Your future success can best be assured by the steps you take today to prepare for it. No field offers a properly qualified young man greater opportunity than electronics. In the Armed Services, electronics gives rockets "brains" to make scientific observations, gives airplanes "eyes" and "ears" to navigate, gives explosives target directions.

In industry, electronics prepares the vast number of devices utilized by the Armed Services—the countless radars, two-way radios, and communications equipment used by modern armies, fleets, and planes. In peace, electronics provides good jobs for trained engineers and technicians. Television's fantastic growth from 10,000 sets in 1945 to 8 million by the end of 1950—with set production currently at the rate of 6 million—is typical of the speed at which the electronics bandwagon is moving. It is the new field, where know-how is rewarded with excellent jobs and lifetime careers. And authorities are agreed that the one sure way to acquire this training is from a good school.

How can a young man select a "good school"? By its reputation in the industry ... the professional standing of its faculty ... the quality of its courses ... the length of time it has been in existence ... and its accomplishments.

CREI invites investigation and comparison. An accredited technical institute founded in 1927, CREI's home-study graduates today fill important engineering, research, and radio-TV posts through the industry. While CREI makes no job promises to its graduates, the Placement Bureau generally has on hand more requests than it can fill. During World War II CREI trained thousands of technicians for the Army, Navy and Coast Guard. Hundreds of thousands of special CREI technical texts were used in the Navy's own training program. Leading industrial firms—RCA Victor, United Air Lines, TWA, Pan American Airways, All America Cables & Radio, Inc., Sears Roebuck & Co., to name only a few—have selected CREI for technical training for their technicians at company expense.

CREI, through home study, offers practical training that starts with basic principles and goes step-by-step through the more advanced subjects of TV and its related fields. Each student is grounded thoroughly in the fundamentals required for development work in TV, guided missiles, communications and industrial electronics. You study Optics; Pulse Techniques; Deflection Circuits; RF, IF, AF, and Video Amplifiers; FM; Receiving Antennas; Power Supplies; Cathode Ray, Iconoscope, Image Orthicon and Projection Tubes; UHF Techniques, TV Test Equipment, and many other subjects.

There are three basic CREI courses: Practical Radio Engineering (fundamental course in all phases of radio-electronics); Practical Television Engineering (specialized training for professional radiomen); Television and FM Servicing (streamlined course for men in top third of field). Courses are also available at the Residence School in Washington, D. C.

Write immediately for complete information. The cost is within reach of all, the terms easy. Mail this coupon at once.

CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 14128, 16th & Park Rds., N. W., Washington 10, D. C.

Gentlemen: Send booklet, "Your Future in the New World of Electronics," together with details of your home study training. CREI self-improvement program and outline of course. I am attaching a brief resume of my experience, education and present position.

Check the Field of Greatest Interest: [ ] PRACTICAL TELEVISION ENGINEERING, [ ] PRACTICAL RADIO ENGINEERING, [ ] TV, FM & ADVANCED AM SERVICING, [ ] AERONAUTICAL RADIO ENGINEERING, [ ] BROADCAST RADIO ENGINEERING (AM, FM, TV), [ ] RADIO-ELECTRONICS IN INDUSTRY.

NAME..............................................AGE..............................................
ADDRESS..............................................If Residence School
CITY..............................................ZONE......STATE..............................................

If Washington, D. C. preferred, check here.

DECEMBER, 1950

www.americanradiohistory.com
SYLVANIA TV Picture Tubes are natural-born leaders because... they come from a leading family

Radio Tubes... 25 years' experience in building high quality tubes for every radio and television need.

Electronics... wide experience in designing radar and electronic equipment for war-time and post-war commercial use.

Phosphors... production of white and colored phosphors for the "Finest in Fluorescent Lighting."

Lighting... half a century of research and manufacture of incandescent and fluorescent lamps to meet longest life and highest vision standards.

This unique combination of experience naturally fits Sylvania for top position in the TV Picture Tube field.

Maintaining this leadership is a continuing program of research and engineering. A Sylvania engineer, for example, invented the famous "Ion Trap," now licensed to numerous other picture tube makers.

Sylvania achievements in fluorescent powders, tungsten wire, and precision parts are some of the other reasons which lie behind the consistent color, greater clarity, and longer life of all Sylvania TV Picture Tubes.

Backing up each Sylvania advance is a rigid system of quality control... of checking and rechecking every step of every process... so that TV set owners everywhere will continue to look to Sylvania for the finest performance possible. New booklet gives information concerning the complete line of Sylvania Picture Tubes. Write for your copy today. Address Sylvania Electric Products Inc., Dept. R-1012, Emporium, Pa.
NOW... GET EVERYTHING YOU NEED TO LEARN AND MASTER

TELEVISION

RADIO-ELECTRONICS

...AT HOME!

Use REAL commercial-type equipment to get practical experience

Your future deserves and needs every advantage you can give it! That's why you owe it to yourself to find out about one of the most COMPLETE, practical and effective ways now available to prepare AT HOME for America's billion dollar opportunity field of TELEVISION-RADIO-ELECTRONICS. See how you may get and keep the same type of basic training equipment used in one of the nation's finest training laboratories—how you may get real STARTING HELP toward a good job or your own business in Television-Radio-Electronics. Mail the coupon today for complete facts—including 89 ways to earn money in this thrilling, newer field.

Here's the REAL THING!

SET UP YOUR OWN HOME LABORATORY

* Oscilloscope
* R-F Signal Generator
* G-Tube Radio
* Multimeter

ABOVE: Build and keep a real 16 INCH commercial TV receiver. Optional after completing regular training at slight additional cost.

GET BOTH of these information-packed publications FREE!

D.T.I., ALONE, INCLUDES BOTH MOVIES and HOME LABORATORY

In addition to easy-to-read lessons, you get the use of HOME MOVIES—an outstanding training advantage—plus 16 big shipments of Electronic parts. Perform over 300 fascinating experiments for practical experience. Build and keep real commercial-type test equipment shown at left.

MODERN LABORATORIES

If you prefer, get all your preparation in our new Chicago Training Laboratories—one of the finest of its kind. Ample instructors, modern equipment. Write for details!

MILITARY SERVICE!

If you're subject to military service, the information we have for you should prove doubly interesting. Mail coupon today.

ACT NOW! MAIL COUPON TODAY!

De FOREST'S TRAINING, INC., Dept. RE-G-12
2533 N. Ashland Ave., Chicago 14, Ill.

Without obligation, I would like your late News-Bulletin showing 89 ways to earn money in Television-Radio-Electronics...and how I may prepare to get started in this thrilling field.

Name: ___________________________ Age: ______
Street: __________________________ City: __________ Zone: ______ State: ______
Street: __________________________ Apt: ______

De FOREST'S TRAINING, INC.
CHICAGO 14, ILLINOIS
A DeVRY INSTITUTION

DECEMBER, 1950
The Radio Month

WAVELENGTHS are under discussion by committees of the seven-nation North American Regional Broadcasting Conference. Delegates to the conference are from Canada, Cuba, the Dominican Republic, Haiti, Mexico, the United Kingdom (on behalf of the Bahamas and Jamaica), and the United States.

Facing the conference is the problem of dividing up the 108 channels of the broadcast band (540 to 1620 ke) among 3,000 stations, some 2,000 of which are in the United States. An earlier agreement lapsed in March, 1949, but some of the conference members are still abiding by the old terms. However, Mexico and Cuba have complained that their broadcast needs have so increased that new allocations are necessary.

GENERAL ELECTRIC CO. opened the new home of its research laboratory October 9 last. Dedication of the new building coincided with the anniversary of the founding of the laboratory, which came into existence 50 years ago in the barn of Charles Steinmetz, electrical and mathematical genius.

The new laboratory is five stories high, with the lower two stories below ground level. It houses 107 laboratory rooms, an auditorium, various special and office areas and extensive shop space. Movable steel partitions permit considerable flexibility in size and number of laboratory rooms.

Besides the main building, there are four other structures: the low-temperature laboratory; a chemical pilot plant; a radiation laboratory, which will house a 300-million-volt synchrotron; and a heating plant.

Dedication of the laboratory also marked the opening of the annual autumn meeting of the National Academy of Sciences, which commenced technical sessions in the auditorium of the new laboratory on the morning of Tuesday October 10 and continued till Thursday afternoon. It was the first time in its 88-year history that the Academy held one of its regular meetings at an industrial laboratory.

VIDEOGNOSIS may some day bring big city medical specialists practically to the bedside of patients in rural hospitals. The technique consists of transmitting X-ray pictures via television and has already been worked successfully by Dr. J. Gershon-Cohen and associates of the Jewish Hospital of Philadelphia.

The patient's own physician and the specialist can consult by telephone while viewing the X-ray picture and its TV image. The TV image is said to be better in some respects than the original because the contrast can be adjusted for easier reading.

TV MEMORY TUBE may bring a radical improvement in television receiving apparatus within the next two years. Similar to the memory tubes used in computing machines, the device was described recently by Philo T. Farnsworth, vice-president of the Capehart-Farnsworth Corporation.

Doing away with the present interlace system, the tube will receive two frames every 1/60 second, store these until the picture is complete, and then project the completed picture only once each 1/60 second.

The tube will virtually eliminate flicker because the scan lines are not used. The only movement seen is the change from one complete image to the next, and this takes place so fast that it is not apparent. Another advantage is that the image brilliancy will be up to 6,000 times as great as in present tubes, thus making better projection television possible.

TV CONJUNCTIVITIS is a new ailment resulting from the rigors of modern life. Ben Payne Sr. of Columbus, Ohio, watched his set from 6 to 10 pm one evening with no breaks. When his eyes finally began to smart he went to bed. He woke up after midnight and found that he couldn't open his eyes and his head ached. At the hospital the doctors diagnosed his case as television conjunctivitis or looking too long.

An overall view of G-E's new research laboratory building at Schenectady N. Y.
Train at Home in Spare Time for Radio and Television

I Send You 18 BIG KITS OF RADIO-TELEVISION EQUIPMENT

My Famous Training System Prepares You Double Quick For a Good Job or Your Own Profitable Radio-Television Business

Radio-Television is an America's greatest opportunity field! Trained men are needed to fill good jobs and handle profitable Radio-Television service work. I have trained hundreds of men for success in Radio-Television—and I stand ready to Train you too, even if you have no previous experience. My training is 100% practical—designed to give you the knowledge and experience you need to make money in Radio-Television in the shortest possible time. I Train you with up-to-the-seconds revised lessons—PLUS many big kits of Radio-Television equipment. You actually do over 300 demonstrations, experiments and construction projects. In addition, you build a Powerful 6-tube-2 band radio, a multi-range test meter and a complete Television receiver! All equipment is YOURS TO KEEP.

EASY TO MAKE EXTRA MONEY WHILE YOU LEARN

You do all your training with me AT HOME in spare hours. Keep right on with your present job and income while learning—and earn extra cash besides! The day you enroll I begin sending you plans and ideas for doing profitable spare time Radio-TV work. Many of my Sprayberry students pay for their entire training this way. You get priceless experience and many plans for making extra money. You build all your own Radio-TV Test Equipment from parts I send you—nothing else to buy. Just one more reason why I believe I offer the ambitious man the biggest value in top notch Radio-TV Training available anywhere in America today.

BE READY FOR TOP PAYING RADIO-TELEVISION JOBS

Radio-Television is growing with amazing speed. More than 2000 Radio broadcasting stations PLUS an additional 100 Television stations are now on the air. Radio eqn. and TV receivers are being made and sold in record breaking numbers. If you enjoy working with your hands if you like to do interesting and varied work—if you really want to make good money and work in an industry that has a future YOU BELONG IN RADIO-TELEVISION. But you MUST have good Training to "cash in"—the kind of training that starts you out with basic fundamentals and courses you right through every circuit and problem of Radio-Television Servicing and Repair. In a word...that's Sprayberry Training—the course backed by more than 20 years of association with the Radio-Television Industry.

FREE 3 BIG RADIO AND TELEVISION BOOKS

I want you to have ALL the facts about my complete system of Radio-Television Training! Art and Radio-Fundamentals— Illustrated Television Soldering—Leading-edge and Tube-Testing. No obligation and no salesman will call on you. Send this coupon in or mail in both of post cards. I will rush all three books at once.

Sprayberry Academy of Radio, Dept. 20-R
111 North Canal St., Chicago 6, III.

Mail Coupon Today! No Obligation No Salesman Will Call

I F YOU ARE EXPERIENCED in Radio-TV quality you for Television in 4 to 8 weeks. Rush course.

S A Y S R I A Y: "My States Training replaced for

Sprayberry Academy of Radio, Dept. 20-R
111 North Canal St., Chicago 6, III.

Please rush to me all information on your Radio-Television Training course. I understand and do not obligate me and that no salesman will call upon me.

Name...Age...

Address...

City...State...

Mail Coupon Today! No Obligation No Salesman Will Call

Please Check Here About Your Experience

□ Are You Experienced? □ No Experience
ALARMING SHORTAGE of engineers is predicted by the American Society for Engineering Education. Based on enrollments of engineering schools, the forecast estimates that the present freshman class of engineering students is only about half what it should be.

300,000,000-VOLT synchrotron to be installed at the General Electric Laboratory at Schenectady, N. Y., works on a new principle.

Dr. James L. Lawson, manager of the Electron Physics divisions of the laboratory, gave details of the new machine, called a "non-ferromagnetic synchrotron," to members of the National Academy of Sciences at their autumn meeting in October.

In the usual synchrotron, a stream of electrons, originating from a heated filament, is accelerated to high energy in a doughnut-shaped vacuum tube between the poles of a powerful iron-core electromagnet. The magnetic field gives them their original acceleration, until they are moving at nearly the speed of light. As they receive further increase in energy, by passing a strongly electrified metal gap, the magnetism guides them in their orbit. At full energy they hit a metal target, generating a beam of X-rays, which emerges from the tube.

In the non-ferromagnetic synchrotron, as developed by Dr. Lawson and his associates, the necessary magnetic fields are produced by current-carrying coils rather than by iron-core electromagnets. There are sets of coils to provide the field for initial acceleration of the electrons (up to about 2.5 million volts) and to continue guiding them as they are further energized by passage through the electrified gap. The high fields which are possible from such coils results in a very compact machine compared with those of conventional type, in some of which the iron core of the magnet may weigh up to hundreds of tons.

SUBSCRIPTION TV began a series of test broadcasts over station WOR-TV in New York recently. Called Subscriber-Vision, the system is being tested by the Kroonics Electronic and Television Corporation, and these first on-the-air trials will be observed by the FCC.

Television receivers will not be able to get a picture from the subscription broadcasts unless equipped with a special decoder. The decoder is equipped with a plastic card which is identical within 1/10,000 inch to one used at the transmitter. These cards control the scrambling and unscrambling of the TV signal, and no telephones lines are needed. These tests will not interfere with WOR-TV's regular programs.

TEST PILOTS will no longer have to risk their necks, thanks to TV. The Air Force stated that planes under test would be equipped with TV cameras focussed on the instrument panel, while the pilot operated the plane by remote control from the ground. The new method will make it possible to get data never before obtainable.

Two war surplus planes equipped with the system are now under test. So far the results indicate that the use of TV is entirely practical and it may even be used on some of the new super high-speed planes.

MULTIPLEXED FM was demonstrated recently by the Multiplex Development Corporation of New York when they transmitted two separate sound programs simultaneously over a single FM station channel. For part of the demonstration, two microphones were used to pick up the program at the transmitter, the sound was divided between the two channels, and was reproduced over two loudspeakers at the receiving end. It was said to give a stereophonic, or presence effect at the receiver.

The system was also used to send program material over one channel and facsimile signals over the other, with no noticeable cross interference.

Scientists make some preliminary tests on G-E's new high-energy synchrotron.
Thanks to Mr. Gupton. His unsolicited appreciation naturally warms our heart.

More important, he gives all service-dealers an excellent reason for picking Hytron rectangulars.

Does he choose Hytron: Because the rectangular is Hytron’s baby... the original leader? Because Hytron’s picture-tube plant is the most modern in the country? Because nine out of ten leading TV set makers choose Hytron? Because more and more service-dealers show equal shrewdness?

He has an even better reason: experience. His own experience proves Hytron better. Hytron rectangulars give him amazingly clearer, sharper, more brilliant pictures. They’ll do the same for you. Demand original Hytron rectangulars. Prove by your own tests that Hytron is also your best choice.
Merchandising & Promotion

Sprague Products Co. issued a new revised edition of its Tell-U-How wall chart. Color lithographed, the chart measures 22 x 28 inches. It gives service data on capacitors; descriptions of common circuit troubles and their remedies; color codes on capacitors, transformers, and resistors as well as electrical formulas and other useful service information. The chart is available to radio and television service technicians without charge from Sprague distributors or directly from the company for a 10¢ handling charge.

Littlefuse, Inc., introduced a counter card display for their Snap-On TV Fuse Holder. The colorful card holds 24 fuse holders and may be used as either a counter display or wall chart.

Allen B. Du Mont Laboratories, Inc., announced a stepped-up sales training campaign for TV dealers. As a follow-through, the company inaugurated an extensive educational advertising program for service technicians, trade papers, and magazines. The first of the series was devoted to the Du Mont Sensituner.

The Radio-Television Manufacturers Association set up a 16-man committee of radio-television set sales managers which drafted a proposed code of ethics for selling and advertising TV sets. Copies of the code were distributed among members for comment and criticism. The RTMA also announced plans for publicizing the fact that the association has established standards for measurement, manufacture, and rating of microphones, speakers and amplifiers.

Brach Manufacturing Corp. is under way on a nation-wide campaign to acquaint TV dealers with the new Brach antennas and the sales potential of the Brach Mul-Tel System. In each area, local Brach jobbers arrange the showings.

Servicing Business

New York Better Business Bureau reported a marked improvement in radio and television advertising and selling practices since the adoption of its fair practice standards. The Bureau has already distributed over 100,000 of its consumer booklets on TV receivers.

The Television Service Contractors Association of Detroit was successful in delaying an action by the Detroit City Council to regulate TV installation and servicing companies. The association objected to a clause in the ordinance proposing the licensing of TV service technicians.

Television Associates, Inc., a Washington, D. C., organization of service firms, has requested the District of Columbia License Committee to consider licensing service firms in the District.

The Television Contractors Association of Philadelphia has directed a campaign to the leaders of the television industry pointing out the critical shortages of skilled service technicians in civilian occupation. It suggests that leaders in manufacturing, broadcasting, servicing, and government meet to prevent the disintegration of TV servicing.

Production

The RTMA reported a peak production in August of 702,287 TV sets, bringing the industry total for the first eight months of 1950 to 4,146,602, already 1,100,000 higher than for all of 1949. The RTMA pointed out further that 3,107,000 TV sets had been shipped to dealers during the first seven months of 1950.

The RTMA estimated radio set production at 1,203,447 for August and 8,750,965 for the first eight months of 1950. Breakdown of the radio production figure for August showed 754,232 home radios, 320,560 auto radios, 128,255 portables.

Radio receiving tube sales hit an all-time high in August—36,269,435 bringing the year's total to 227,773,373 as against 196,753,295 for the entire year of 1949. Tube sales were 28,202,620 for new sets in August and 7,017,115 for replacements. The balance was used for export or for government agencies.

August sales of 767,051 TV picture tubes to manufacturers more than doubled July sales, the RTMA announced. 87% were 16 inches or larger and 51% were rectangular. Sales of transmitting, communications, and radar equipment to the government increased from $30,640,943 in the first quarter of 1950 to $33,393,693 in the second. Government orders went up from $41,305,390 to $51,701,467.

New Plants and Expansions

RCA Victor Division announced the purchase of the Cincinnati plant of the Rich Ladder & Manufacturing Co. for the manufacture of miniature receiving tubes.

Simpson Electric Co., Chicago, opened its new plant No. 5 in Aurora, Ill. The nearly 90,000-square-foot plant will be devoted to the manufacture of panel meters.

La Pointe-Plascomold Corp. purchased an entire new plant in Windsor Locks, Conn. The plant will provide 105,000 sq. ft., doubling the company's facilities for the manufacture of Vee-D-X television antennas and accessories.
PERFECT RECEPTION IS AS SIMPLE AS

You can have nearly perfect TV reception — strong, "snow"-free images — regardless of how faint an image you now receive — with the complete Tel-a-Ray System for fringe areas! It's simple and economical.

The first step in the Tel-a-Ray System is the Tel-a-Ray "T" antenna, which consistently receives images from stations 200 miles away.

To your Model T antenna, mount the new, powerful Tel-a-Ray Pre-Amplifier. This amazing new product of the Tel-a-Ray Research Department eliminates, or greatly reduces, "snow." Because it mounts right to the antenna, it has a high signal-to-noise ratio, bringing you stronger, clearer pictures with less noise. It furnishes consistent reception beyond the fringes and eliminates matching problems and line loss. It is completely weather-resistant, like all Tel-a-Ray products, and sells at a much lower price than other antenna-mounted amplifiers or boosters.

WITH THE COMPLETE Tel-a-Ray System

The final step that brings you almost perfect TV reception is your TV receiver. This simple parlay, A-B-C, is your guarantee of hours of television pleasure, unmarred by foggy images and irritating noise.

FOR PRIMARY AREAS

The Tel-a-Ray Butterfly receives 13 channels and FM radio. Guaranteed to be weather-resistant, it will consistently provide the best reception possible. And the price is just $2.95 (suggested list).

Televiewers throughout the country have come to associate the name Tel-a-Ray with good reception through quality products. If you have a particular reception problem, Tel-a-Ray engineers will be glad to help you.
LEARN ELECTRIC MOTOR REPAIR!

If you're looking for something different—something that not everybody has in his home—something you can learn at home from this book, here's your chance! YOU CAN LEARN ELECTRIC MOTOR REPAIR! from the pages of this book.

There's good pay in this uncrowded field. There are not enough electric motor repairmen in this country. Today's electric motor is so efficient that it lasts longer than ever before. This means that when an electric motor does break down, it seldom breaks down completely. Now you can learn how to service electric motors, and start earning a good living. The possibilities are unlimited.

LEARN TO USE THE OSCILLOSCOPE FULLY!

Not one radio-electronics man in a dozen really knows how to use the oscilloscope—and, if he did, he'd be worth a lot more money. This great instrument saves time, assures better efficiencies on almost any electronic device or service job. Learn how to use it and watch your earnings increase now! MODERN OSCILLOSCOPE and TROUBLESHOOTING TRICKS FOR OSCILLOSCOPES book has given more than any other book or course! During your first 3 lessons you'll train in a familiar language, and with familiar instruments. You'll learn quickly, and you'll be producing results in very little time. Wouldn't this book pay for itself in less than a month? More than a month? It will pay for itself in less time at 35.00 and you pay only $5.00. This makes this book a truly remarkable money-maker. 50 lessons in all. 2nd Edition.

Sylvania Electric Products, Inc., Parts Division, constructed a new plant for the production of plastic and plastic-metal components for the new television and lighting industries. The new plant in Warren, Pa., will provide 30,000 sq. ft. of production space.

Altec Lansing Corp. moved to new and larger quarters in Beverly Hills, Cal. The new plant gives the company an additional 20,000 sq. ft. and enables it to consolidate all three factories under one roof.

Oak Ridge Products moved to a larger plant in Long Island City, N. Y.

Financial Reports

<table>
<thead>
<tr>
<th>Year</th>
<th>Allied Electric Products</th>
<th>Radio &amp; Electronics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>$160,814</td>
<td>$1,658,365</td>
</tr>
<tr>
<td>1949</td>
<td>$160,814</td>
<td>$1,658,365</td>
</tr>
</tbody>
</table>

Hallericrafts Co.

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>$1,167,086</td>
</tr>
<tr>
<td>1949</td>
<td>$1,167,086</td>
</tr>
</tbody>
</table>

Raytheon Manufacturing Co.

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>$508,850</td>
</tr>
<tr>
<td>1949</td>
<td>$508,850</td>
</tr>
</tbody>
</table>

Standard Coil

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>$1,335,393</td>
</tr>
<tr>
<td>1949</td>
<td>$1,335,393</td>
</tr>
</tbody>
</table>

Dividends

ClaroStar declared a dividend of 8c on common stock.
Cornell-Dubilier announced a special 15c extra dividend on common stock. Hallericrafts authorized a 15c dividend on common stock.
Hytron declared a regular quarterly dividend of 12c on preferred stock.
Tung-Sol Lamp Works ordered a 1.25c dividend on common stock.

Business Briefs

RCA Tube Department issued a new edition of the RCA Receiving Tube Manual. . . . HTMA approved membership applications of several laboratories. . . . Celco (Constantine Eng. Labs.); General Ceramics & Steatite Corp.; Telephone Radio Corp.; Trad Television Corp.; Wright-Zimmerman, Inc. . . . RCA Service Co. established a special government service division to expedite government requests for technical personnel and the installation and servicing of electronic equipment. . . . Trad Television is making giant TV sets for military and naval training centers. . . . A U. S. centering all Air Force electronic development activities in Rome, N. Y., was passed by Congress and approved by the President.

Radio Business for...
Testing for sound lost between telephone receiver and ear. Many subjects were used in these tests.

How to compensate for a curl ... and add to your telephone value

Bell scientists know that the telephone is not used under ideal laboratory conditions. There is never a perfect seal between receiver and user's ear. A curl may get in the way, or the hand relax a trifle. And ears come in many shapes and sizes. So some sound escapes.

Now, sound costs money. To deliver more of it to your ear means bigger wires, more amplifiers. So Bell Laboratories engineers, intent on a thrifty telephone plant, must know how much sound reaches the ear, how much leaks away. They mounted a narrow "sampling tube" on an ordinary handset. The tube extended through the receiver cap into the ear canal. As sounds of many frequencies were sent through the receiver, the tube picked up a portion, and sent it through a condenser microphone to an amplifier. That sampling showed what the ear received.

As a result, Bell scientists can compensate in advance for sound losses—build receivers that give enough sound, yet with no waste. That makes telephone listening always easy and pleasant.

It's another example of the way Bell Telephone Laboratories work to keep your telephone service one of today's biggest bargains.

**BELL TELEPHONE LABORATORIES**

Working continually to keep your telephone service big in value and low in cost.
Eye witness reports from a fiery furnace!

A new television development which adds to industry's efficiency

No. 11 in a series outlining high points in television history

Photograph and painting from the RCA collection

Something's wrong in a big blast furnace, and it is too hot for engineers to approach in safety. But now, with the Vidicon camera of an RCA Industrial Television System focused on the flames, the furnace can be studied closely and carefully on a television receiver.

Photograph and painting from the RCA collection

One of the great advantages of this system—other than its contributions to industrial safety—is its ability to save both time and money. No longer need engineers "shut-down" machines or processes to observe them. Normal operations can continue without waste, while the Vidicon System gathers information.

Key to the success of Vidicon is a tiny television camera—small enough to hold in one hand—and inexpensive. The camera's "eye" is the sensitive Vidicon tube developed by scientists at RCA Laboratories. The only other equipment needed is the Vidicon camera's suitcase-size portable control cabinet, which operates on ordinary household current, and any television receiver—on which to view the pictures.

Adaptable to many uses, RCA's Vidicon camera could be lowered under water to watch divers at work—or stand watch on atomic piles, secure from radiation. And this RCA Industrial Television System can also be arranged for 3-dimensional pictures...real as life!

Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION
RADIO-ELECTRONICS for
PAT REID SAYS:

Salesman, United Radio Supply, Inc.
Portland and Eugene, Oregon

"Our 379 servicemen and dealers tell us N. U. tubes are best, because their own experience has proved N. U. tubes are reliable, uniform, and above all are properly designed for interchangeability. What's more, costly call-backs are minimized by N. U.'s proven quality control. That's why we've featured N. U. tubes for 15 years. They mean good business for all of us.

- RADIO AND TELEVISION RECEIVING TUBES
- VIDEOTRON TELEVISION PICTURE TUBES
- PANEL LAMPS
- TRANSMITTING AND SPECIAL PURPOSE TUBES

NATIONAL UNION RADIO CORP.

Main Office: 350 Scotland Rd., Orange, N. J.
Research Division: Orange, N. J. • Plants: Newark, N. J. • Hatboro, Pa.

DECEMBER, 1950
EDW. H. GUILFORD
Vice President

I can train you to pass your FCC License Exams in a minimum of time if you’ve had any practical radio experience—military, Army, Navy, radio servicios or other. My time-proven plan can help you too, if on the road to success. Just fill out the coupon and mail it. I will send you free of charge, a copy of our, to Pass FCC License Exam,” and make FCC radio exam. You can do this right away. “Making FCC License Information.”

Get Your FCC Ticket
Then Use Our
Amazingly Effective
Job-Finding Service
To Get a Better Job

How to Pass
FCC License Exams

FREE

TELLS HOW— WE GUARANTEE
TO TRAIN AND COACH YOU AT HOME
IN SPARE TIME UNTIL YOU GET
YOUR FCC LICENSE

TELLS HOW— Employers make
JOB OFFERS Like These
to Our Graduates Every Month

Telegram, August 9, 1936, from Chief Engineer, Broadcast Stations, Pennsylvania: “Have
Job opening for one transmitter operator to start immediately, contact me at once.”
Letter, August 18, 1936, from James A. Miller, University of Chicago, Chicago, Illinois: “We have two
vacancies in our Radio Communication Division, starting salary $200-$320 after six
months. How about your students—will you recommend graduates of your school?”
These are just a few examples of the job offers that come to our office periodically. Some licensed operators filled each of these jobs—some might not have been

HERE’S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING AT HOME IN SPARE TIME

<table>
<thead>
<tr>
<th>Name and Address</th>
<th>License</th>
<th>Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lee Worby</td>
<td>2nd Phone 16</td>
<td></td>
</tr>
<tr>
<td>2210 W. Wilkerson St., Bakersfield, Cal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clifford Vogt</td>
<td>1st Phone 20</td>
<td></td>
</tr>
<tr>
<td>3429 E. Lake, Fla.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bob Chote</td>
<td>1st Phone 20</td>
<td></td>
</tr>
<tr>
<td>20 Bellevue Pl., Bergenfield, N. J.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bob Davis</td>
<td>2nd Phone 23</td>
<td></td>
</tr>
<tr>
<td>317 North Roosevelt, Lebanon, Ill.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albert Tinswell</td>
<td>1st Phone 20</td>
<td></td>
</tr>
<tr>
<td>110 West 11th St., Euclid, Cal.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk R-24, 4900 Euclid Bldg., Cleveland 3, Ohio
(Approved for Veteran Training Under "GI Bill of Rights")

How to Earn Your FCC License

- Commercial Radio Operator
- Money-Making FCC License Information

Money-Making
FCC Commercial Radio Operator
LICENSE Information

Get All 3 FREE
MAIL COUPON NOW

Cleveland Institute of Radio Electronics
Desk R-24, 4900 Euclid Bldg.,
Cleveland 3, Ohio
(To avoid delay.)

I want to know how I can get my FCC License in a minimum of time. Send me your FREE booklet: "How to Pass FCC License Examinations" does not cover many of the FCC's regulations, as well as a sample FCC type exam and the amazing new booklet: Money-Making FCC License Information.

NAME
ADDRESS
CITY
STATE
ZONE
Vet check for enrollment under G.I. Bill.

RADIO-ELECTRONICS for
ON October 11 the Federal Communications Commission threw a bombshell into the television industry by approving the Columbia Broadcasting System's non-compatible mechanical color television method, as the standard for commercial color telecasting.

As must be well known by this time, the CBS color system consists of a three color spinning disc which when placed in front of the television tube screen gives the viewer color television.

Radio-Electronics finds no fault with the CBS system any more than with a Ford Model T. Both work—both are archaic. Nor can we imagine that ten years hence a mechanical gadget with a spinning disc will be found in our future television sets.

Indeed, television started in 1884 with the famed Nipkow rotating disc. In 1928 the English television pioneer Baird produced color television with the self-same spinning disc.

To us—as it does to most responsible radio engineers—it seems that the F.C.C. decision is most unfortunate because in the end we will have electronic—not mechanical—color television without any doubt whatsoever. It is true that the C.B.S. system today produces color television, with better definition than several of the proposed electronic systems. But, tomorrow it is certain that this condition will reverse itself, as it must.

What then will become of the public's investment in the cumbersome spinning disc color television receivers?

Worst of all, at present the CBS system can only produce 10½ inch pictures. To have color television on a 19-inch screen you would require a rotating disc at least 38 inches in diameter, which would increase the television cabinet size by three to four feet—a monstrosity. Such a television set would occupy more room, or almost as much width as a grand piano! Obviously, such a contraption is not evolution—it's a throwback.

Most of the responsible television manufacturers will have none of the revolving disc television sets because they realize that they will not prevail in the future.

Why did the FCC take such an ill-advised step? As a government agency, the FCC felt that it could not stand by idly while millions upon millions of black-and-white television sets were manufactured which the Commission honestly believed would become obsolete on the advent of color. This to us is fallacious thinking. The coming of color—as engineered in the near future—need do no such thing and we are certain that it will not play havoc with existing television sets.

In our considered opinion black-and-white sets will always be with us in television, or at least for a long time to come.

We have excellent parallels to the present disturbing situation. It is possible today to print every newspaper as well as every magazine in full color. It has been possible to do so for several generations. Yet, how many magazines or newspapers are printed in full color? Only a very small percentage.

Nor are we certain that every reader would want color to the exclusion of black and white, even if it were no more expensive.

The same argument can be made with motion pictures. There is no question that the quality of color in motion pictures today has reached a high state of perfection. But even today with television competition making inroads on motion pictures we only have 14¾ per cent of color motion pictures. It seems that color motion pictures are not universally demanded by the public; otherwise the studios would furnish color exclusively. Furthermore, color motion pictures are more tiring to the eye for most people, particularly when the picture runs for more than one hour.

Perhaps the same reasoning will hold true for future color television as well.

In the meanwhile a most unfortunate situation has arisen in the television industry in that the average layman has become so befuddled on television color that he has no clear idea of what it is all about. The average man believes that if he buys a black-and-white set today it will be obsolete tomorrow. So he refrains from buying.

Actually, in spite of the FCC, no such thing will happen, in all probability.

We have been of the opinion right along that color television—when properly developed—will not disturb in any way our present black-and-white sets. Just as you can take three magazine cover plates and print red, blue and yellow on top of each other to produce a color picture, so you can take the same plates running them in a single color—black—on top of each other. This will produce a good black-and-white picture. Exactly so will your present-day television set continue to receive black-and-white even if "color" is broadcast from every TV transmitter in the land.

As we go to press, Robert C. Sprague, president of the Radio Television Manufacturers Association, predicts a new system in a very short time which does not require adapters for TV sets for black-and-white reception as the CBS systems now does. We quote from his statement:

"The vast majority of the engineers and scientists in the electronic field believe that there will be available within a reasonable length of time a satisfactory commercial color system which is compatible, i.e. a system which can be received in black-and-white on present day black-and-white sets without any change in or addition to these sets whatsoever."

With such a system, in the near future, when all stations transmit color exclusively you can still use your black-and-white set or you can buy a color receiver. The latter will also have a switch so you can change the color picture to black and white, or switch back to color again.

To repeat, all the present day black-and-white sets will not be affected and will give service as they do now. Television should be allowed to evolve in a normal manner just as did radio. Using forceps to force a premature birth may mutilate the color television child for life.
PRESENT Du Mont television receivers have many interesting circuits, some of which are unique with Du Mont, and all of which contribute to uniform and better performance. Better performance implies better pictures. Better pictures must have high definition; sharp focus, full contrast range, freedom from noise, stable synchronization with immunity to noise impulses, high brilliance, freedom from spurious responses, freedom from interfering signals, and many other characteristics.

Improved circuits in Du Mont's 1951 receivers aim for better performance

By RICARDO MUNIZ*

Fig. 1—The narrow-band sync amplifier circuit and sync and a.g.c. detectors.

The circuits discussed in this article are: the narrow-band sync circuit which provides both synchronization and automatic gain control signals with unusual freedom from noise impulses and spurious responses; the cathode drive of the kinescope with a single video amplifier which is free from white compression commonly found in single-stage video amplifiers; a d.c. restoring circuit for the cathode drive; link coupling from the tuner to the first video i.f. stage to provide for use of a u.h.f. tuner and to make lead length and lead dress less critical; double- and triple-tuned video i.f. amplifier stages for minimum phase distortion and maximum skirt selectivity; cathode-coupled vertical blocking oscillator and saw-tooth generator to furnish vertical sweep free from oscillator transformer ringing; and continuous tuning for low noise figure, low susceptibility to FM harmonics, and low oscillator radiation.

Narrow-band sync

Fig. 1 is the circuit of the narrow-band sync circuit as it is used in the Du Mont model RA-112 TV receiver chassis. The full video bandwidth of the video i.f. amplifiers is not needed to amplify the sync signals adequately. By using a sync amplifier with a considerably smaller bandwidth, the amplified signal will have a lower noise content. Noise is further reduced by grid cutoff and plate saturation limiting in this stage. This tends to increase the sync stability of the picture and, since the a.g.c. voltage is also derived from this amplifier, the a.g.c. is more stable.

The i.f. signal which is applied to the video detector is also amplified by 6BA6 sync and a.g.c. amplifier and then is passed through a 1-mc wide, double-tuned transformer centered on the video carrier. Two detectors then detect the signal: a peak detector for the a.g.c. voltage, and a video detector for the sync signals. The sync detector is much more efficient than the usual video detector because its bandwidth need be only 0.5 mc.

The smaller bandwidth of the inter-stage transformer reduces the noise content of the signal before detection but has adequate width to reproduce the sync signal as the receiver is tuned across the picture carrier. There is no sync signal or a.g.c. except close to the optimum tuning point. This means that the set owner cannot have his receiver mistuned by very much and therefore cannot receive with degraded sound and picture quality.

Cathode drive

Several of the current Du Mont models use cathode drive on the picture tube with a single-tube video amplifier. Fig. 2 shows this circuit as it is used in model RA-112. The diode video detector is not linear and has a rather sharp curvature as the voltage goes toward zero or, in the case of a TV signal, toward white. This causes the white portion of the video signal to be compressed as shown in Figs. 3-a. 3-b, and 3-c. If this voltage can be counteracted by the grid-voltage-plate-current char-

*General Manager Television Receiver Mfg. Div., Allen H. Du Mont Laboratories

Fig. 2—Schematic showing the cathode-driven kinescope and the d.c. restorer.

RADIO-ELECTRONICS for
characteristic of the video amplifier, the over-all characteristic will be more nearly linear and the white compression caused by nonlinearity of the de-

tector is minimized as indicated by Figs. 3-d and 3-e.

White compression on a TV receiver is most noticeable at the bulb's-eye center of a test pattern. Fig. 4-a shows a test pattern with the gradations as they should be, and 4-b shows white compression which appears as a lack of difference in shading between the two outer and lighter rings. When viewing a picture, white compression shows up as a lack of "snap" or crispness in the picture which leaves the viewer vaguely dissatisfied but not quite sure what's wrong.

**D.C. restorer**

The conventional d.c. restorer circuits being ineffective with cathode drive, the circuit shown in Fig. 2 is used. The coupling and the video amplifier. The plate of the video amplifier is also coupled directly to the cathode of the picture tube. This tends to put a high positive voltage on the cathode which may exceed the heater-cathode rating of the tube. To avoid this, a negative voltage is applied directly to the cathode to make the positive voltage on the cathode 65 at no signal. A negative voltage is also applied to the grid of the cathode-ray tube, the net effect being to keep the screen at a gray level when no signal is present. When a signal is applied, the screen becomes black at the black parts of the picture. The d.c. restoration is applied to the grid of the cathode-ray tube because the cathode circuit impedance is too low for efficient operation.

**Link-coupled tuner**

Link coupling is used between the tuner and the i.f. amplifiers for greater flexibility in chassis layout and to make the circuit adaptable to a u.h.f. tuner in place of or in addition to the v.h.f. tuner normally delivered with these receivers. Neither this low-impedance link coupling, the lead dress, nor the lead length is critical. Fig. 5 shows the circuit from the plate of the mixer tube to the grid of the first video i.f. stage.

Winding L2 is closely coupled to the mixer plate winding L1, and varying L3 varies both the coupling and the bandwidth between the two circuits. Fig. 6 is an equivalent circuit of the coupling network which shows how L3 provides an effective shunt inductance to vary the coupling and bandwidth.

**The video i.f. stages**

Fig. 7 is the circuit of the video i.f. amplifier. T2, T3, and T5 are top capacitance-coupled transformers. T4 is a triple-tuned stage of which one section is a 21.75-mc sound trap. The 6BC5 is used in the last stage to get more signal at the video detector before sync compression takes place than is possible with a 6AU6. An interesting feature of the top capacitance-coupled stages is that the variable capacitance coupling is achieved by a wire inserted a varying distance in a ceramic sleeve mounted in the i.f. transformer as shown in Fig. 8.

A block diagram of the i.f. amplifier is shown in Fig. 9. Below the blocks are the individual bandpass characteristics achieved in production alignment. This i.f. circuit is designed to get a minimum bandpass with minimum phase distortion and maximum skirt selectivity.

**Vertical sweep generator**

One of the big problems of vertical sync circuits is furnishing a vertical sawtooth voltage that is free from the ringing or damped oscillations that usually appear in blocking oscillator transformer windings. Fig. 10 is the circuit of the vertical sawtooth generator used

---

**Fig. 3—How tube characteristics are combined to reduce white compression.**

**Fig. 1-a, top—Normal tone gradation from black to white at the bulb's-eye.**

**Fig. 1-b, bottom—Compression of whites.**

**Fig. 2—Restoration and coupling network.**

**Fig. 3—How tube characteristics are combined to reduce white compression.**

**Fig. 6—Equivalent circuit of the link coupling to show how the tuning works on Du Mont chassis models RA-112 and RA-113.**

This circuit is a typical blocking oscillator except that one side of the transformer is in the cathode circuit of the tube. This isolates the sawtooth voltage at the plate from the ringing voltage that appears in the transformer winding when the tube is in the cutoff condition. This is not true when the transformer winding is in the plate circuit.

---

**Fig. 7—Circuit of the video i.f. amplifier. The 6BC5 i.f. output is used to get more signal at the video detector before sync compression takes place. The top capacitance coupling of T2, T3 and T5 is varied by the novel method shown in Fig. 8.**

---

**DECEMBER, 1950**

www.americanradiohistory.com
Continuous tuning

The Du Mont Inputunera\(^2\) used in the current TV receiver production use the same principle of continuous tuning by inductance variation as in older models but have some electrical and mechanical improvements. Among these are an additional tuned circuit without increase in size and a skip tuning device which automatically bypasses the unwanted part of the spectrum between the FM band and channel 7.

The new Inputunera have a sliding-contact gang inductor called the Inductuner\(^3\). The latest Inductuner uses flat spiral inductors which allow room for four tuning sections in less space than was used by three sections in the older type. The added section is hooked up between the antenna and the r.f. tube to give better rejection of unwanted signals and to improve gain and signal-to-noise ratio. The circuit of the r.f. assembly is shown in Fig. 11.

The r.f. gain increase \(i\) in the order of 2 to 1. Image rejection is improved by five to ten times over that of previous tuners. I.f. rejection is increased by over 100 times due to the trap action of the coupling circuits.

The band-skip feature reduces the number of turns of tuning motion from six to four and improves the tuning curve over the high-frequency channels. This jump from the FM band is accomplished by the design of the contact mechanism in the tuner.

The continuous tuning assures optimum picture and sound setting because the input circuits and the oscillator are shifted together as vernier adjustment is made.

Other than the spiral inductance tuning, the r.f. circuit has no unusual features. A 6J6 triode is used as the r.f. amplifier. This tube generates less noise than a pentode. While more gain could be achieved with a 6CR6 or similar pentode, the added section of the spiral tuner makes this unnecessary. The parallel-connected tube gives the r.f. stage adequate gain.

---

ADVICE TO TV OWNERS CUTS NUISANCE CALLS

To cut down the number of nuisance service calls on TV sets, the Akron (Ohio) Merchants Association is distributing a Television Card to set owners with suggestions for checking the set's operation. Compiled by the Television Committee of the Electric Institute of Washington, the list contains this advice:

Before you call your Television Serviceman—

1. If the set is completely dead, is the line cord plugged into the electric outlet? If the cord is plugged in, unplug it and try a lamp in the same outlet. If the lamp lights try the set when plugged in again.

2. Look at the antenna wire on the back of the set. Make sure the leads are firmly connected to the terminals on the set and that the bare leads are not touching each other.

3. If the sound is normal, but you have no picture, turn on the brightness and contrast control full on and also try another channel.

4. If the picture is normal, but you have no sound, adjust the “fine-tuning” control with the volume control turned full on. Also try another channel.

5. In suggestions 3 and 4, if only one channel is affected, allow the station time to announce any technical difficulty which might have occurred.

6. If sound is normal and picture tube has light with the brightness control full on, but the picture is rolling, tearing out or no picture on all channels, adjust the “horizontal hold” or “vertical hold” controls. Try reducing contrast or picture control and readjust tuning.

7. If sound is weak and noisy, and the picture has excessive snow, see if the antenna is still installed in its original position. Also recheck suggestion No. 2.

After following these seven suggestions, if the trouble has not been corrected, call your service dealer.

Many set owners have very little idea of the complexities of a television receiver. When something goes wrong they will call the service technician whether they need him or not. The seven rules printed above will make both parties happier.

The committee might have included an additional rule: If you get four images at once on the screen when adjusting the hold controls, don’t worry—you are picking up a color broadcast.

NEW STEEL FOR TUBES

Larger rectangular picture tubes are promised as a result of a new stainless steel having a heat expansion rate practically the same as that of glass. Developed by the Carnegie-Illinois Steel Corporation, the new alloy retains all the desirable characteristics of stainless steel for picture tubes, but will not crack the glass when the tube heats up.
Fundamentals of Radio Servicing

Part XXII—How to Trap a Signal

By JOHN T. FRYE

We are ready to try out the broadcast receiver we have been studying stage by stage for the past several chapters. What is needed now is a live signal to make our radio set perform. Since the air is filled with transmissions from many broadcast stations, all we have to do is to intercept one of these signals and lead it into the signal grid of our mixer tube. We know what will happen to it from there on.

Before we set out to trap a signal we should, like any good trapper, have some idea of the characteristics and habits of the game we are after. The “trapee” in this instance is a transmitted radio signal; and, while its characteristics are somewhat more complicated than the rules for playing post-office, they are by no means beyond comprehension.

We already know that, when a 60-cycle alternating current flows through a wire, the conductor is surrounded by a panting magnetic field. Part of the electrical energy is alternately stored in this field and then returned to the wire. If the frequency of the alternating current is increased to 10,000 cycles a second and beyond, some of the energy delivered to the field about the wire does not return to the conductor but sails off into space as radiated energy. When a transmitting antenna is substituted for our conducting wire and certain other favorable conditions are established, vast encouragement is given to the high-frequency alternating current to leave home and to keep going.

Fig. 1—Patterns showing the electromagnetic and the electrostatic fields of force of a radiated electric signal.

Fig. 1-a gives us a head-on view of this free-wheeling radio wave as it zips through space directly toward us at a speed of 186,000 miles a second. Notice that there are really two fields, which share the energy of the wave equally between them: an electrostatic or “voltage” field, and an electromagnetic or “current-inducing” field. These two fields are as inseparable as Siamese twins, and they always act at right angles to each other, and both operate at right angles to the direction of travel.

Broadcast-band waves ordinarily have their electrostatic fields producing lines of force in a vertical direction with regard to the earth and are said to be “vertically polarized.” Television stations in the United States send out waves whose electrostatic stress is exerted parallel to the earth and are called “horizontally polarized” waves.

Fig. 2—A simple antenna circuit with inductive coupling to the mixer grid.

At the instant pictured in Fig. 1-a, the electrostatic stress is from top to bottom, and the electromagnetic stress is from left to right. Fig. 1-b pictures the same wave passing the same place at a time interval equal to one-half wavelength later. Note that by now the electrostatic stress is from bottom to top and the electromagnetic stress is from right to left.

The thing to keep clearly in mind’s that these two fields are moving and that as they move past a stationary portion of space they produce stresses in that space. For example, as the electrostatic portion of the wave encounters two points in space, one directly above the other, first the top point will be positive with respect to the bottom point and then the bottom point will be positive with respect to the top point. If the two points are connected by a length of wire, an alternating current will flow in this wire as the radio wave zips past it.

Sna-ring the signal

Fig. 2 shows how we take advantage of this fact to trap a signal for use in our receiver. A vertical wire is connected through coil L1 to the earth. The top of this antenna and the earth constitute the two “points in space” mentioned in the foregoing paragraph. The current flowing in L1 is inductively coupled to the tuned circuit L2-C1. By resonating this tuned circuit to the signal we want to receive, we can reject all other signals flowing in the antenna circuit and allow only the wanted one to appear on the grid of our mixer tube.

This “outside” antenna provides a good method of intercepting a radio signal, but it has some disadvantages. First, since its effectiveness depends to a large degree on its height, it is difficult to install; second, special precautions must be taken to prevent this elevated antenna from extending the welcome-mat to a bolt of lightning; third, few antennas of this kind do anything for the appearance of a home; and fourth, a radio used with such an antenna is more or less rooted to one spot near where the lead-in is brought into the house.

This last item was particularly exasperating to those housewives—and their name is legion—who dearly love to shuffle the furniture around the house every few weeks. The little women demanded a radio that could be moved! So, the radio engineers sighed, picked up a candle, and disappeared into their attic of discarded electronics. A few hours later they reappeared
triumphantly clutching a dusty and cobwebbed "loop" antenna that they had wrested from one of the earliest console battery receivers. As can be seen from Fig. 3, the modern high-impedance loop antenna is really just an expanded antenna transformer. Instead of occupying only a couple of inches of space, the secondary of the transformer is wound in the form of a spiral or large diameter helix so that it has an area of many square inches. In this enlarged form, it can intercept a sizeable portion of the field of its plane and so provide sufficient signal for the receiver without being connected to an outside antenna.

**Directional properties**

Such a loop antenna is directional; that is, it will receive a signal much better when the loop is arranged so that its plane is parallel to the line of transmission of the radio signal than it will when this plane is at right angles to the line of transmission. If you will look at the simplified one-turn loop shown in Fig. 4, you can see why. At 4-a the incoming signal strikes both sides of the loop at the same instant. The currents induced in the two sides of the loop by the passing magnetic field—the loop depends upon the electromagnetic field of the radio wave for its action—are equal and opposite in phase; so they simply buck each other out and the signal is received very weakly if at all.

At 4-b, however, the wave strikes one side before the other. If you keep in mind that, as the wave moves through space, its fields are constantly shifting back and forth, you can see that the direction and intensity of the current induced in the first leg of the loop cannot be identical with the direction and intensity of the current induced in the second leg, because the wave has traveled through space between these two encounters and the electromagnetic field that produces the current has changed somewhat during that short trip. Since the two currents are not identical, they cannot balance each other out, and we shall have an alternating current flowing in our loop. Do not think that the two currents are in phase when the loop is parallel to the line of transmission—the loop would have to have its two sides a half-wavelength apart for that—but they are not 180 degrees out of phase as they are when the plane of the loop is at right angles to this line. This slight shift away from the 180-degrees-out-of-phase condition is all that is needed to let a signal be received.

The voltage pickup, as can be easily understood, is proportional to the loop area. The farther the loop is located from the chassis or any other large metal object, the lower is its distributed capacitance, the higher is its Q, the sharper it tunes, and the more directional it is. Unfortunately, the usual small receiver permits the loop to be placed only an inch or so from the chassis.

One way of overcoming some of these disadvantages is to make the loop detachable from the receiver and arranged so that it can be held in the best position by suction cups.

**Improved loop antennas**

An approach that is more electronic and less mechanical is diagrammed in Fig. 5. Here a loading coil L is used in series with the loop. This loading coil has a very high Q and a low distributed capacitance. Since the distributed capacitance of the loop circuit is thus reduced, the tuning range of the loop is extended for use with a given capacitor. Raising the Q of the tuned circuit gives sharper tuning and better signal response. In many receivers, this loading coil is slug-tuned for best tracking over the tuning range.

Provisions are usually made for connecting an outside antenna to these loops for receiving distant or weak stations. A low-cost way of doing this is to place a single turn of wire around the loop at the low-potential side as is shown in Fig. 3. Such an arrangement tends to favor the high-frequency end of the band, but that can be overcome by inserting a resistor of 500 or 1,000 ohms in series with the single turn. If too much coupling is provided, the signals tend to be hum-modulated and the selectivity suffers.

A high-impedance primary, such as that shown in Fig. 5, gives a more uniform coupling than does the single-turn job of Fig. 3, but it is guilty of the cardinal sin of manufacturing it costs more! When such a high-impedance primary is used, it is usually provided with a shorting link to be used when an external antenna is not connected. This is to prevent the absorption of energy by the primary coil at its resonant points that fall in the broadcast band.

One manufacturer has still another system for getting around the disadvantages of the high-impedance loop. He uses a low-impedance loop, as shown in Fig. 6, which consists of two to four turns of large-diameter wire. This is inductively coupled to the grid of the mixer tube through a very high-Q autotransformer. The low-impedance loop is relatively insensitive to capacitance effects and to calibration changes due to changing its position. Both the Q and the response are practically uniform throughout the broadcast band. The external antenna, when used, is connected directly to the high-potential side of the loop.

Many of the better receivers place loop antennas inside electrostatic shields. This serves the double purpose of cutting down on much man-made interference and of insuring uniformly distributed capacitance effects for the loop. These directional properties of a loop antenna are very fine for cutting down on interference, either from an unwanted radio station or from a noise source that occupies a single point in space, but like most good features it also has a few drawbacks.

Even those who do understand the operation of a loop are loath to be twisting the set about every time a station is tuned in. When the set is a large console and has a fixed-position loop, taking advantage of its directional properties requires the energy of a fox terrier and the physique of a piano mover.

Fortunately, a lot of movement is not required. The "null" or no-reception points of a loop are very narrow compared to the area through which reception can be had. Moreover, all except the cheapest consoles provide some method of varying the position of the loop through a few degrees without moving the cabinet.

While it must be admitted that the loop antenna is not the most efficient device for snatching radio signals out of the ether, there can be no doubt that it is the most popular with radio receiver owners today. Because of the number and power of broadcasting stations, the majority of receiving locations are blanketed with powerful signals that make it unnecessary to have an antenna system of maximum efficiency. A loop antenna will usually pick up enough energy for satisfactory reception—and remember, the little woman can move a loop set to her heart's content!
Readers of this column have noted that in the last three months, the dx reports have all been for the low channels. DX on the high bands scarcely ever goes over about 300 miles.

This month we do have three reports of dx on the high band. One is from F. J. Glaub of East Moline, Ill., who picked up WHIO-TV in Dayton, Ohio on channel 13, and station WKRC-TV in Cincinnati, Ohio on channel 11 September 5. The airline distance in both cases is about 370 miles. The receiver is an Admiral 30C1 and the antenna a Taco stacked dipole 20 feet off the ground and aimed at Chicago.

The second high band report is from E. Swanson of Rockford, Ill., who received WSPD-TV, channel 13, in Toledo, Ohio, on September 6 and 7. In this case the receiver is a G-E Model 805, the booster an Anchor, and the antenna a 4-bay Radiant conical. The distance is about 300 miles.

One reader in Halifax, Nova Scotia reports several dx receptions, of which three were over 1,000 miles on the low band, and one high band reception of 450 miles. This report includes an interesting observation on cloud formations and their effects on dx receptions.

Apparently dx reception is possible at this location only when alto-cumulus or cirro-cumulus clouds are in the sky. The alto-cumulus, a feecly cloud formation often seen in flocks or rows, seems to give the long hops; and the cirro-cumulus, clouds in small round masses at high altitudes and usually in lines (called a mackerel sky), seems to give the double hop. An interesting feature of this report is that the strongest signals were received from the most distant stations.

What really happens in these long distance receptions is still not fully understood by the engineers. Part of the radiated energy from the transmitting antenna goes up toward the sky at anywhere between 3 and 90 degrees with the horizontal. These waves soon reach the ionosphere, a region about 70 miles above the earth's surface which contains large concentrations of charged particles, both free electrons and ions, as well as neutral molecules.

The prodigal sky wave may or may not be reflected back to the earth when it hits this region. This depends on several conditions, of which the most important are the angle at which the sky wave hits the ionosphere, the frequency of the wave, and the concentration of the charged particles of the ionosphere. While the first two of these can be determined exactly, the third is a largely unknown factor which is continually changing. This, of course accounts for the unpredictability of tv dx.

The reason the high band dx is less frequent is that the higher frequencies are not as readily reflected as the lower. It is likely that some of the waves will reflect from cloud formations, as the letter from our reader in Nova Scotia indicates. What seems more likely is, that the cloud formations are an indication of the condition of the ionosphere. In any case, much more must be known about the propagation of radio waves before anything certain can be said.

The low band reports of over 1,000 miles are shown in the two tables below as in the past, and again we thank those who have sent in their dx records.

### Table I — Report of Reception

<table>
<thead>
<tr>
<th>STATION</th>
<th>REPORTED BY</th>
<th>TIME RECEIVED</th>
<th>MILEAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEYV-TV</td>
<td>H. Brink</td>
<td>6 18</td>
<td>1,000</td>
</tr>
<tr>
<td>KOB-TV</td>
<td>W. R. Henry</td>
<td>9 24, 9:25-10 pm</td>
<td>1,200</td>
</tr>
<tr>
<td>KPBC-TV</td>
<td>K. D. Anderson</td>
<td>7 13, 7 14</td>
<td>1,000</td>
</tr>
<tr>
<td>KHLV-TV</td>
<td>Mrs. W. Callin</td>
<td>8 1, 10:30 pm</td>
<td>1,120</td>
</tr>
<tr>
<td>WAGA-TV</td>
<td>A. C. Olberg</td>
<td>7 7, 7-8 pm</td>
<td>1,015</td>
</tr>
<tr>
<td>WBAP-TV</td>
<td>A. C. Olberg</td>
<td>6 18, 11:30 pm</td>
<td>1,060</td>
</tr>
<tr>
<td>WBC-H-TV</td>
<td>A. C. Olberg</td>
<td>7, 7-8 pm</td>
<td>1,095</td>
</tr>
<tr>
<td>WBTY-TV</td>
<td>A. C. Olberg</td>
<td>7 12, 4-5 pm</td>
<td>1,030</td>
</tr>
</tbody>
</table>

### Table II — Receiver Data

<table>
<thead>
<tr>
<th>NAME</th>
<th>LOCATION</th>
<th>RECEIVER</th>
<th>BOOSTER</th>
<th>ANTENNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. D. Anderson</td>
<td>Kirkhove, Minn.</td>
<td>Emerson Tech Master Kit Muntz Philco 51-T-1443B</td>
<td>Triac Lite 45-bay conical Folded dipole double Vee</td>
<td>Masco Anchor</td>
</tr>
<tr>
<td>H. Brink</td>
<td>Dixon, Ill.</td>
<td>A. C. Olberg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mrs. W. Callin</td>
<td>Altoona, Pa.</td>
<td>Mr. Roland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Anderson</td>
<td>Lazy H</td>
<td>A. C. Olberg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. Bennett</td>
<td>Midwest</td>
<td>Olberg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T. Row</td>
<td>Arkansas</td>
<td>Olberg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

December 1, 1950

www.americanradiohistory.com
CONVERSION business is becoming an important part of readers' work, to judge from the increasing number of letters being received. Many small-screen TV sets now require a replacement for the picture tube and naturally the owners want a larger picture. In many cases a tube can be made without changing the switch from a 10- to a 12-inch picture cabinet. Sometimes a rectangular 14- or 16-inch tube can be mounted with only minor changes in the cabinet. Many service dealers are accepting older TV sets as trade-ins and reselling them with a larger tube and a new cabinet.

Radio-Electronics has featured several articles on converting TV sets to larger picture tubes, the most recent and comprehensive in the January, 1950, issue. Conversion kits are available at radio supply houses, each with a detailed circuit description. It would be repetitious to go into details of all these circuits, but the principles of converting TV receivers deserve some discussion.

Most of the larger screen tubes differ in two main aspects from the 10- or 12-inch tube found in older sets. First, the new tubes require a higher second-anode voltage for proper brightness and sharp focus. The second requirement is additional deflection, especially horizontal. More horizontal sweep is required because of the higher second-anode voltage and because the new tubes are relatively short and therefore have a larger deflection angle. An illustration of the effect on bulb length and deflection angle is given in Fig. 1.

The deflection angle for all 10-inch tubes is 52 degrees and for most 12-inch tubes it is 55 degrees, which permits direct substitution whenever plenty of horizontal sweep is available for the 12-inch tube. The larger screen picture tubes, however, have a deflection angle ranging from 60 to 70 degrees and 90-degree tubes are being developed. To deflect the wide-angle tubes, the deflection yokes must be shorter and designed to eliminate neck-shadow as shown in Fig. 2.

The vertical deflection circuits of most receivers have enough reserve power to sweep the new tubes, but in some cases the vertical circuit must be changed. Connecting the plate of the vertical output amplifier to a higher voltage, usually the boost obtained from the horizontal damper tube, or increasing the sawtooth driving the output amplifier is the simplest way to increase vertical sweep.

To get more high voltage and at the same time more horizontal sweep it is necessary to use a suitable flyback transformer and deflection yoke. Most of these transformers are of the high-efficiency type, containing not a powdered iron but a ceramic core which gives higher Q and more permeability. Such a transformer is the G-E 77J1 or its counterparts from other manufacturers. To match the transformer the deflection yoke is of special design, usually also containing a ceramic core and specially shaped windings. The inductance of most of these yokes is higher than the original 8.3 mh, ranging from 10 to 18 mh. The circuit used...
with the G-E 77J1 and similar flyback transformers requires a special width-control coil.

In addition to requiring changes in the flyback circuit and the deflection yoke, many of the large screen picture tubes also require more focusing flux. This is obtained by using a larger focus coil or by installing one of the new combination EM-PM units. Lately some all-PM focusing rings have appeared on the market which could be used for some large-screen tubes. Many of the new tubes have a tilted electron gun which needs a single-pole magnet ion trap as compared with the double-pole magnet used on the 10BP4 or the 12LP4. The table shows the different picture tubes and the requirements for conversion.

**Horizontal pull**

I have especially bad horizontal pull on a 630-type TV set when a close-up appears. I also have a white smear running down the left side of the picture. Tubes and voltages appear to be correct.

—E. B. N., San Francisco, Cal.

The best way to find the fault is to observe the different waveforms on an oscilloscope and compare them with those shown in the RCA instruction manual. If you can improve the condition somewhat by lowering the bias on the 6SK7 sync amplifier, the trouble may lie in the video or the d.c. restorer circuit. Measure the bias voltages on the 6AU6 and 6K6 video amplifier carefully and replace the 6AL5 d.c. restorer with a new tube.

Both shorts on the synchrolock transformer must be properly adjusted before any other circuit can be checked. Also try replacing the 6AL5 sync discriminator and the 6AC7 reactance tube. Emission checks are not good enough with these tubes. As a last resort, replace this synchrolock transformer itself, as it may have some shorted turns.

**Poor contrast**

I own a 16-inch Transvision TV receiver. The contrast is poor. The picture tube is a 16DP4. Will this tube work with 13.5 kv on the second anode?


The contrast depends on the gain of the receiver, especially the video amplifier. If the i.f. sensitivity is satisfactory, you may need a new video amplifier tube. As a last resort, a higher value plate resistor in the video output tube will give you more contrast.

The 16DP4 may be operated with 13.5 kv on the second anode without damaging it.

**Hash**

Many 630-type receivers which have been converted for larger picture tubes and keyed a.g.c. have a faint hash. This appears on weak stations and I feel sure that it is not an external interference.

—H. W., Brooklyn, N. Y.

There are several possibilities. It may be a 4.5-mc beat which becomes more apparent when a direct connection is made from the detector to the first video amplifier, necessary for keyed a.g.c. A 4.5-mc trap in the last video amplifier will eliminate this.

The hash may also come from i.f. misalignment, especially the traps. Re-alignment is necessary when a.g.c. is added to the 6L0. To disable the a.g.c., simply shunt a 3-volt battery across the bias source with the negative side to the bias and the positive side grounded.

A third possibility is that the hash may not be apparent on the smaller screen, but only on the larger picture tube. However, some a.g.c. circuits alter the video amplifier response curve and cause a loss of detail. In that case the fault is not in the a.g.c., but in the values of the video peaking coils. It may be necessary to use new coils.

**No picture**

I have an RCA 730 TV2 on which I can't get a picture. Sound and raster are O.K. All tubes check good.—E. S., Chicago, Ill.

If sound and raster are O.K., the trouble must be either in the picture i.f. amplifier, the video detector, or the video amplifier. While tubes may check good in a tester, it is better to check them by substituting new ones. This is especially important in the case of the 6AL5 video detector.

Barring tube failure, a close inspection for broken leads, poor tube socket contacts, charred resistors, etc., in the i.f. and video amplifiers may show the defect. Measure all plate voltages. If the defect still is not apparent, check each coupling capacitor by shunting it with one known to be good. If you have an oscilloscope, you can trace the picture from the second detector to the defect. Measure the detector output. A small d.c. voltage should be developed across the diode load resistor as the set is tuned from one active channel to another. If no change occurs, the trouble can probably be localized in the video i.f. amplifier.

**Distorted picture**

An Emerson model 571 takes a few minutes before the test pattern becomes round. After another 5 minutes, the picture at the left side stretches while at the right it remains normal. Changing tubes in the horizontal deflection circuit did not help.—B. F., Brooklyn, N. Y.

A defective capacitor is probably the fault. This is most likely one of the coupling capacitors going to the horizontal output amplifier grid. Checking such a capacitor with a meter is not sufficient as it apparently goes bad only when heated up. The best method is to substitute a good capacitor for each coupling capacitor and for the charge and discharge capacitor (C-59) in the plate circuit of the horizontal discharge or sawtooth generator tube. Paper and electrolytic capacitors are more likely to become leaky than micas or ceramics, although the latter may become intermittent.

**Airplane flutter**

Whenever an airplane passes over my house, a diagonal white line appears and the picture moves on my De Wald BT100 TV set, chassis 630.—N.B., Elizabeth, N. J.

This set does not have a.g.c., and therefore you get the airplane flutter. When a plane passes over rapidly, the reflected TV signals change slightly in frequency. Unless you are willing to add a special tube and make several wiring changes, you cannot get rid of this effect on your present set. A special keyed a.g.c. is used in many 1950 TV sets to compensate for airplane interference. Tech-Master Products offers a Keyed A.G.C. Kit, available in most radio supply houses, to eliminate airplane flutter in 630-type sets. This kit contains all parts and mounting brackets to eliminate the need for additional holes in the chassis and major circuit changes. Complete instructions are furnished with the kit.
The time-base generator is an important part of the cathode-ray oscillograph. The signal to be investigated usually must be plotted as some function of time. This is done by feeding the signal to one pair of deflecting plates while a second voltage proportional to time is fed to the other pair. The circuit that generates this latter voltage is called a sawtooth time-base generator. Not only used in oscilloscopes, the saw-tooth generator is essential to TV because it separates the picture for transmission and puts it back together at the receiver.

To better understand the sawtooth generator, suppose we analyze a simple form using a neon bulb as in Fig. 1. The capacitor C charges through R from the supply voltage at a rate depending upon the R-C time constant (the time required for the voltage on the capacitor to reach 63% of the applied voltage) which is the product of R×C or 200,000 microseconds. During the charging time, the neon bulb is an open switch. If the conducting point of the neon bulb is 100 volts, it will fire when the capacitor charges to that value and discharge the capacitor. Then this process repeats, charging and discharging the capacitor. The output voltage waveshape is in the shape of a sawtooth due to the capacitor charging voltage rising along a logarithmic curve to the conducting point and then discharging rapidly to the extinction point. These intervals continue as long as the voltage is applied. The frequency depends upon the supply voltage, the ignition voltage of the lamp, and the R-C time constant. Usually the R-C time constant is varied by switching in different capacitor values, providing a rough frequency control, while R is varied for a fine adjustment. However, the neon sawtooth generator is not often used because it is difficult to synchronize.

Single sweeps
In some cases the signal to be observed exists only for a short time and then disappears. This is called a transient. If the ordinary sawtooth generator is used for such a signal, the electron beam moving across the face of the cathode-ray tube is independent of the beginning of the transient and there is no way to determine when it occurs. This problem is solved by using a single-stroke sweep generator that generates a time base only when the transient occurs. The sweep is started by the transient itself or some identical signal voltage applied to the sync input terminals.

An ordinary thyatron sweep circuit can be used for this purpose without much change.

In the circuit of Fig. 3, the plate of a diode-connected 6C5 is connected to the plate of the 884 thyatron through a small resistor. The cathode of the diode

---

Fig. 1—This neon lamp circuit is the simplest form of time base generator.

Fig. 2—A thyatron sawtooth generator with frequency from 20 cycles to 30 kc.

Fig. 3—a thyatron single sweep circuit for observing transient signals.
electrically charged particles for their part, repel the point with the same strength with which they are in turn repelled by it. This is the basis of the electric windmill (Fig. 3). In denser air the electric wind blows slowly, though this is compensated by a greater impulsive force or impact compared with the energy used. In thinner air its velocity is higher, but the impulsive force is less compared with the energy produced. In denser air the electrically charged particles (charged molecules, ions, or electrons) pass between the uncharged molecules of the medium and drag them along, at the same time, of course, the particles initially very rapid flight being thereby slowed down. Accordingly, the greater the number of air around the charged particles, a large mass of air is set in motion—but with only a small velocity; if the air is thin, the charged particles encounter fewer uncharged molecules, and the velocity of the gas streaming away is correspondingly higher. In a highly evacuated Geissler tube, for example, the molecules and atoms which fly from the anode develop mean velocities of 30 to 250 miles/sec, whereas in contrast to this the cathode emits free electrons for the most part which, because of their small mass, can reach velocities of 56,000 miles/sec. For a given quantity of energy supplied, the recoil action increases with the increase in the quantity of matter repelled, but the velocity of repulsion diminishes. This is also true in a vacuum where all the repelled particles are table 1

<table>
<thead>
<tr>
<th>(m/sec)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>10</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>m&lt;sub&gt;1&lt;/sub&gt;</td>
<td>0.6</td>
<td>0.51</td>
<td>0.42</td>
<td>0.34</td>
<td>0.28</td>
<td>0.19</td>
<td>0.13</td>
</tr>
<tr>
<td>m&lt;sub&gt;2&lt;/sub&gt;</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

which are flung off nevertheless remain longer in the neighborhood of the rotating wheel, and therefore have more time in which to exert their repulsive force on the particles. Accordingly, as indicated in equation (1), it is possible with the same consumption of material to develop a greater recoil momentum in highly rarified gases, as a result of high recoil velocities (though at the cost of greater expenditure of energy). A perceptible electric wind arises only when enough electrically charged molecules are set in motion. In dense air the electric wind produced electrically, is only in the vicinity of charged points where the charge density is very large, unless the potentials are millions of volts. But if we are dealing with high rarefaction of the surrounding gas, the electric density is sufficient to charge a considerable percentage of the surrounding air molecules; in which case the electrodes need no longer be pointed, and the charged particles are emitted from rounded or flattened surfaces and proceed in a direction perpendicular to the surface. If air or other gases are completely absent, such a stream of particles can be generated only if the electrodes themselves supply the particles. This is the case, for example, of the hot cathode which surrounds itself with a cloud of electrons, of the potassium-containing photo cell which upon irradiation with ordinary light emits charged particles, or of anodes which either consist of fused salts as in the von Gehrke-Reichenheim method and from which individual ions are torn loose, etc. Electrodes Accordingly, the electrodes of the electric spaceship might look like the model in Fig. 4. This should be a cylinder whose walls and one end are impermeable to both gas and electricity, but the other end of which is fitted with a permeable material. This end can be either porous or at least permeable so far as the contents are concerned. In the cylinder is a substance which, if the end piece is porous, had best be a liquid, though it can also be a solid if its vapor tension is high enough (solid carbonic acid or ice). This material, or at least its vapor, oozes through the porous end of the cylinder. Since the cylinder is highly charged, the charged particles fly out with considerable velocity. The quantity of matter which trickles through the porous end of the cylindrical electrodes depends on the nature of the porous material and on the chemical nature of temperature of the contents of the cylinder. It would be most useful to provide the electrode with an electric heating device, which would keep the temperature at the desired level. Then the velocity of efflux and electrotech could be regulated. Up to now everything pertaining to the invention of the electric spaceship electrically charged and the latter no longer drag along any uncharged molecules in their flight. In this case, when the first stream of matter repelled, the electric field carried along will accumulate to form a high potential—causing a more rapid flight of the particles. When more particles are present, one will...
Electronics

is quite clear. But in the second part of this article, I shall make several reservations. Problems arise which can be solved only when enough measurements and data concerning the nature of interplanetary space are available.

For example, the behavior of the electrodes of Fig. 4 can be predicted only when the effect of various radiations which are absorbed by our atmosphere on the processes taking place at the porous end of the electrode is known. It is therefore pointless to introduce detailed calculations based only on the experience gained from Geissler tubes.

One possibility

This uncertainty is particularly large in the selection of the source of current. It appears that a thermopile would be the simplest and most suitable device. Fig. 5 shows a piece of the thermopile on an enlarged scale and in a rather schematic representation.

The dashed arrows indicate the incident rays of the sun. One junction of the thermopile is connected to the sun and is also irradiated by reflected sunlight from below: the other junction is in the shade. The sheet-metal strips can be soldered together on the earth and wound on a drum in such a way that they are bent in the proper position on the upper side, which can be done very easily and quickly. If one wants to go further, one can either roughen the strips in those places shown in black in the diagram or paint them black. and at the same time polish the places shown in white. The effectiveness of the arrangement will be increased by this operation. From measurements of the temperature of the surface of the moon it is possible to calculate that the side turned to the sun will be heated to about 140° C, while the side in the shadow will drop to a temperature of 100° C below zero.

The potential difference between two adjacent metal strips is only of the order of a hundredth of a volt, but when several hundred thousand of these are soldered together in series, a marked difference of potential between the ends can be obtained. These connected strips could be wound about the spaceship in a helical line, and, since the acceleration of the spaceship is small, as has been brought out above, it would hardly be necessary to reinforce or stiffen this helix.

The question now, however, is whether it will fulfill its function; for it is possible that certain cosmic radiations might cause an equalization of the potential difference between the metals at the ends of the thermopile, somewhat in the way the electron cloud about a hot cathode tends to bring about the same result. It is also possible that the traces of gases found in cosmic space might discharge the electric charge built up in some other way than the desired one (though I do not believe this will happen), and so on.

Ullinski, the first to suggest such a thermopile (though his design was not very promising), thought of providing it with an insulating coat. But an application of this sort would have considerable weight and would tend to prevent the warming and cooling of the proper junctions. Furthermore organic materials would soon be destroyed by the cosmic radiations, an insulating coat of glass or some ceramic material would easily crack and split off, because of the temperature difference and the corrective bending of the metal helix, etc. I do not mean to imply that Ullinski's suggestion cannot be realized, but simply wish to indicate that many questions regarding it remain unanswered, and that the final result might very well be far less promising than it appeared at first sight.

RADIO-ELECTRONICS for 1. Other figures are frequently given for both the distance of the orbit above the earth and for the velocity of rotation. This is due to the fact that the authors concerned have failed to take into account the fact that this station would not travel about the earth in one solar day of 24 hours, but in a sidereal day, if it is to remain over the same meridian.

MATHEMATICAL ANALYSIS

The principles of rocket propulsion are interesting to contemplate.

If the mass of the material expelled is m, and the velocity of this material is c, then the recoil momentum is measured by:

\[ P_{1} = mc_{1} \]  \hspace{1cm} (1)

However, the total energy which must be expended on this propellant is also given by the formula:

\[ E = \frac{1}{2}mc^{2} \]  \hspace{1cm} (2)

If we consider another mass m, with the velocity c, then the corresponding equations are:

\[ P_{2} = mc_{2}, \] \hspace{1cm} (3)

\[ E_{2} = \frac{1}{2}mc_{2}^{2}, \] \hspace{1cm} (4)

If the source of energy does the same work in both cases, then

\[ E_{1} = E_{2}, \] \hspace{1cm} (5)

and from equations 2 and 4 we have:

\[ m_{1}c_{1}^{2} = m_{2}c_{2}^{2}. \] \hspace{1cm} (6)

This means that for equal work performed by the source of energy, the recoil effect is inversely proportional to the velocity of efflux. That is, the smaller the velocity of efflux, the greater the recoil itself.

But it follows from equation 5 that the loss of material depends on the square of the velocity of efflux. This means, in agreement with equation 1, that the mass of propellant is consumed more sparingly the higher the velocity of efflux, but this is at the cost of greater energy consumption.

For example, if the electric spaceship expels 10 tons of matter at the rate of 10 km/sec and during this time it reaches a velocity of 2 km/sec, it would be able to expel only 2.5 tons of propellant and reach a velocity of only 1 km/sec with a velocity of expansion of 20 km/sec. But if it worked four times as long, it would again consume the original mass of 10 tons, but would then reach a velocity of 4 km/sec.

We are dealing here with an inverse relationship. For a given amount of energy, the more rapidly the mass is expelled, the smaller is the amount which can be expelled in unit time, and the slighter is the recoil and hence the acceleration. But, using the same quantity of propellant, the spaceship can continue to accelerate for a longer period of time. This longer period of time has the same ratio to the shorter period as the square of the higher velocity of efflux has to the lower velocity of efflux. Therefore the spaceship reaches a velocity at the end of the longer period of acceleration which has the same ratio to the velocity reached in the shorter period as the higher velocity of efflux has to the lower.

The electric spaceship is certainly not very exacting as to the fuel it would use. Anything might serve as propellant - if it will diffuse readily through the porous end of the cylinder and if it is sufficiently inert so it will not attack the walls of the electrodes.
Relays Do Simple Arithmetic

Part III—How to use relay adding circuits for subtraction and multiplication in the binary system

By EDMUND C. BERKELEY* and ROBERT A. JENSEN

In the two earlier articles we have seen how an electric brain can:
1. store information in a register;
2. transfer information from one register to another; and
3. add two numbers expressed in binary notation (the scale of two).

Being interested in constructing a relay calculator, in this article we shall consider subtraction and multiplication using relays.

We shall keep to binary numbers for the present for three reasons: It is easy to carry out the operations we are interested in. Also, binary notation is good for electron-tube calculating circuits as well as relay calculating circuits. Finally, it is a good introduction to the circuits needed for calculating in the decimal scale.

Suppose we wish to subtract the binary number 101 (read “one-oh-one,” meaning one 4 plus no 2’s plus 1, or 5) from the binary number 111 (read “one-one-oh,” and meaning one 8 plus one 4 plus one 2 plus no 1’s, or 14). We write 101 under 1110 and subtract:

\[
\begin{array}{c|c}
1110 & \\hline
101 & 1001 \\
\end{array}
\]

How do we manage to subtract? We recall the binary addition table:

\[
\begin{array}{c}
+ & 0 & 1 & 10 \\
0 & 0 & 1 & 11 \\
1 & 1 & 10 & \hline
\end{array}
\]

Then we say under our breath, for the first column at the right: “1 from 0 does not go, borrow 1; 1 from 10 (read “one-oh-one” not “ten”) is 1, write down 1.”

For the next column, we say, remembering the borrow: “0 from 0, write down 0.” For the third column: “1 from 1 is 0, write down 0.” For the last column: “nothing from 1 is 1, write down 1.” The result is 1001 (read “one-oh-one,” meaning one 8 plus no 4’s plus no 2’s plus one 1, or 9) just as we would expect it to be.

We could set to work and design a circuit which would reproduce this process and give the precise result we desire. But isn’t there an easier way?

There is an easier way to subtract—by using the addition circuit shown in the last article, and using the mathematical fact that subtracting a number is the same as adding the complement.

To make the idea of complement clear, let us return for a moment to decimal notation (the scale of 10) and consider a desk adding machine having just five columns. Suppose we consider a number 864 (eight 100’s plus six 10’s plus four 1’s). Suppose we set the machine at 0 and subtract 864. We will obtain 99136. This is called the complement of 864 (also called the tens complement of 864). For, if we take 864 and 99136, and add them, we get 100,000: but the extreme left-hand digit (the 1) being beyond the capacity of the five-column adding machine, it vanishes and the result is 00,000 or zero. (In a machine of ten columns instead of five the complement would be 9,999,999,996, correspondingly.)

Now to subtract 864 from any number—suppose it is 3,145—we add the complement:

\[
\begin{array}{c|c|c}
3145 & -864 & 99136 \\
\hline
2281 & 102281 \\
\end{array}
\]

The extreme left-hand digit in 102,281 will disappear off the machine, giving 2,281 as the result, which is correct.

The complement (such as 99,136) is easily found for any number (such as 00,864) by two rules:

1. take each digit away from 9 (obtaining what is called the nines complement, in this case 99,135);
2. add 1 to the result (obtaining in this case 99,136, the tens complement).

What is the analogue in binary notation to these complements in decimal notation? In decimal notation we have a nines complement, nine being one less than ten, the base of the scale of notation; so, in binary notation, we shall have a ones complement, since one is less than two, two being the base.

\* Author: Giant Brains

DecemBer, 1950
Suppose we do this arithmetically first and then examine a series of circuits which will produce the same result. Let us return to the example of subtracting 101 from 1110. Let us assume that we have a five-column binary calculator. The ones complement of 101, then, is 11010; adding 1, we get the twos complement, 11011. We add:  
\[ \begin{array}{c} 
1110 \\
+ 11011 \\
\hline 101001 
\end{array} \]

The extreme left-hand digit 1 vanishes ("goes off the keyboard") and the result is 1001, the same result as before, as would be expected.

### Subtraction circuits

A series of circuits for subtraction is shown in Fig. 1. First (see part 1), the number to be subtracted is stored in the C register in relays C5 to C1. The example shows 101 stored (or 00101) where the first 0 tells us the number is positive. The C3 and C1 relays only are energized as shown in red. At Time 1, terminal T1 holds these relays energized through their hold contacts.

At Time 2 (see part 2), the ones complement of the C number is obtained, by reading out from terminal T2 through normally closed contacts of the C relays, into the D relays. Hence, the number stored in the D relays is 11010, precisely the ones complement of 00101.

All the rest of the calculation is "reduced to the previous case," as the mathematicians say: reduced to transfers and additions, which have been described in earlier articles but are as follows:

The D number—the ones complement (see part 2) is transferred via the transfer circuits of part 4 into the augend relays of the addition circuits (see part 5). A constant 1 stored in the relay El (see part 5) is transferred (see part 4) into the addend relays of the addition circuits (see part 5). The sum obtained in the sum register; the S relays (see part 5), is routed back via the transfer circuits of part 4 (and perhaps via an extra temporary storage register) into the addend relays of the addition circuits. So at this point we have the twos complement of the number to be subtracted, stored in the addend of the addition circuit.

Next, the number to be diminished is transferred from whatever register it is stored in via the transfer circuits of part 4, into the augend relays (see part 5) of the addition circuit.

Then finally we pulse the addition circuit a second time, and the result of the subtraction is produced in the sum register of the addition circuit.

Note that the transfer circuits of part 4 are here assumed to transfer a five-digit binary number from a five-relay register via a five-line bus into another five-relay register. The transfer circuits of Article I of this series show only two-relay registers and a two-line bus; but the extension should give no difficulty.

### Plus and minus numbers

At this point we start thinking again and say to ourselves, "It is foolish to have a calculator that can only handle positive numbers. Our calculator should handle both positive and negative numbers. How shall we arrange that?"

A good answer, though not the only one, is to agree that the extreme left-hand digit of the number will tell the
sign of the number, whether plus or minus. For example, in decimal notation, with a five-column calculator, we would stop using the fifth column from the right for showing digits. Instead we would say: "If it holds 0, the other four digits are a positive number; if it holds 9, the other four digits are the complement of a negative number." For example, 09136 would mean +9136, but 99136 would mean +864. As a result, the machine would be unable to express any number greater than +9999 or less than -9999.

In binary notation we can do almost the same thing. We say, "If the extreme left-hand digit is 0, the remaining digits make a positive number. If that digit is 1, the remaining digits are the complement of a negative number."

We need to adjust our calculating circuits for adding two numbers which are both positive, or both negative, or one positive and one negative. We also need to adjust our calculator to ring an alarm in cases where the result is beyond the capacity of the calculator—that is, beyond +9999 or -9999 in terms of the example given above. A third consideration is the decimal point or, in binary notation, the "binary point." In fact, there are a number of little adjustments needed. But it is probably better to neglect them at this stage, and go on to the next main process, multiplication.

### Multiplication

In binary notation, the multiplication table becomes simply:

<table>
<thead>
<tr>
<th></th>
<th>01</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>00</td>
</tr>
<tr>
<td>1</td>
<td>01</td>
</tr>
</tbody>
</table>

or, in other words, 0 times 0 is 0, 0 times 1 is 0, and 1 times 1 is 1.

Multiplication becomes either adding or not adding, and shifting.

For example, let us multiply two binary numbers, 1101 (one-one-oh-one: 8 plus 4 plus 1, or 13) and 1011 (one-oh-one-one: 8 plus 2 plus 1, or 11):

1101

1011

1101

1100

1101

10001111

The result is 10001111 (one-oh-oh-oh-one-one-one-one, or, one 128 plus no 64's plus no 32's plus no 16's plus one 8 plus one 4 plus one 2 plus one 1, or 143), which is of course what we would expect from ordinary multiplication of 13 and 11.

Fig. 2 shows circuits with energized relay contacts in red. Fig. 3 is the timing chart, showing how the circuits are to operate one after another, and over again, for successive digits of the multiplier. These circuits are preliminary, and not final. We have assumed that the multipli-

---

**Table 1 — Multiplication Sequence**

<table>
<thead>
<tr>
<th>Name</th>
<th>Number</th>
<th>Relays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial sum</td>
<td>000000</td>
<td>H to J</td>
</tr>
<tr>
<td>1st multiple</td>
<td>000101</td>
<td>D</td>
</tr>
<tr>
<td>New partial sum</td>
<td>000101</td>
<td>H to J</td>
</tr>
<tr>
<td>2nd multiple</td>
<td>001010</td>
<td>D</td>
</tr>
<tr>
<td>New partial sum</td>
<td>010011</td>
<td>H to J</td>
</tr>
<tr>
<td>3rd multiple</td>
<td>000000</td>
<td>D</td>
</tr>
<tr>
<td>New partial sum</td>
<td>010011</td>
<td>H to J</td>
</tr>
<tr>
<td>4th multiple</td>
<td>110000</td>
<td>D</td>
</tr>
<tr>
<td>Final sum</td>
<td>1000111</td>
<td>H to J</td>
</tr>
</tbody>
</table>

---

In the timing chart of Fig. 3, a good deal of useful information is summarized in this chart.

Successive time intervals, 1, 2, 3, 4, etc., are shown from left to right. The different terminals are shown from top to bottom, together with the relays they energize.

Opposite each terminal, the horizontal line begins at the time when the terminal is energized and stops when the terminal ceases to be energized. For example, the three terminals that energize the K relays T3.1, T3.2, and T3.3 are energized from time 6 to 9, from time 11 to time 14, and from time 16 to time 19, respectively. The following parts then complete the multiplication in four similar cycles.

Sections of different horizontal lines are connected with Y’s and O’s. These vertical lines with their marks summarize the functional relation of circuits. X marks the relays that are energized at a certain time, and O’s mark the relay contacts through which these relays are energized. For example, at times 3, 8, 13, and 18, the D relays of circuit 5 are energized by current flowing from terminal T5 through contacts of the A relays and the C relay. For another example, at time 2, terminal T4 is energized, and the C relay is picked up, reading through B relay and K relay contacts. The K relays at this time have not been energized; but this is correct, because the first multiplier digit has the position 0. It should be emphasized once more that there are many ways of condensing and improving these circuits. For example, parts 4, 5, and 6 can be combined, and the C and D relays eliminated. But the resulting circuit would have been harder to understand than the separate circuits here shown. (To be continued)

---

**Fig. 3—Multiplying circuit timing chart which shows the sequence of operation.**

---

DECEMBER, 1950
**Electronics and Music**

**PART VI**

*A nonresonant frequency divider to make a one-octave instrument cover the whole audio-frequency spectrum*

**By RICHARD H. DORF***

VERY few electronic musical instruments of the monophonic or melody type are manufactured commercially. The best known is the Hammond Solovox, which uses a system of master oscillator and frequency dividers to obtain its musical range. A complete article will be devoted to the Solovox in a future issue; meanwhile we shall discuss another frequency divider invented by Nicholas Langer (of neon-tube organ fame) and assigned to Central Commercial Co., maker of the Lowrey Organ, which will also be described in a coming issue. The patent describing the dividers is No. 2,486,039, granted in October, 1949.

The complete circuit diagram of a three-stage divider appears in Fig. 1. This circuit takes oscillations generated by a master oscillator at a frequency one octave above the highest note desired in the instrument and derives from that note of the top and two successive lower octaves. Additional stages may be added to give as many octave divisions as desired. In a monophonic instrument, the master oscillator would have a variable frequency over at least one octave. Depending on the switching system used, the corresponding notes of the lower octaves would then be heard, either one octave at a time or several octaves in unison.

How the divider works

Unlike many divider circuits, this one is aperiodic or nonresonant, and is very nearly independent of actual frequency. It will work over almost the complete audio range without any changes. Circuit constants of the three stages are alike, so that a description of the first suffices also for the others.

The input signal is furnished by a master oscillator which should generate a nonsinusoidal waveform. A sawtooth oscillator would be suitable, as would any other furnishing a wave high in upper harmonics. A neon oscillator would do, but like any other source used, its frequency must be stable. The signal at the input to the circuit of Fig. 1 should have predominantly negative pulse form, which in the case of a sawtooth generator would merely require that polarity be appropriate. If necessary, a crystal rectifier could be placed in the circuit to short out the positive parts of the wave.

C1 and R1 form a simple differentiator circuit. Essentially it is a highpass filter which, when fed a complex wave, tends to remove the fundamental and lower harmonic components and leave only the higher harmonics; the result is a rather sharp waveform.

The triode sections of the first 6SN7-GT form a pair of cross-connected amplifiers. The plate of the second feeds the grid of the first, and the plate of the first feeds the grid of the second. When the unit is first turned on, therefore, and there is no signal, the first slight electron flow in one tube starts the action. Let us assume that this takes place in V1 and that the grid becomes slightly positive with respect to the cathode. There is, then, a small plate-current flow through V1, which makes its plate become more negative. This negativity is transferred to the grid of V2, decreasing V2 plate current and making the plate more positive. The positiveness is transferred to the grid of V1, adding to the positiveness there at the start. The whole action snowballs in a very short time until V2 is completely cut off and V1 is conducting strongly. At that point, the grid of V1 is receiving the full 150 volts positive which the 150-volt supply is placing on the plate of V2 in the absence of plate current. At the same time it is polarized 100 volts negative by the bias supply. Its net voltage is therefore plus 50 volts, and there the circuit is in equilibrium—V1 conducting and V2 cut off.

Now let us apply a negative pulse from the master oscillator to the input terminals. Passing through the C1-R1...
network, the pulse is sharpened and transferred through the two 500-uf capacitors simultaneously to the grids of both triodes. Since V2 is already cut off, it has no effect on V2 plate current. The positive pulse, when applied to the V1 grid, however, reduces the positive potential there, and as a result V1 plate current instantly decreases. The plate of V1 thus produces a positive pulse; transferred to the grid of V2 the positive pulse starts the plate-current flow, making the V2 plate positive. The negative voltage at the V2 plate is applied to the V1 grid, assisting the original negative pulse from the master oscillator. Again the action snowballs, until V1 is cut off and V2 is fully conductive.

The next negative pulse from the master oscillator reverses the situation again. It is apparent, then, that each time a negative pulse is applied, the two triodes change states.

The cathode resistors of 1,000 ohms do not change this explanation appreciably. They are there merely to provide an output point of reasonably low impedance which can be connected to outside circuits without harming operation of the divider.

A full cycle of output from a single triode includes one "on" and one "off" of plate current. Since it takes two negative pulses from the master oscillator to make a triode go through this one cycle, obviously the output of the divider is at half the frequency of the master oscillator. Output is taken in Fig. 1 from the cathode of V2 through a d.c. blocking capacitor and a 10,000-ohm isolating and leveling resistor R2.

An additional output is taken from the plate of V1 by effectively tapping down on the plate resistor R3-R4. This output is fed to the grids of the next similar frequency divider, and so on.

Each of the cathode outputs is of substantially square waveshape and contains large amounts of odd harmonics. It may be fed to following amplifiers and tone controls, in which rectifiers may be provided to give some even harmonics.

Switching systems

There are three principal ways in which switching may be arranged with the larger frequency-divider circuits, though not all of them are suggested in the patent itself.

If the master oscillator itself can be varied over a range of several octaves without losing stability, the scheme of Fig. 1 may be used. Here S1, S2, and S3 select the ranges which are to be sounded. If, for instance, the oscillator covers the top three octaves of the piano keyboard, notes A2 through B6 (see frequency chart on page 42 of the August, 1950, issue), then, if S1 is closed, notes 40 through 76 will be heard. S2 will bring in notes 28 through 64 and S3 will cover notes 16 through 52. The range in which the instrument will work at any given time may thus be selected with the three "stop" switches. Since two or all three of them may also be closed at a time, the player may bring in unisons with a maximum of three octaves relative notes at once.

Fig. 2 shows a switching circuit to be used with master oscillators that cover only one octave. Each playing key activates two s.p.s.t. switches. The lower switches substitute different tuning components in the master oscillator (shown in the figure as a neon lamp). The upper ones connect the output of the correct divider to the amplifier. This is not a very flexible system, as each key will only sound one note at all times. If there are to be more than the three octaves shown in Fig. 2, as many keys as there will be notes in the instrument must be furnished.

A third system, shown in Fig. 3, utilizes nine relays to make a three-octave keyboard effective over a five-octave range when the oscillator is kept within in a one-octave variation range. (This latter condition is often necessary for stability with many types of oscillators. Large tuning range and stable operations do not usually go together.)

As in Fig. 2, the lower bank of keying switches tunes the master oscillator over its one-octave range. The top bank, however, energizes relay coils. Three relays each are provided for high, low, and middle ranges. With the high-range selector switches (the lower three-ganged units) closed, pressing any key draws sound from its own frequency divider. With the middle-range switches closed, each key draws sound from a divider giving a tone an octave lower. And the low-range switch sounds the lowest-octave dividers. One, two, or all three switches may be closed at once for unison effects. A system like this will give much the same effect as the Solovox, and as a matter of fact an earlier model of the Solovox did use a relay system somewhat like this one.

The relays must, of course, act quickly and quietly. The diagram provides for 6.3-volt a.c. coils, which might well be amateur keying relays. These may be too noisy, however, and it may be better to substitute some small sensitive relays. These normally operate in the plate circuits of vacuum tubes and require very little actuating current. The gaps being small and the armatures light, they make almost no noise.

With next month's article we shall discuss vacuum-tube tone generator systems for use in polyphonic instruments —those which, like the organ, can produce complete harmony.

Fig. 2—Switching circuit for a master oscillator that covers only one octave.

Fig. 3—The lower part of this circuit is like Fig. 2. The relays in the upper part of the figure extend the range of a three-octave keyboard to cover five octaves.
Easter Rabbit Calls Hundreds To Oats Park for Egg Hunt

Churchill county's children of all ages turned out several hundred morning, and for those who didn't, eggs were provided. At least 50 of the youngsters were lucky enough to turn up with a numbered egg which entitled them to a prize.

Lions Chairman Jerry Donthe and his crew of Paul Oggert, Wayne Mills, Schools Walker, George Chambers and Lou Parks expressed thanks to the ladies for their help in the announcing of the Stores that and the each donation.

A mobile PA system can give you efficient, low-cost advertising as well as profit

By PAUL W. STREETER

THE postwar boom in radio sales and repairs has definitely declined for many radio shops in smaller towns, and many radio repairmen have turned to increased advertising in various forms to stimulate sales and repairs. More and more radio shops are using public address systems for advertising, because of their very effective results.

Either direct or indirect advertising is most efficient when the equipment can be taken to the audience. For that reason, mobile public address equipment installed in a car or truck is unusually effective. Such equipment does not rely on a commercial power source and can be easily moved from place to place as the movements of the audience dictate.

Direct advertising also may be under-
In addition to the chimes, 15 minutes of recorded carillon music is given each evening just before the motion picture home shows start at 10 o'clock each Saturday morning. These carillon recordings are not expensive and can be obtained in either 331⁄3- or 78-r.p.m. platters. We have about two dozen recordings in stock and have a variety to choose from since only three are played during each evening's concert.

Many shops have made it a practice to have their public address equipment available for community activities at no charge. This has been particularly true of the locally owned local shops since they can keep a close eye on their customers and at the same time they can add to their advertising.

One example of this which comes to mind is a parade held recently to publicize a Community Chest campaign being undertaken in the writer's locality. About a month in advance, the parade committee notified the merchants (including this writer), asking each to have a float or other entry in the parade. We suggested that we be allowed to "announce" the parade as it passed the judges' stand. Permission was gladly given and the response was so great that the local officials were delighted with the offer, and their whole-hearted cooperation was readily obtained. A letter was secured from them, outlining the permission granted.

We took this letter to one of the local automobile dealers and he agreed to "sponsor" the announcing, and to furnish one of his new demonstrators (with suitable signs, of course), on which we would mount the PA equipment. Other merchants were approached to get information on their entries. This information was for the use of the announcer during the parade.

The chief of police was asked for permission to cruise along the parade route with a sound car before the parade, to entertain the crowd with recorded music, to locate strayed youngsters, to keep the crowd back of the curb line, etc. The event was a great success from the standpoint of the police, and the sponsor wrote out a check for $75 with a big smile the following day. It was well-spent money for him. He reported later that four sales of new cars resulted from the project.

Every event that we handle is followed up in a few days by form letters sent to sponsors and committees in charge of the events, asking for their comments on our performance. Results of these form letters have shown a remarkable similarity—the public address equipment, being mobile, really reaches the public. Sponsors have been shown the value of this kind of advertising, and today we have had one prospect a year to get him to sponsor an event.

Every effort should be made to communicate with committees in charge of events in advance of dates of the event as far in advance of the date of the affair as possible. This should always be done by a personal call, never by mail. It must be done to insure that complete arrangements will be made in time to put on a good, intelligent job of announcing.

The chamber of commerce or some leading merchant will want to sponsor programs of Christmas music in the business district during Christmas shopping hours. Re-entrant speakers be placed on lighting poles along downtown Main Street. Driven by a medium-sized amplifier coupled to an automatic record changer, the installation will require a minimum of attention. The "works" can be placed in the radio shop if it is conveniently located, or in the back of some store on the street. The speakers, with the radio shop's name inside the bell, are signboards advertising the radio shop all along the street.

Many events of local interest are also the subject of local radio broadcasts. Parades, air shows, rodeos, etc., generally can be used as radio broadcast material. The aggressive public address operator—or whose equipment is used at any event of this kind will also arrange to carry the broadcast station's announcer on his speakers. Since radio station microphones are sensitive, precautions have to be taken to eliminate audio feedback and echo effects from the PA speakers to the microphone. By placing the equipment in position well ahead of time, these problems can be ironed out easily.

Fairs, races, carnivals, air shows, and other events all have considerable use for public address equipment, announcing, and prior publicity from mobile units. Since most of these events occur during local or national holidays, they can become a source of additional income and will occupy time that will not be put to use otherwise. The announcing of these events can be broken down into three distinct divisions: (a) crowd control before the start of the "doings", (b) announcing the event, and (c) crowd and traffic control afterward. Crowd and traffic control before and after the show is all too often unorganized, with the result that patrons are inconvenienced and traffic hazards ensue.

Fire, police and sheriff departments welcome the use of the equipment during emergencies. Every effort should be made to see the local officials to acquaint them with the possibilities of using the equipment in their work. We have been asked to clear streets of parked cars, assist at road blocks, at mounted police activities, major fires (both in direct firefighting and in traffic control), and to direct traffic at intersections during rush hours.

Many lodges, fraternal organizations, and clubs hold dances periodically that are open to the general public. Committees in charge of the dances invariably had "intended" to get in touch with us. When the chips are down, however, we notice that we made the contacts. It is good policy to go after the business—don't wait for it to come to you.

All good publicity helps the radio as well as the public address business. It is well to develop a good "mike voice" and personality. Never inject your personal opinions or relate personal experiences over the system. Be factual in announcing events. During a pause in the activities, it is better to turn on a recording rather than try to keep a mike "hot" when there is nothing to talk about. Proper announcing that keeps an audience interested is strenuous work, and a break is welcome.

The most trying problem in PA work is to determine the proper volume level at which to operate the equipment. Too much volume is extremely annoying to the listener. Not enough volume is as bad, since you cannot be understood. For mobile equipment, volume should never be higher than necessary to be heard for one full city block under most conditions, and a lower setting is often desirable. Have someone on the sidewalk check the volume level, while the car is in operation.

Always look at it from the listener's angle, and do everything possible to make your announcing a service, not an annoyance. Remember that demands for regulation of public address equipment have only been advanced in communities where no common sense was shown by one or more PA operators. Don't let that happen to you—or your community!

![Radio Slim Streeter, left, and assistant with his mobile public address equipment.](image-url)
A sample analysis of a well-known circuit—the Williamson amplifier

By GEORGE FLETCHER COOPER

In the two previous articles of this series the general principles of design of amplifiers with negative feedback were discussed. The procedure, essentially, is to design the amplifier, test it, not in the solid but on paper, and then modify the design if necessary to obtain the final circuit.

In this article we shall consider a concrete design, and I shall try to emulate the Butcher, who...

... wrote with a pen in each hand
And explained all the while in a popular style
Which the Beaver could well understand.

"The method employed I would gladly explain,
While I have it so clear in my head,
If I had but the time and you had but the brain—
But much yet remains to be said."

The Butcher took three as the subject to reason about but I am going to use instead a high-quality amplifier which has received much attention in Europe and which is, I think, fairly well known in the United States. Before going any further I must state that as far as I know this is a jolly good amplifier and any criticism which may appear is only a reflection of the fact that one designer's meat is another designer's poison.

The circuit is shown in Fig. 1. The output tubes, type KT66, are closely equivalent to the 6L6, although being British they are rather more powerful or are less conservatively rated. If we neglect the feedback for the moment we can consider this circuit as our preliminary design and we can calculate how much feedback is permissible if the amplifier is to remain stable. The original designer has given us all the stage gains, except for the last stage. Here the total load, plate to plate, is 10,000 ohms, so that the peak voltage across the transformer primary must be 173 volts for 15 watts output ($E_0/R = 15, R = 10,000$, so that $E_{peak} = E_0 \sqrt{2} = \sqrt{30,000} = 173$ volts).

**Low-frequency response**

There are three primary and two secondary factors governing the low-frequency response. The three primary factors are the two resistance-capacitance interstage couplings and the output transformer. At low frequencies the circuit is completely symmetrical, which makes things rather easier. At high frequencies this is not true, because the stray capacitance at the plate of V2 is in parallel with R7 and the impedance of V2, which is high due to the feedback in the cathode resistor R5.

The stray capacitance at the cathode of V2, a different capacitance, is in parallel with the impedance of V2 acting as a cathode follower. This difference could be quite important if the output stage was operating in class B. It is mentioned here merely as an indication of the special difficulties which the high-frequency response presents when compared with the low-frequency response.

Assuming complete symmetry, the primary factors in the low-frequency response are:

1. $C9R8 = C4R9 = 0.05 \mu F \times 0.47$ meg $= 1/42$;
2. $C6R10 = C7R11 = 0.25 \mu F \times 0.15$ meg $= 1/27$;
3. $L/R$ in the output transformer circuit. Here R is the resistance produced by the load in parallel with the tube impedance. The load, at the primary side, is 10,000 ohms: reference to data sheets shows that the KT66 has an impedance of 1,250 ohms when connected as a triode. The 6L6 is rather higher, 1,700 ohms, but it has a lower transconductance, so that the main effect of replacing the KT66 with the 6L6 is to reduce the gain without feed-

---

1. The Hunting of the Snark. Fit the Fifth. Lewis Carroll

---

Fig. 1—The complete circuit of the Williamson amplifier. The underlined voltages are the peak signal voltages required for full output of 15 watts.
back, and leave the stability about the same as a lower feedback factor.

Two KT60 tubes in series give 2,500 ohms, and this in parallel with 10,000 ohms gives R a value of 2,000 ohms (1/10,000 + 1/2,500 = 1/2,000). Using 6L6's, we should have R = 2,500 ohms.

We assume that L = 100 henries, which gives L/R = 1/20. The choice of 100 h may be because this is the largest inductance obtainable with a reasonable size of transformer, or because we want to keep a very low-frequency characteristic. In this particular amplifier it was chosen because the designer is doing without an air gap and must allow for the increasing permeability at high flux densities.

The L/R factor must, therefore, be free to increase without equalling either of the R-C factors.

The secondary factors are:

4. C12R = 8 µF x 33,000 = 1/4;
   R2/R3 = 33/47 = 0.7;

5. C2R6 = 8 µF x 22,000 = 1/5.7;
   R6/R7 = 22/23 = 1.0.

These secondary factors cause the response to rise at low frequencies, and thus provide a small amount of phase correction. In the critical region this amounts to 30°, and is, in fact, the feature which keeps the amplifier stable.

The response curves

The individual responses are drawn in Figs. 2 and 3, and the total responses are plotted for the critical region. These responses were plotted by the method described in the previous article, and even drawing them rather carefully to please the editor took only about ten minutes. If the figures are examined, we see that we have a 180° phase shift at ω = 10.5, at which point (A on both curves) the amplitude response has dropped by 24 decibels.

If we wish to have 20 decibels of feedback, we must also consider the phase at the point R, ω = 13. This is 170°. Remembering the definition of margins, we see that the phase margin is 10°, and the amplitude margin is 4 decibels (24-20). The reader will see that these margins are rather narrow.

Two other factors must be taken into account in deciding whether they are safe margins. The first, which may not be very large, is the inner feedback loop produced by the choke L1. At the critical frequencies in the region of ω = 10 (about 2 cycles), C5 is a very high impedance, so that V1 and V2 have a common load in L1. This produces a small amount of negative feedback, which I do not propose to calculate.

The second factor is the increase in inductance produced by any signal in the output transformer. The maximum permeability of the core may be five times the initial permeability, and this will shift curve 3 to the left. The reader can confirm, if he wishes, that this does improve the margins. He can also confirm that improved margins can also be obtained by moving curve 1 to the right, by reducing C3 and C4. In general, stability can always be increased by moving the extreme curve away from the others.

One more factor should be noted. At 10 cycles the response without feedback is only 3 db down. This means that we still have 17 db of feedback at 10 cycles, so that the full distortion-reducing effect of the feedback is in force.

High-frequency response

The calculation of the high-frequency response is never very easy because of the lack of essential data. We shall ignore in the first calculation the circuit C8-R1 connected to the plate of V1. The response is then settled by the shunt capacitances of each stage and by the output transformer. Unfortunately the capacitances depend on the way in which the components are arranged, while the transformer's response may be complicated by resonances between the capacitance of one section and the leakage inductance of another.

Let us plunge in boldly, however, and assume a stage capacitance of 20 µF. We also have the original designer's figure of 30 mH as the maxi-
mum leakage inductance, measured at the primary side of the output transformer. The factors controlling the high-frequency response are then, if 
\[ C = 20 \ \mu\text{H} \] is the plate-ground capacitance and \( R_v \) is the impedance of tube \( V_n \), and allowance is made for local cathode circuit feedback:

1. \[ C \times R_v = 20 \times 10^{-12} \times 10,000 = 1/5 \times 10^{-6}; \]
2. \[ C \times R_7 = 20 \times 10^{-12} \times 22,000 = 5/2 \times 10^{-6}; \]
3. \[ C \times R_n = 20 \times 10^{-12} \times 7,500 = 1/67 \times 10^{-6}; \]
4. \[ L/R = 20 \times 10^{-12} \times 12,500 = 1/0.4 \times 10^{-6}. \]

These factors give the curves which are shown in Figs. 4 and 5. These were drawn in just the same way as before, using the simple templates, and only the important part of the total re-

due to higher frequencies the response is reduced; that is, the phase margin characteristic has been drawn. The phase shift reaches 180° at \( \omega = 2.6 \times 10^6 \) (\( f = 300 \) kc). At this point the amplitude characteristic has fallen by 22.5 db, indicated by the point A in Fig. 4. If we take 150° as the safe limit, we have B, and a maximum feedback is of 16.5 db. The amplitude margin is then 6 db, and the phase margin 30°.

Increasing stability

One way of increasing the stability is to increase the leakage inductance; another is to reduce the stray capacitances, especially that of the first stage. The reader will do well to recalculate these curves for, say, 60-mH leakage inductance and 15-µH capacitance. In the original version of this amplifier it is clear that the margins were rather small for the use of production transform-

ers, for the circuit C8-R1 has been added. Let us see what this does.

The capacitance C8 is 200 µH. At a frequency \( \omega = 1/C8 \times R_n \), the re-

due of the first stage will start to drop, and it will run down to meet a curve defined by C8 and R1. At still higher frequencies the response will drop owing to the 20-µH plate capacit-

tance in parallel with \( R_v \) and R1. Instead of the curves in Figs. 4 and 5 we will have the curves shown in Figs. 6 and 7. We need the character-

istic factors:

1. \[ 1/\omega_1 = C8 \times R_v = 200 \times 10^{-12} \times 10,000 = 1/0.5 \times 10^{-6}; \]
2. \[ 1/\omega_2 = C8 (R1 and R_v, in parallel) = 200 \times 10^{-12} \times 3,000 = 1/1.5 \times 10^{-6}; \]
3. \[ 1/\omega_3 = C (R1 and R_v, in parallel) = 20 \times 10^{-12} \times 3,000 = 1/15 \times 10^{-6}. \]

We could now redraw Figs. 4 and 5, but this would take up too much space for this article, and it is sufficient if we simply compare the curves 1 of Figs. 4 and 5 with the total response curves of Figs. 6 and 7. At \( \omega = 2 \times 10^6 \), for example, we had a contribution of about 1 db and 20° from the simple circuit, and the addition of C8-R1 has increased the attenuation to 7.5 db and the phase to 32°.

This means that the phase is now just over 180° at this point, and the attenuation is about 28 db. The amplitude margin of 6 db will then allow us to use 20 db of feedback. At \( \omega = 1.6 \times 10^6 \), the C8-R1 circuit gives us 6 db and 35° instead of 0.5 db and 15°, so that the total response at this point will have a phase shift of 160° and will be 18 db down.

By examining a few more points we can determine the phase margin exactly, but it is a little under 20°. These margins are rather tight; but, as we are making no allowance for the output transformer capacitance and as any assumed capacitance can be in error by ±25% or more, we must not be too critical. In a later article we shall see how to deal with high-frequency instability.

At this point let us look back. We have taken as a design basis the circuit shown in Fig. 1 and have made certain assumptions which have enabled us to draw the amplitude and phase character-

istics. These, in turn, showed us that we could apply 20 db of feedback with-

out low-frequency instability, but that we require the stabilizing circuit C8-

R1 if the amplifier is not to be unstable at high frequencies. We can also see that, without feedback the response being only 3 db down at 10 cycles, we get the full feedback over this range for the reduction of distortion and intermodulation.

The feedback circuit

One more thing remains to be deter-

mined. In the actual design process we must calculate the value of R12 which will give 20-db feedback. Usually, of course, we must just calculate the gain without feedback, but it is assumed that the reader knows how to do this. The designer tells us, or your own calculations will tell you, that the input voltage between grid and cathode for 15 watts output must be 0.19.

We shall ignore the local feedback produced by R4 and assume that with R12 connected we want the gain to drop 20 decibels, making the new input for 15 watts output 1.9. Then we have 1.5 volts from grid to ground, 1.71 volts from cathode to ground, and the neces-

sary 0.19 volt from grid to cathode.

Let us assume that the transformer is designed for a 3.5-ohm secondary load. The 15 watts output then corre-

sponds to 3.5 × 15 volts across the load, or 74 volts. My calculations give R12 = 1,570 ohms to produce this required 1.71 volts at the cathode, while the original designer gives 2,200 ohms.

The reason for this discrepancy is the difference in what is meant by 20-

db feedback when the main feedback loop also involves a local feedback of 6 db. Two different answers are ob-

ained depending on whether the feedback is removed by disconnecting R12 and by short-circuiting R4 to alternating current with a very large electrolytic capacitor.

In commercial design one more factor needs to be considered. Is the amplifier open-circuit stable? Often we need to have an amplifier switched on, but idle, and, if it operates from a common supply system with other amplifiers, it cannot be allowed to be unstable even when not in use. To test this we must redraw the characteristics for the amplifier with no load on the output transformer. The general question of load impedance will be discussed in a later article.

These calculated response curves are, of course, not the same as the actual measured response curves of the ampli-

fier. We cannot, without a great deal of cumbersome mathematics, account for such things as tolerances of the compo-

nents, stray wiring capacitance, and a number of other factors. However, most of these items are rather small, and they also tend to average each other out. That is, the tolerances may be either plus or minus.

What we do get from these curves is a very substantial idea of how the ampli-

fier will behave once it is constructed. We immediately see any important flaws in the basic design so that the necessary corrections can be made at no cost of time or parts.

The next article will describe a loud-

speaker amplifier designed by the writer. Unlike Mr. Williamson’s ampli-

fier, the design is based on a minimum size of transformer, and a comparison of the two designs will show the reader how flexible the design method is in some ways, and how inflexible are some of the restrictions.

RADIO-ELECTRONICS for

www.americanradiohistory.com
There's Only ONE COMPLETE CATALOG for EVERYTHING IN RADIO, TELEVISION & INDUSTRIAL ELECTRONICS

IT'S YOUR FREE ALLIED 212-PAGE VALUE-PACKED CATALOG!

Send For It Today!

HERE'S the only complete Buying Guide to TV, Radio and Industrial 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; radio-phonos; new Sound Systems and P.A. equipment; high-fidelity custom sound components; recorders and accessories; full selections of newest Amateur receivers and station gear; test instruments; builders' kits: huge listings of parts, tubes, tools, books—the world's most complete stocks of quality equipment.

ALLIED gives you every buying advantage: speedy delivery, expert personal help, lowest prices, assured satisfaction, liberal time payment terms. Get the 1951 ALLIED Catalog. Keep it handy—it will save you time and money. Send today for your FREE copy!

ALLIED IS YOUR TELEVISION HEADQUARTERS

ALLIED Radio

WORLD'S LARGEST STOCKS

- Radio Parts Unlimited
- Test Instruments—All Makes
- Television & Home Radios
- P.A. and Hi-Fi Equipment
- Amateur Station Gear
- Supplies for Industry

QUICK, EXPERT SERVICE

www.americanradiohistory.com
Christmas Package for Future Hams

Novice and experienced technician will benefit from two new classes of license proposed by the FCC

By LARRY LE KASHMAN, W2IOP

Amateur radio, like the rest of electronics, has come along way in the past decade. The electronic hobbyist who is not seriously considering getting into the “new” amateur radio may be denying to himself thrills—and opportunities for self-advancement—that few other modern hobbies can offer. The Federal Communications Commission has recognized the importance of radio amateurs to an even greater degree than heretofore and, as a result of this recognition, is wrapping up one of the best Christmas gifts ever presented to the electronic hobbyist.

The era of haywire is gone. The modern radio amateur has taken advantage of the wide availability of good low-priced commercial components, of technical literature never before obtainable, and of over-all advances in the art. The result is that whether the amateur station is low-power or high-power, it usually represents a neat and business-like approach to electronics. But, of course, the hobby has become more complex.

In the postwar period, faced for the first time with a major service harmonically higher in frequency, the hams came up against television interference. TVI was long the scourge of hams operating in television centers, but with their customary doggedness the amateurs are licking TVI and, in doing so, pointing ways of harmonic suppression and interference elimination that are becoming standard.

Along with the rush to get back on the air after the war came a host of new techniques including single-sideband phone, practical microwave communication, and the corollary demand for better and more stable equipment design. To the newcomer without technical training the past and current knowledge added up to an almost insurmountable barrier. It almost seemed that the hobby was degenerating into a plaything for engineers. For the technician anxious to experiment with some of the war-born developments and continue their development as a hobby, much of the paraphernalia required for “standard” operation seemed like unnecessary work. So the technician stood on the sidelines, not making his engineering contributions to one of the best hobbies in the world. The Christmas package is for the bewildered novice and the advanced engineer.

Why amateur radio?

Everyone who has had an opportunity to work in amateur radio, or with amateurs, has benefited from this experience. As have the military services, the entire electronics industry, and virtually every community in the country at one time or another. The problem facing amateurs and their supporters is how to nurture the continued growth of amateur radio in the face of its new-found complexities. One solution is the proposal creating two entirely new classes of amateur license. These licenses, when they are finally enacted into law, will mark the beginning of a new era for hams.
NEW COMPLETELY REVISED SECOND EDITION

THE RADIO & ELECTRONICS HANDBOOK

By WILLIAM F. BOYCE, Publisher
and
JOSEPH J. ROCHE, Editor
and
24 Qualified Experts & Leaders in The Electronics Field Who Have Contributed To This Work

MAKES PRODUCTION BETTER, FASTER, EASIER

Plan every operation in radio and electronics with the Radio & Electronics Handbook—THE ONLY RADIO HANDBOOK OF ITS KIND. Use it every day on the bench, at the factory, or on the way! Use this famous, newly-improved "radio bible" for engineering, construction, troubleshooting, testing, design, layout...any and every operation in radio and electronics!

900 PAGES...18 SECTIONS, EACH A COMPLETE COVERAGE OF ONE RADIO SUBJECT.

Practical engineers and skilled editors worked five years to gather and digest this great storehouse of radio principles and operation...statistics...newest developments in electronics...fundamentals, theory and know-how. Everything is worked out clearly, readable, with every possible detail. The same Boyce-Roche staff, creators of electronics manuals for the U. S. Signal Corps, have made the Radio & Electronics Handbook a priceless book for general reference, and most of all for practical on-the-job help.

Use this valuable book ABSOLUTELY FREE for 10 days! Send the coupon now.

HANSONELY BOUND IN DURABLE FABRIKOID WITH ALUMINUM STAMPING...18 SECTIONS...900 PAGES...COMPLETELY ILLUSTRATED...$5.95

ALSO DON'T MISS

THE VIDEO HANDBOOK

The Complete Television Manual

By MORTON G. SCHERA, Television Consultant, Allan B. Du Mont Labs., and JOSPEH J. ROCHE, former Editor, Radio & Television Maintenance.


SPECIAL OFFER

SAVE $1.00 on this practical, handsome RADIO & TELEVISION LIBRARY SET

Covers Radio, Electronics and Video—A Gold Mine of Information! RADIO & ELECTRONICS HANDBOOK and VIDEO HANDBOOK

Both in a handsome slip case for ready reference $10.00 for the set. We are confident that these books will fill your every expectation and therefore offer to send them to you on approval—mail this coupon today.

BOYCE-ROCHE BOOK CO., Princeton 35, N. J.

DECEMBER, 1950
40-METER M ANTENNA

By Jerome Maslowski, WBKLX

A ham for 15 years, the author has put up many so-called sky hooks. Most of these have been quarter-wave and half-wave antennas suitable for operating on 40 and 80 meters. However, trying out other antennas, a folded dipole was put up as a receiving antenna in the attic where it would not be too close to the transmitting antenna. One night after trying many calls and just not getting out, this folded dipole was hooked up to the transmitter and the results were surprising. The antenna in the attic had to be put up in an M shape because of the lack of space. An antenna may be bent to fit a restricted space if the bend does not exceed ¼ wavelength at each end.

In this case the bend was more than that. According to the books this reduces the efficiency of the antenna and having it in the attic doesn’t help any. Nevertheless, this antenna outperformed any of the authors has ever set up.

Dimensions for the antenna for the 40-meter band are shown in Fig. 1. Made of 300-ohm ribbon line, it may be suspended in any convenient way. The feeder can be any suitable length and now, for the first time, participation in a tuned and grounded coupling coil. The tuning may be either series or parallel as shown in Fig. 2.

The dimensions given should give good performance on the 40-meter band, and, once tuned, will cover the band.

The antenna system is a great "leveler" in ham radio. A properly designed and installed radiating system can give signal gain of many times. Thus, the 100-watt signal can be multiplied in effectiveness to 500, 1000 watts and even more. It doesn’t make much difference whether the original signal came from a modest basement shack feeding a well-designed antenna system or from a millionaire’s palatial mansion feeding a piece of baling wire. All the receiver can do is pick up the two signals. The best one is going to be the loudest. And, while it is true that high-gain antenna systems are desirable, don’t be misled into thinking that a simple dipole won’t work.

What it all adds up to is that, while electronics has become increasingly complex and the ham is constantly adding to his store of knowledge, it is still possible to get on the air and enjoy the many advantages of ham radio without being an electronic expert—without investing a tremendous amount of money in equipment that makes any other hobby unaffordable.

Plus benefits

What are all these “benefits” we talk about? Of course, there is the natural self-interest that motivates every hobbyist. He is looking for some relaxation. Whether you get your relaxation from the enjoyment by building a new gadget or enjoying the hobby without operating, there is no hobby that can rival ham radio. But ham radio offers something that few other hobbies do. It offers the individual an opportunity to add to his own knowledge—to improve his education—and, as a direct consequence, to improve his stature in our society.

There are many successful technicians and even engineers who have done only formal training has been through amateur radio. There are many individuals whose mark in life was not very bright until sparked by the knowledge gained through amateur radio.

In almost every great national emergency whether it has been a flood, a tornado, or a world holocaust, the hams have served their community with distinction. Few hobbies offer such a sense of security. This hobby offers a fraternity among men and women which is virtually unknown in any other group, because hams can talk to one another over great and small distances on what are considered bridges communications channels. They meet other hobbyists in a far more intimate manner than, say, the group whose only common meeting place is a political organization, or a social organization. And, of course, amateur radio, through its very nature, is a leveler of men because bankers and students, doctors and mechanics talk to one another on the ham bands without regard for the usual social barriers.

What it all sums up to is the irrefutable fact that amateur radio can offer more thrills and opportunities than any other facet of electronics. And now, for the first time, participation in the hobby is being made so simple that anyone with just a little fundamental interest can get started. Amateur radio might be compared to any gift which keeps on giving, because the benefits are truly endless.
Back in 1922 the first National communications receiver was offered to the public. Model SW-3 was among their first great units, the mention of which may evoke some nostalgia in the old timers of the radio fraternity. Ever since, National has always been in the vanguard with every great receiver development and today their place as undisputed leader in the field of communications equipment is acknowledged by all. The name National on a receiver means the finest in performance, the utmost in value.

Radio Wire Television was proud to offer the first National equipment to its public back in 1922, and its pride has increased many fold since then. R.W.T., where delivery, price and quality of service on National receivers have matched the superb performance of these products, has come to be regarded as National headquarters by radio men everywhere. For the greatest possible satisfaction in your National communications receiver, buy yours from Radio Wire Television.

NEW BOOK!
HOT-OFF PRESS!
LATEST BUYS!

RADIO WIRE TELEVISION (Lafayette Radio)
100 Sixth Avenue, N. Y., Dept. JL-50

- Enclosed $__________ (Include shipping charge, excess will be refunded). Rush me National Model__________
- Please rush FREE Buying Guide 950F.

Name__________________________
Address_________________________
City______Zone______State______
Hi-Fi AM Tuner and Amplifier

By D. V. R. Drenner

The 6J6, a companion for the AM tuner described last month, is a good high-fidelity unit. Although it departs from the conventional in many respects, it has no fancy hard-to-adjust features. A frequency run with a Hewlett-Packard oscillator and a GE VU panel shows it to be flat within 1½ db, 20 to 26,000 cycles. The output transformer governs the frequency response, and that depends on what the pocketbook will stand. Fig. 1 is the schematic of the amplifier.

Except for the output tubes, all stages use miniatures. The phase inverter stage—a 6J6 duo-triode—is cathode-coupled; so you don't have to juggle resistors. The only transformer in the amplifier is in the output stage. The final tubes are driven by cathode followers for low driving impedance and a good way to adjust the balance of the final stages. The 6AG5's are triode-connected to make the whole amplifier triodes from input to output! That should satisfy even the most rabid "triodes-are-best" boys.

The first 6J6 is a preamplifier to drive the phase inverter and also an electronic bass-boost stage. The mathematics of the bass-boost stage get rather complicated, but the values shown make it perform well.

The second 6J6 dual triode is the cathode-coupled phase inverter. The grid of one section is fed the audio signal, and the other grid is grounded. The cathodes, being tied together, work in unison. Both plates also vary as the input signal varies, but the signal outputs are 180° out of phase. It's a neat scheme that works nicely. Since the 6J6 is a high-mu triode, good stability and low hum level are important. The phase inverter stage must be shielded with a miniature spring-loaded tube shield to minimize microphonics which 6J6's often develop. The a.c. circuits should be carefully laid out to keep hum pickup low. With these precautions the 6J6 performs well. This type of phase inverter shows no aging effects, as is often the case with other inverter circuits.

The next stage uses two 6AG5's, triode-connected, to drive the 6C4 cathode followers. The fixed bias for the final tubes is fed through the cathode loads of 6C4's; and, by varying a portion of this voltage on the 6C4 grids, the bias can be adjusted so the signal in the final output tubes is balanced.

In the final stage either 6B4-G's or 6AS-G's is can be used. When this amplifier was built, the 6AS-G wasn't available, but it is preferable because the cathode-type construction further reduces hum.

Cathode bias can be used, but the fixed bias gives increased output and
keeps the bias voltage constant under all plate conditions. This bias voltage is stabilized by an 0D3 regulator tube.

For an output transformer you can take your choice. If you want the ultimate in performance, use one of the best quality transformers, so long as it loads the tubes with 3,000 ohms.

The physical layout of the amplifier can take almost any form, provided the usual wiring precautions are observed. Run the a.c. wiring close to the chassis and so that no ground loops are formed. A common-ground bus is better than the usual chassis ground.

While separate chasses were used for the amplifier and for the two power supplies, both could be on the same chassis if the power transformers are mounted away from the input stages. The input operates at relatively low level and has high gain; stray fields are apt to raise the output—of noise! With a 15-inch speaker bass reflex cabinet or a woofer-tweeter combination, this amplifier will deliver 15 watts of low-distortion, high-fidelity amplification from a tuner or phone pickup.

The author wishes to acknowledge the assistance of D. W. Gillette in the design of this equipment.

**Materials for Amplifier**

Resistors: 2-100, 1-680, 1-2,200, 2-5,100, 4--47,000, 2-54,000, 1-62,000, 4-100,000 ohm, 5-1 megohm, 1 watt; 2-6,000, 1-50,000 ohm, 1-1 megohm potentiometers: 1-5,000 ohm, 25 volt; 1--50,000 ohm, 50 volt.

Capacitors: 2-0.1 uf, 400 volt, paper; 1--0.2, 5--0.6 uf, oil filled; 1--0.4, 600 volt, paper; 2--0.5-16 uf, 400 volt, 1-100 uf, 50 volt, electrolytic.

Miscellaneous: 1--350-0.350 volt, 90 ma, 1--350-0.350 volt, 120ma power transformers with filament windings; 2-10 h. 180 ma, 2-15 h. 75 ma chokes; 1--output transformer, 3,000 ohm primary; 2-448, 2-644G, 2-448-G or 6A5-G, 2-5Y3-GT, 1-0D3 tubes with sockets; 2-1-amp fuses and holders; chassis, hookup wire, switches, assorted hardware.

**Blinker Circuit**

A blinker circuit was required to control two strings of lights which were to blink on and off at approximately 5-second intervals. Standard bimetallic blinkers could not be used because one string had to light at the instant that the other went off.

Blinks and dashes are provided by the flip of a switch. This switch turns on the oscillator coil, which is the bottom half of the tickler coil. A condenser is used to provide the correct frequency required to light the lamps. By connecting the condenser to the oscillator, the lamps light on the second stroke of the oscillator and remain lit until the condenser has discharged. When the condenser is disconnected, the lamps will go out on the next stroke of the oscillator.

A relay is used to control the coil. The relay is turned on by the oscillator and the energy is stored in the condenser. When the oscillator stops, the relay develops 110 volts for the transformer, which provides a peak of 310 volts. This is more than enough volts to light the lamps.

**What's New...**

Input Calibration Voltage—provides a standard for measuring unknown voltages. Vertical polarity switch allows you to reverse the polarity of vertical deflection voltage. New return trace blanking—all electronic—provides clearer, sharper image. New styling—helps you locate controls more quickly, matches Jackson Television Generator.

**Plus All These Important Features...**

Dual purpose vertical amplifier. Wide band, flat within 1.5 db, 20 cycles through 4.5 megacycles. Vertical deflection sensitivity .018 rms volts-per-inch. Saw tooth sweep, 20 cycles to 50 kilocycles. Intensity modulation, either 60 cycle or from external source. Direct connection through capacitors to deflection plates. Removable calibration screen. Many more important features.

**See your distributor, or write**

**Announcing a NEW**

**Jackson 5-inch Oscilloscope**

**Model CR02**

**Blinker Circuit**

A blinker circuit was required to control two strings of lights which were to blink on and off at approximately 5-second intervals. Standard bimetallic blinkers could not be used because one string had to light at the instant that the other went off.

**New Jackson Oscilloscope**

**Model CR02**

**What's New...**

Input Calibration Voltage—provides a standard for measuring unknown voltages. Vertical polarity switch allows you to reverse the polarity of vertical deflection voltage. New return trace blanking—all electronic—provides clearer, sharper image. New styling—helps you locate controls more quickly, matches Jackson Television Generator.

**Plus All These Important Features...**

Dual purpose vertical amplifier. Wide band, flat within 1.5 db, 20 cycles through 4.5 megacycles. Vertical deflection sensitivity .018 rms volts-per-inch. Saw tooth sweep, 20 cycles to 50 kilocycles. Intensity modulation, either 60 cycle or from external source. Direct connection through capacitors to deflection plates. Removable calibration screen. Many more important features.

**See your distributor, or write**

**Police Alarm Model PR-11**

**What's New...**

Input Calibration Voltage—provides a standard for measuring unknown voltages. Vertical polarity switch allows you to reverse the polarity of vertical deflection voltage. New return trace blanking—all electronic—provides clearer, sharper image. New styling—helps you locate controls more quickly, matches Jackson Television Generator.

**Plus All These Important Features...**

Dual purpose vertical amplifier. Wide band, flat within 1.5 db, 20 cycles through 4.5 megacycles. Vertical deflection sensitivity .018 rms volts-per-inch. Saw tooth sweep, 20 cycles to 50 kilocycles. Intensity modulation, either 60 cycle or from external source. Direct connection through capacitors to deflection plates. Removable calibration screen. Many more important features.

**See your distributor, or write**
SENSATIONAL TRIO TV YAGI PROVIDES HIGH GAIN ON 2 CHANNELS

Here's the New TV antenna everyone is talking about — the most desirable antenna for two band operation. Unlike customary yagis, where gain falls off sharply on adjacent channels, the new and revolutionary development by TRIO actually provides full 10 DB gain on each of two channels — in a lightweight, compact array. It's the reason it's the most sought after antenna in America today!

It's available for channels 4 and 5, in the low band, and channels 7 and 9 in the high band.

If it's dual channel performance you want for local or fringe area reception, here's the antenna that out performs them all — in better picture quality, cost and weight.

COMPARE THESE ADVANTAGES

- Provides gain on both channel 4 and 5 (or 7 and 9) and equal to any two conventional 4-element yagis!
- One bay replaces bulky stacked array!
- One lead replaces old-style 2-lead systems!
- Less weight-per-gain than any other TV antenna!
- Greatly reduced installation costs for complete TV coverage!
- Can be stacked for additional gain.

HOW IT WORKS

Antenna consists of 4 elements whose functioning is different on the two channels. For example: in Model 445, the elements, on channel 4, act as reflector, dipole, director, in that order; while on channel 5, the same elements act as reflector, dipole, and director. Careful design insures proper impedance match with standard 300 ohm lead.

Eliminates Co-Channel Interference — Venetian Blind Effect

When used with TRIO "Controlled Pattern" System

Because of the high gain and front to back ratio of the new 2-channel single or stacked yagi, most co-channel interference is eliminated. When the problem is unusually difficult, such as when the TV receiver is located in the center of several TV stations operating on the same channel, co-channel interference can be completely eliminated with the use of the "Controlled Pattern" system. This unique system uses 2 bays, off-set stacked and tuned with the remarkable TRIO "Phasotron." TRIO antennas will give you TV reception when the rest fail.

Model 445 — Single bay Yagi for Channels 4 and 5.
Model 445-2 — Conventional 2 bay stacked array for Channels 4 and 5.
Model 479 — Single bay Yagi for Channels 7 and 9.
Model 479-2 — Conventional 2 bay stacked array for Channels 7 and 9.
Model 645 — "Controlled Pattern" System for Channels 4 and 5, and Model 679 for Channels 7 and 9.

Here's what the new TRIO yagi provides high gain on: two channels.

HERE IT IS—

The Issue You've Been Waiting for
RADIO-ELECTRONICS
ANNUAL TELEVISION ISSUE
Bigger and Better Than Last Year!
ON SALE DECEMBER 27, 1950
Reserve Your Copy Today

HIGH-EFFICIENCY CRYSTAL RECEIVER
By ROBERT E. KELLEY

The crystal detector offers no hope as an amplifier (disregarding such related devices as the transistor). The experimenter must increase the signal input to a maximum for maximum output to the load. The more input to the crystal detector, the more output over the linear range of the crystal.

Many tuned antenna and input coupling systems have been devised to improve the input signal level and, in some cases, the selectivity. The simple input circuit given here illustrates the improvement obtainable with a good load-coupling circuit.

The tuned circuit L2-C1 (Fig. 1) should present an infinite impedance at resonance under ideal conditions. Never obtained of course in practice, it is approached if a high Q coil is used with proper antenna matching and impedance matching. The crystal headphones, on the other hand, offer relatively low impedance to r.f.

To get a good match, simply tap the crystal lead to the coil L2 at the point where maximum current flows in the load circuit. The tap may be adjusted by turning in a station and adjusting for maximum volume or for maximum indication of a microammeter in the output circuit.

With ordinary headphones (about 2,000 ohms impedance) the author was able to read 18 µA of rectified d.c. with the crystal lead tapped at the top of the coil. By adjusting the crystal lead to about three-quarters of the way toward the bottom of the coil, the reading was increased to 280 µA. Both volume in the phones and selectivity were increased tremendously.

Fig. 1 — Hookup of the crystal receiver.

The explanation for this is simply that matching the impedance of the load circuit to the very high impedance of the tuned circuit gives a much higher effective Q and better power transfer to the load.

By using the variable tap, any reasonable load (500 to 20,000 ohms) may be matched to the tuned circuit simply by adjusting the tap for maximum current in the load. High impedance loads will have lower meter readings than low impedances. The meter readings are significant only as comparisons on the same or similar load impedances.

The coil L1 is 16 turns of No. 30 enameled wire on a ½-inch diameter form. L2 is 65 turns of No. 30 enameled wire on a ¾-inch diameter form and is tapped every five turns.

RADIO-ELECTRONICS for
4 Pages of TEST EQUIPMENT at prices every serviceman can afford!

**MONEY BACK?**
Every single unit described on this and the following pages is offered on a strict "money-back-if-not-satisfied-basis." No if's—no but's—no maybe's. Simply send your order for any unit or units you select and try them out for 10 days. If not completely satisfied—return for refund in full. No explanation necessary. You are sole judge.

**GUARANTEE?**
Every instrument sold by us is covered by a one year guarantee. Guarantee registration card is included with shipment.

**KITS?**
We have discontinued advertising TEST EQUIPMENT in Kit form. The units offered on these 4 pages are completed instruments, NOT KITS! Every model is factory-wired, calibrated and ready to operate.

---

**TUBE TESTERS**

---

**THE NEW MODEL 247**

- Check octals, loctal, pentode sections, magic eye, hearing aids, thyatrons, the new type H.F. miniatures, etc.
- A newly designed element selector switch reduces the possibility of obsolescence to an absolute minimum.
- When checking Diode, Triode and Pentode sections of multi-purpose tubes, sections can be tested individually. A special isolating circuit allows each section to be tested as if it were in a separate envelope.
- The Model 247 provides a supersensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

* One of the most important improvements, we believe, is the fact that the 4-position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

---

**SUPERIOR'S NEW MODEL TV-10**

- Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Pentode, Bantam, Hearing-aid, Thyratron, Miniatures, Sub-Miniatures, Norvals, etc. Will also test Pilot Lights.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests for "shorts" and "leakages" up to 5 Megohms.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the R.M.A. base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with elements terminating in more than one pin are truly tested with the Model TV-10 as any of the pins may be placed in the neutral position when necessary.
- The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes.
- Newly designed Line Voltage Control compensates for variation at any line voltage between 105 Volts and 130 Volts.
- The Model TV-10 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

---

Model 247 comes complete with new speed-read chart. Comes housed in handsome hand-rubbed oak cabinet sloped for bench use. A slip-on portable hinged cover is indicated for outside use. Sizes: 19½"x15½"x15½". ONLY

---

$29.90 NET

---

$39.50 NET

---

**TO ORDER—TURN TO PAGE 56 FOR RUSH ORDER FORM**

---

**GENERAL ELECTRONIC DISTRIBUTING CO.**

DEPT. RC-12, 98 PARK PLACE

NEW YORK 7, N. Y.

DEC. 1950
BUY WITH CONFIDENCE!!

WE KNOW THE PRICE IS UNBELIEVABLY LOW,

but that's not all! In addition, this finely engineered instrument provides a degree of accuracy never before attained in a unit selling for even double this price. Furthermore—in designing this unit, we took advantage of every recent improvement in components. For example, by using slug-tuned coils, we are able to efficiently adjust each instrument for perfect accuracy. This feature will also enable you to recalibrate the model 200 periodically without having to return it to the factory. The use of a Nosal tube (the 12AU7) with its extremely low inter-electrode capacity enabled us to reach a higher frequency range than was heretofore possible in a unit of this type.

THE NEW MODEL 200

AM and FM

SIGNAL GENERATOR

SPECIFICATIONS

* R.F. FREQUENCY RANGES: 100 Kilocycles to 150 Megacycles.
* MODULATING FREQUENCY: 400 Cycles. May be used for modulating the R. F. signal. Also available separately.
* ATTENUATION: The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.
* OSCILLATORY CIRCUIT: Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.
* ACCURACY: Use of high-Q permeability tuned coils adjusted against 1/10th of 1% standards assures an accuracy of 1% on all ranges from 100 Kilocycles to 10 Megacycles and an accuracy of 2% on the higher frequencies.
* TUBES USED: 12AU7—One section is used as oscillator and the second is modulated cathode follower. 6C4 is used as rectifier.

The Model 200 operates on 110 Volts A.C. Comes complete with output cable and operating instructions.

$18.85 NET

TO ORDER—TURN TO PAGE 56 FOR RUSH ORDER FORM.

GENERAL ELECTRONIC DISTRIBUTING CO.
DEPT. RC-12, 98 PARK PLACE, NEW YORK 7, N. Y.
Superior’s model 770
AN ACCURATE POCKET-SIZE VOLT-OHM MILLIAMMETER
(SENSITIVITY—1000 OHMS PER VOLT)

FEATURES
- *Compact-measures 3½” x 5½” x 2¼”.
- *Uses latest design 3½” accurate 1 Milli-D’Arsonval type meter.
- *Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range.
- *Housed in round-cornered, molded case.
- *Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

SPECIFICATIONS
6 A.C. VOLTAGE RANGES:
0—15/50/150/300/1500 Volts
6 D.C. VOLTAGE RANGES:
0—7.5/15/75/150/750/1500 Volts

4 D.C. CURRENT RANGES:
0—0.5/1.5/15/150 MA. 0—1.5 AMPS.
2 RESISTANCE RANGES:
0—500 OHMS 0—1 MEGOHM

SUPER-METER
A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:
D.C. VOLTS: 0 to 7.5/15/75/150/300/1,000/3,000 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,000/5,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 MA. 0 to 1.5 Amperes
RESISTANCE: 0 to 500/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. 1.1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8,000 Henries

20,000 OHMS PER VOLT MULTI-METER and TELEVISION KILOVOLT METER

SPECIFICATIONS
- 9 D.C. VOLTAGE RANGES. (at 20,000 ohms per Volt)
  0-2.5/0-5/0-10/0-50/0-500/0-1,000/0-5,000/0-10,000 Volts
- 5 A.C. VOLTAGE RANGES: (at 1,000 ohms per Volt)
  0-2.5/5/10/25/50/100/500/1,000/5,000 Volts
- 5 D.C. CURRENT RANGES
  0-50 Microamperes
  0-500/500 Milliamperes
  0-5 Amperes
- 6 RESISTANCE RANGES:
  0 to 5,000/0-10,000 ohms 0.2/10 Megohms
- 7 D. B. RANGES: (All D. B. ranges based on 0.001 ohm as 1 Mr.)
  0–4 to +10 dB +30 to +50 dB
  0 to +22 dB +40 to +50 dB
  0 to +10 dB +48 to +62 dB
  0 to –10 dB +36 dB
- 7 GOOD/BAD VOLTAGE RANGES:
  0 to 7.5/15/30/50/100/250/500/1,000 Volts

ADDED FEATURE:
The Model 670 includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.
The Model 670 comes housed in a rugged, crinkle-finished steel cabinet complete with test leads and operating instructions. Size 5½” x 7½” x 3”.

Superior’s new model TV-20

20,000 OHMS PER VOLT MULTI-METER and TELEVISION KILOVOLT METER

SPECIFICATIONS
- 9 D.C. VOLTAGE RANGES. (at 20,000 ohms per Volt)
  0-2.5/0-5/0-10/0-50/0-500/0-1,000/0-5,000/0-10,000 Volts
- 5 A.C. VOLTAGE RANGES: (at 1,000 ohms per Volt)
  0-2.5/5/10/25/50/100/500/1,000/5,000 Volts
- 5 D.C. CURRENT RANGES
  0-50 Microamperes
  0-500/500 Milliamperes
  0-5 Amperes
- 6 RESISTANCE RANGES:
  0 to 5,000/0-10,000 ohms 0.2/10 Megohms
- 7 D. B. RANGES: (All D. B. ranges based on
  0.001 ohm as 1 Mr.)
  0–4 to +10 dB +30 to +50 dB
  0 to +22 dB +40 to +50 dB
  0 to +10 dB +48 to +62 dB
  0 to –10 dB +36 dB
- 7 GOOD/BAD VOLTAGE RANGES:
  0 to 7.5/15/30/50/100/250/500/1,000 Volts

ADDED FEATURE:
The Model TV-20 includes an Ultra High Frequency Voltmeter Probe, A Silicon V. H. F. Diode together with a resistance capacity network provides a frequency range up to 1,000 MEGACYCLES. When plugged into the Model TV-20, the V. H. F. Probe converts the unit into a Negative Peak-Reading, H. F. Voltmeter which will measure gain and loss in all circuits including F. M. and T. V. check capacity and impedance; test efficiency of all oscillator circuits; measure bandwidth of F. M. and T. V.; etc.

The Model TV-20 operates on self-contained batteries. Comes housed in beautiful hand-rubbed, oak cabinet complete with portable cover. Built-in High Voltage Probe, Ft. F. Fin. W. Test Leads and all operating instructions. Measures 4½” x 10½” x 11½”.

Shipping Weight 10 lbs.

TO ORDER TURN TO PAGE 56 FOR RUSH ORDER FORM

GENERAL ELECTRONIC DISTRIBUTING CO.
98 PARK PLACE DEPT. RC-12 NEW YORK 7, N. Y.

DECEMBER, 1950
**SIGNAL TRACER**

**THE WELL KNOWN MODEL CA-12 IS THE ONLY SIGNAL TRACER IN THE LOW PRICE RANGE INCLUDING BOTH METER AND SPEAKER!!!**

**SPECIFICATIONS**

★ Comparative intensity of the signal is read directly on the meter—quality of the signal is heard in the speaker.

★ Simple to Operate—only one connecting cable—no tuning controls.

★ Highly Sensitive—uses an improved vacuum-tube voltmeter circuit.

★ Tube and Resistor Capacity Network are built into the detector probe.

★ Built-In High Gain Amplifier—Alnico V Speaker.

★ Completely Portable—weighs 8 pounds—measures 5½" x 6½" x 9".

Model CA-12 comes complete with all leads and operating instructions

---

**$29.95 NET**

---

**TELEVISION SIGNAL GENERATOR**

**ENABLES ALIGNMENT OF TELEVISION I.F. AND FRONT ENDS WITHOUT THE USE OF AN OSCILLOSCOPE!**

**FEATURES**

Built-in modulator may be used to modulate the R. F. Frequency also to localize the cause of trouble in the audio circuits of T. V. Receivers.

Double shielding of oscillatory circuit assures stability and reduces radiation to absolute minimum.

 Provision made for external modulation by A. F. or H. F. source to provide frequency modulation.

All I. F., frequencies and 2 to 13 channel frequencies are calibrated direct in Megacycles on the Vernier dial.

Markers for the Video and Audio carriers within their respective channels are also calibrated on the dial.

Linear calibrations throughout are achieved by the use of a Straight Line Frequency Variable Condenser together with a dermaility trimmed coil.

Stability assured by cathode follower buffer tube and double shielding of component parts.

**SPECIFICATIONS**

**Frequency Range:** 4 Bands—No switching: 18.32 Mc., 35.65 Mc., 54.98 Mc., 150.25 Mc.

Audio Modulating Frequency, 400 cycles (Sine Wave). Attenuator 4 positions, ladder type with constant impedance control for fine adjustment.

Tubes Used: 6C4 as Cathode follower and modulated buffer. 6C0 as R.F. Oscillator. 6SN7 as Audio Oscillator and power rectifier.

Model TV-30 comes complete with shielded coaxial lead and all operating instructions. Measures 5½" x 7½" x 9½". Shipping Weight 10 lbs.

**$29.95 NET**

---

RUSH ORDER FORM

CUT OUT AND MAIL TODAY!

**GENERAL ELECTRONIC DISTRIBUTING CO.**

DEPT. RC-12, 98 PARK PLACE, NEW YORK 7, N. Y.

GENTLEMEN:

PLEASE RUSH THE MATERIAL LISTED BELOW:

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>MODEL</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL

$…………… (Payment in Full Enclosed) $…………… (Deposit Enclosed—Ship Balance C.O.D.)

SHIP TO:

Name……………………………………………………………………………………………………………………………

Address…………………………………………………………………………………………………………………………

City………………………………………………………………………………………………………………………………

Zone………….. State…………………………………………………………………………………………………………

---

RADIO-ELECTRONICS for
3-TUBE RECEIVER FOR WIRED RADIO

BY RUFUS P. TURNER

Many hobbyists do not care to obtain amateur radio licenses but wish to enjoy the fun of two-way radio communication over the power lines, wire fences, telephone lines, metal clothes lines, etc. Here is a compact, sensitive wired-radio receiver that the beginner will find easy to build and put into operation. A companion transmitter will appear in an early issue.

To keep within the law, the power output of a carrier current transmitter must be kept low. Its frequency is generally below the broadcast band to prevent radiation and interference with nearby broadcast receivers. For this reason receiver sensitivity must be fairly high. When amateur stations were shut down during the last war, carrier current experimenters tried various types of low-frequency receivers. These tests proved that a hot regenerative receiver is entirely satisfactory for amateur wired radio and in many cases will give a homemade carrier current superhet receiver a run for its money.

This small-sized 3-tube set is complete with a.c. power supply. Its signal tuning range is 95 to 400 kc. Loudspeaker operation is provided. The receiver uses parts which are easily obtained, and takes little table space. Its cabinet measures only 11 x 7 x 7½ inches. It has three controls. One dial takes care of all tuning. The only other adjustable items are the volume control and regeneration control. The setting of the regeneration control has little effect on the dial calibration.

A STANDBY (or TRANSMIT-RECEIVE) switch is provided so the receiver may be shut off during transmitting intervals without turning off the tube heaters. A second ON-OFF switch interrupts the a.c. line to shut off the entire receiver.

Regeneration control is smooth and covers a wide range. Regeneration may be eliminated entirely by turning the regeneration control potentiometer all the way down—the receiver then operates as a simple non-regenerative detector and one-stage power amplifier—or it may be increased to maximum where oscillation begins. Between these two extremes there is a wide range of receiver sensitivity to suit all manner of reception conditions.

Fig. 1 is the schematic of the receiver. A special three-coil coupler L1-L2-L3 provides input coupling and inductive feedback. The grid coil L2 is one coil taken from an old 455 kc i.f. transformer.

The other i.f. coil is removed from the wooden dowel on which the two are mounted. The input coil L1 is 15 turns of No. 26 d.c.c. wire closewound around the dowel and separated from L2 by about ¼ inch as shown in Fig. 1. The tickler coil L3 is the largest honeycomb pie from a National type R-152.

Here it is...Concord's New Buying Guide...The most current listing on leading TV, Radio, and electronic equipment in the field. Concord is issuing periodically, these "guides" to give you the finest buying scopes at hand. You'll get complete information on all the latest available merchandise...at the lowest possible price. In this way you're assured of only the best up-to-date selection of equipment on the market at the time. When the merchandise is available to use...it goes straight to you. You can't afford to miss an issue...Get on Concord's mailing list now...It's the only way to keep posted!

Put Your Name On Concord's Mailing List

CONCORD RADIO CORP. Dept. JH-50

CRUSH me your Latest Buying Guide

Name: ____________________________
Address: ________________________
City: ____________________________
State: __________________________

SOME $5 SAVING CONCORD SPECIALS

SAVE...12” CO-AXIAL HI-SPEAKER

...Expertly engineered to give finest in natural reproduction for high-fidelity audio systems and radios. 12” woofer has heavy duty 31 ounce Alnico 3 magnet for reproducing lower musical register down to 40 cycles. Coaxially mounted tweeter has specially designed cone for higher register of musical and vocal sound...will respond up to 17,500 cps. High pass filter is attached and combined impedance can be hooked to any 8 ohm output transformer. Rated at 20 watts. 22-193632—Ship. Wt. 10 lbs. $12.95

EXCLUSIVE...DIAMOND STYLUS CARTRIDGE

Another Concord Exclusive! A Variable Reluctance Cartridge with a Genuine Long-life Diamond Stylus for Standard 78 RPM recordings. Dramatically reduced in price, this cartridge formerly sold at $31.00. Now only at Concord, you can have it at less than 1/2 the original net price...a 50% saving. Frequency response limited only by record itself. Extremely low needle tip and scratches. Unaffected by varying temperature and humidity conditions. Requires 3/4 oz. or less pressure for optimum tracking. May be used with most standard tone arms. Can also be used with Garrard record changers (old or new), and Webster changer's (with the exception of those that employ plug in heads). Preampifier is required between pick-up and input. Size: 2-1/32 x 3/4 x 1/6”, mg. wts. 1/2. 96-0815 — List: $55.00...And only $9.95

VALUE...NEW CON-CAP CONDENSERS

<table>
<thead>
<tr>
<th>No.</th>
<th>Capacity</th>
<th>Working</th>
<th>Lot</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-682</td>
<td>20</td>
<td>150</td>
<td>294</td>
<td>376</td>
</tr>
<tr>
<td>5-684</td>
<td>40</td>
<td>150</td>
<td>135</td>
<td>436</td>
</tr>
<tr>
<td>5-692</td>
<td>20-30</td>
<td>150</td>
<td>875</td>
<td>556</td>
</tr>
<tr>
<td>5-693</td>
<td>40-50</td>
<td>150</td>
<td>596</td>
<td>416</td>
</tr>
<tr>
<td>5-695</td>
<td>30-50</td>
<td>150</td>
<td>596</td>
<td>616</td>
</tr>
<tr>
<td>5-688</td>
<td>15</td>
<td>450</td>
<td>294</td>
<td>376</td>
</tr>
</tbody>
</table>

Concord’s New Con-Cap capacitors...Rigorously tested for mechanical perfection and electrical stability under severe conditions of shock and vibration. Feature seamless extruded aluminum shell with outer closed end, hard paper board insulation and comb gossip leads. Hermetically sealed construction. See complete listing at left...at the lowest prices anywhere!

CONCORD RADIO

Mail Order Center and Showroom
901 W. Jackson Blvd., Chicago 7, Ill.
Branch Showrooms: 265 Peachtree St., Atlanta 3, Ga.

DECEMBER, 1950
transmitting r.f. choke. This pie is cemented flat to one face of L2. A long bronze machine screw passed through the center hole of the dowel holds the three-coil coupler to the receiver chassis.

The in-out coil L1 connects directly to the signal input terminals. If the receiver input is connected to the power line, use the fuse-protected coupler shown in Fig. 2 to prevent burning out L1. This isolating unit is not needed when the conducting line carries no high voltage. A pair of 600-volt paper capacitors will then be sufficient.

The tuning capacitor C1 is a two-section midget broadcast-type unit with 365 µf per section. The trimmers are removed and the two sections are connected in parallel by a short jumper for a total capacitance of 730 µf. The vernier tuning dial is a National type AM.

### Testing and calibration

After the wiring is completed and inspected, connect the loudspeaker, set the regeneration control to zero, the volume control to maximum, and the standby switch S1 to off. Allow about 3 minutes for the tubes to heat. Close switch S1 and slowly advance the regeneration control. At one point in this adjustment a dull thud or pop should be heard as regeneration begins. As the control is advanced still further, a steady rushing noise should begin and should be followed by a loud whistle that indicates oscillation. If you do not get these effects, reverse the connections of tickler coil L3 and repeat the test. With the receiver oscillating, run the volume control through its range, to check volume control action.

To calibrate the receiver, connect an amplitude-modulated signal generator or test oscillator to the signal input terminals of the receiver. Set tuning capacitor C1 to maximum capacitance and set the signal generator for 95 kc. Adjust the generator output for a fairly strong modulated signal, advance the volume control to maximum, and advance the regeneration control until regeneration is established. If the receiver tunes to 95 kc at considerably less than full capacitance of C1, remove a few turns from grid coil L2. Advance the receiver dial a few divisions at a time, following with the signal generator. The completed calibration will be very nearly identical with the data given in the chart. Always use the minimum regeneration which will sensitize the receiver sufficiently to pick up good signals.

### CALIBRATION DATA

<table>
<thead>
<tr>
<th>Dial Setting</th>
<th>Frequency (kc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>360</td>
</tr>
<tr>
<td>10</td>
<td>295</td>
</tr>
<tr>
<td>20</td>
<td>240</td>
</tr>
<tr>
<td>30</td>
<td>205</td>
</tr>
<tr>
<td>40</td>
<td>175</td>
</tr>
<tr>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>60</td>
<td>135</td>
</tr>
<tr>
<td>70</td>
<td>115</td>
</tr>
<tr>
<td>80</td>
<td>105</td>
</tr>
<tr>
<td>90</td>
<td>95</td>
</tr>
<tr>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>110</td>
<td>95</td>
</tr>
<tr>
<td>120</td>
<td>95</td>
</tr>
<tr>
<td>130</td>
<td>95</td>
</tr>
</tbody>
</table>

### Materials for receiver

**Resistors:** 1—2.2 megohms, 1/2 watt; 1—15,000 ohm, 1 watt; 1—25,000 ohm, 4 watt, wire-wound potentiometer with insulated contact arm; 1—500,000 ohm potentiometer; 1—4000 ohm 10 watts.

**Capacitors:** 1—350 µuf silver mica; 2—500 µuf mica; 1—0.05, 2—0.01, 1—0.25, 400 volt paper; 2—8 ft, 450 volt, electrolytic; 1—25 ft, 25 volt, electrolytic; Midget capacitors: 1—audio-frequency choke, 1500 h; 1—radio frequency choke, 100 µf; 1—an universal output 2—tungsten filament varaiable, 315 µuf per section; 1—transformer to match 6V6-GT/G; 1—power transformer, 335-0.150 v or 70 ma, 5 v at 3.5, 6.3 v at 25, 50, 150 ma, chassis, varial wire, tubes, sockets, hookup wire, switches, miscellaneous hardware.

**RADIO-ELECTRONICS** for

---

**Fig. 1**—Circuit of the little 3-tuber. Its tuning range is from 95 to 400 kc.

**Fig. 2**—Fused coupler for the receiver.
Technical Bulletins

EACH $1.00 Postpaid
Foreign $1.25

Electrical Design and Construction

These bulletin give you easy, accurate, dependable methods of designing and building electrical equipment. You just follow simple charts, tables and step-by-step instructions that tell how to figure correct size units to meet specific requirements.

106 Rewinding Electric Motors—Enables anyone without electrical training to locate trouble, repair and rewind a.c. or d.c. motors and generators of all kinds; how to figure wire size and wind coils.

111 Transformers—How to design and build all types and sizes of transformers including special types for neon tubes and ultraviolet lamps. Easy methods of determining core size, choice of core material and estimating methods.

152 House Wiring—Safe, approved way to wire new and old buildings. Shows many different circuits. Explains how to use latest type of materials including fittings. Future. Also gives estimating methods.

101 Resistance Wire—How to use nichrome and similar wire in heating devices, rheostats and resistance coils. Figuring wire size and length how to wind elements and test. Also supply directory.

113 Solenoids & Plunger Magnets—How to make this type of magnet having movable plungers to control other equipment. How to figure dimensions, plunger stroke, wire size, etc.

112 Electromagnets—How to design and build all types and sizes for a.c. and d.c. How to figure lifting power, wire size.

148 Relays—Designing and building a.c. and d.c. relays of any size for various purposes where small currents and voltages must control heavy circuits. Includes control systems for motors and motors.

137 Motors—Designing and building motors, voltimeters, wattmeters, for a.c. and d.c. Includes complete information on calibrating.

127 Small Electric Light Plants—Easy-to-build, low-cost installations for outdoor, indoor, etc. Includes a 110-volt, seven 25-watt-lamp system; also a 6-volt system using auto generator.

Electric Power from Streams—How to survey streams, estimate requirements and available power, design and build dams, select and install the control system and electrical equipment.

161 Burglar Alarm & Time Switches—Dependable type for various purposes. Time switches, made for alarm clocks and used to control lights, sprinkler systems, motors and other devices.

144 Choke Coils—How to design and build for many purposes. How to use them instead of rheostats for voltage control, safety and with much less loss of electricity.

113 Remote Control of Electrical Devices—Circuit and applications. How to use telephone wire and telephone switch. For experimenters and model-tower switching purposes.

114 A.C. Electrical Experiments—Fascinating, important experiments for education and entertainment. Also practical uses.

TECHNIFAX, 520 N. Michigan Ave.,
Chicago 11, Ill.

Enclosed find $____ for which send the following Technical Bulletins at $1.00 each (Foreign $1.25) as indicated by numbers:

[Numbers and options listed]

Name______________________________
Address____________________________
City & State_________________________

DECEMBER, 1950

HETERODYNE SIGNAL GENERATOR

There are many uses around the ham shack or service hench for this crystal-controlled heterodyne signal generator. A few standard parts, a dual triode, and the readily available surplus military-type crystals make the device inexpensive.

Each section of the 6SN7 operates as a Pierce oscillator. Their outputs are mixed in the plate circuits, resulting in four possible output frequencies: fc, fc + f1, fc - f1, and fc + f2. It is especially valuable as a substitute for low-frequency crystals in the broadcast and i.f. channels.

By judiciously selecting the crystal frequencies, a number of useful frequencies can be generated. For example, one extra crystal will give five additional frequencies. A total of four crystals will provide 16 different frequencies.

Although the output is shown feeding into an attenuator circuit for signal generator service, any one of the four frequencies has sufficient strength to drive the oscillator, output a 6L6 or 6V6 buffer or doubler stage in a transmitter.

This circuit was developed to drive a carrier-current transmitter with 807's in the final at KHSM (St. Mary's College) on 880 kc, using available seven crystals of suitable frequencies. The same circuit has since proven its worth as a test oscillator on the bench, being a source of crystal check points throughout the spectrum by using various combinations of crystals.

Robert D. Oliver, WSESP


1. The name and address of the publisher, editor, managing editor, and business manager are: Publisher, Radio & Television Industry, Inc., 55 West Broadway, New York 13, N. Y.; Editor, Hugo Gernsback, 10 West Broadway, New York 7, N. Y.; Managing Editor, Fred Shinneman, 25 West Broadway, New York 7, N. Y.; Business Manager, none.


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 capacity, the name of the person or corporation for whom such trustee is acting:

5. The statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances 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.

G. H. Gernsback, Publisher.

Sworn to and subscribed before me this 28th day of September, 1950, [Seal] Maxine Grace, Notary Public. (My commission expires March 30, 1952.)

NEW Second Edition of the famous RED BOOK tells you in one volume all you need to know about TV and Radio replacement parts for approximately $22,000 sets made from 1934 through 1950! Includes complete, accurate listings of all parts, 22,000 parts for components. Shows proper replacement listings for 22 product lines produced by 19 leading parts manufacturers. Gives original part numbers, proper replacement numbers and valuable installation and service notes on TV and Radio Parts: Tubes, Capacitors, Transformers, Controls, IF's, Speakers, Vibrators, Photo-Cartridges, Batteries plus the first complete TV parts compilation, including replacement parts data for sweep oscillator and horizontal and vertical output systems. Over 600 pages, 8x11, hard cover, binding. You can't afford to be without the RED BOOK—pays for itself with just a few days' use. Order your copy today!

SAVE 95¢! If you own the First Edition RED BOOK, tear out the first page, present it to your distributor, and receive 95¢ credit or allowance on purchase of Second Edition.

Order from your Parts Jobber today, or write direct to HOWARD W. GERNSBACK & CO., INC., 2201 East 46th St., Indianapolis 5, Ind.
My (check) (money order) for $________

□ Page 1 from First Edition RED BOOK is enclosed.

□ Send ______ copies of RED BOOK (B). $3.35 per copy.

Name______________________________
Address____________________________
City______________________________State______________________________
The "real-phonograph and crystal" stage of television is over! With the new AMPHENOL "Auto-Dial" TV Antenna Rotator there are no troublesome buttons or switches to hold, while the antenna turns—no searching over and over again for the position which provides the best picture. An afterthought turn of the knob to the correct setting—a simple as tuning to a radio station—and "Auto-Dial" takes over. Automatically tuning to a radio station—and "Auto-Dial" takes over. Automatically the antenna rotates to point directly at the TV station—then stops! Rotation is in steps of 6 degrees, accurately calibrated on the indicator. Because of this important feature, you can easily "look" the antenna positions where the best picture is obtained and then accurately rotate to them whenever you wish. Since the antenna can always be brought back to exactly the same direction, servicemen can now determine whether an antenna is functioning properly, whether it has the required front-to-back ratio and whether it is properly located for the best possible picture.

**AMPHENOL LEADS AGAIN**

The new "Auto-Dial" is made by the originators of the famous AMPHENOL "Tilt-All" TV Antennae. The same precision-manufacturing and quality materials will be found in the "Auto-Dial." The rotator is lightweight and attractively styled yet ruggedly built for years of trouble-free service. The "Auto-Dial" Control Unit is gracefully designed to blend with any decor. See the completely New AMPHENOL "Auto-Dial" Rotator at your jobber—or write for illustrated folder.

**AMERICAN PHENIC CORPORATION**

1830 SO. 54TH AVENUE · CHICAGO 50, ILLINOIS

---

**New Devices**

**TOOL HOLDER**

Hobby Hill
Chicago, Ill.

Called the GRIP-R, this tool hanger consists of a 22-gauge open-end metal shell 18 inches long 31/2 inches wide, and 11/2-inch thick. Running along the entire length of the shell is a series of slots for holding sliding ring clips. Directly in front of the line of slots is a 5/16-inch plated coil spring which is held in place by the sliding ring clips, and at each end, screws for wall mounting.

All types of tools, with or without handles, are held on the rack merely by placing them under the coil spring. The sliding ring clips can be adjusted to the size of the tool. The tension in the coil spring holds the item securely and yet allows easy removal.

**AUDIO AMPLIFIERS**

Altec Lansing Corp.
Beverly Hills, Cal.

This group of amplifiers, the 1400 series, consists of six units: the A-1400 preamplifier, the 35-watt A-1420 power amplifier, the 75-watt A-1430 power amplifiers, the A-1440A line amplifier, the A-1450A apparatus unit and the 30A power supply. The new 1420A is designed especially for counter display tube testing as an aid in tube merchandising. Individual switches test each tube in the chassis for remote operation. The A-1430A can supply the necessary power for three preamps and provision has been made so that one can be mounted directly on the power amplifier chassis with its two mixer crystals appearing on the control panel. The A-1440A will supply power for six preamps and has provision for mounting two picopoms on the unit and the main chassis. The 30A power supply is used with the A-1440 and A-1450A when they are not used in conjunction with a power amplifier. The 1400A apparatus unit provides input impedances of 50, 250, 500 or 600 ohms for the power amplifiers, when they are not used in conjunction with the preamplifiers. Suitable output impedances are provided for RM470 volt line.

**DUO-CONE SPEAKER**

RCA Victor Div.
Camden, N. J.

The new 15-inch Duo-Cone speaker has been designed for high-quality reproducing systems at both high and low levels. It has a useful response range from 40 to 12,000 cycles and will handle 25 watts of audio power. The vibrating system and magnetic structure of this speaker consist of a duo-cone and two voice coils operating in two separate air gaps excited by a single 2-pound Alnico V magnet. The duo-cone has a large woofer and a small tweeter cone mounted in its own housing so that the large cone is effectively a continuation of the smaller one. The large cone driven by a 12-inch voice coil to produce low frequencies, and the small cone is driven by a 3-inch voice coil to produce the high.

The two cones vibrate as a single unit in the crossover range to avoid crossover interference.

**TUBE TESTER KIT**

Electronic Instrument Co.
Brooklyn, N. Y.

Incorporating the same features as the previous Eico model 625-K tube tester.

This tube tester is also available completely wired.

**TV-FM BOOSTER**

Sonic Industries, Inc.
New York, N. Y.

The Super Sonic TV-FM Amplifier model 115 is designed for high gain pre selection for any TV or FM receiver with adequate bandwidth and will adequately selectivity to reject unwanted signals. It has one continuous tuning control with vernier and high-low switching. Six turns of the tuning control change through channels 1 to 13.

The circuit features pure silver inductances and r.f. circuit consists minimum shunt capacitance, short in and output link coupling, high quality inducting elements, a copper-plated chassis, and a well-filtered power supply. Balanced input and out put circuit reduces the noise pickup. The booster has both 72 and 300 ohm input and output impedances.
TV BOOSTER
Alliance Manufacturing Co.
Alliance, Ohio
The Tenno Scope, as this new booster is called, has a single tuning control to cover all channels and an automatic on-off switch controlled by the TV re-

LP CARTRIDGE
Astatic Corp.
Conneaut, Ohio
Designed especially for LP records, the new CAC-17 cartridge is in-
ternally equalized to follow the ideal frequency response of the recording characteristics of Columbia records and it also plays the 45 r.p.m. platters. Its output is .4 volts at 1,000 cycles on Columbia No. 103 test record and I volt on RCA 12-31-V test record. The cartridge is housed in a light-

SELENIUM RECTIFIER
Precision Rectifier Co.
Brooklyn, N. Y.
Called Pileshott, these rectifiers look like paper capacitors and are installed the same way as mounting holes re-

YAGI ANTENNA
Trio Manufacturing Co.
Griggsville, Ill.
Created to work on two channels (either channels 4 and 6 or the lo-

AUTO ANTENNA
Snyder Manufacturing Corp.
Using army type construction and mounting, the Hot Rod is designed for long-distance and country reception. It has a long 4 section staff of chrome plated brass, a shock absorbing spring mount, red ceramic insulators and a red teatle solid bolt. It comes complete with 8 feet of u.h.f. polyethylene cable and aircraft type fittings.

HIGH-VOLTAGE PROBE
Industrial Devices Inc.
Edgewater, N. J.
Using the extinction voltage of a neon lamp in conjunction with a cal-

How to Use the Diagrams...

American Radio History - December 1950 Edition
NEW TUBES OF THE MONTH

Among the few new tubes that have appeared on the market in recent months are three types by RCA: two kinescopes, and a photomultiplier. G-E has brought out a new transmitting tube and a new kinescope.

RCA's 19AP4-B is a direct-view, metal-cone picture tube for TV receivers. It has a high-efficiency white fluorescent screen on a face made of frosted Filterglass for increased contrast and to avoid specular reflection. Except for its frosted face, this tube is identical with the 19AP4-A.

The other RCA kinescope, the 7NP4, is a projection-type tube for theaters which provides a projected image of 15 x 20 feet at a projection throw distance of about 60 feet when used with a suitable optical system. The tube has a metal-buckled white fluorescent screen for increased brightness of the projected image.

Using electrostatic focus and magnetic deflection, the 7NP4 operates with a maximum anode voltage of 80 kv and a maximum focusing electrode voltage of 20 kv. High-voltage design features include a bulb with corrugated side-walls with insulated coating for a longer external leakage path; an inner cone-neck section for adequate vacuum insulation; and only one high-voltage envelope connection.

The 19NP4 has a 5-inch diameter bulb that is 19½ inches long. Grid No. 2, which draws only negligible current, is used to make the brightness adjustment independent of the focusing adjustment. Similarly, the focusing electrode, grid No. 3, draws only a few microamperes. The tube uses a plastic-filled, diheptal 14-pin base.

The new 5819 RCA's photomultiplier tube for scintillation counters, has a sensitivity nearly five times better than the original 5819 introduced about a year ago. Other improvements are a greater cathode collection efficiency, higher current amplification, strengthened mount structure, shorter over-all length, and a cathode lead termination in the base pin.

G-E's contribution is the GL-5680, a three-electrode tube for use as a modulator, amplifier, and oscillator. In pulsed r.f. power amplifier service the tube delivers a peak power output of 90 kw at 15 kv under typical conditions. G-E's new kinescope is the 19AP4-C, similar to the 19AP4, but having an aluminized screen. This is the first large metal tube with this feature.
AUTOMATIC MOTOR TUNING FOR RECEIVERS
Patent No. 2,506,869
Roy A. Gull, Kenmore, N. Y.
(assigning to Colonial Radio Corp.)

A motor controls the variable capacitors in
this automatically tuned receiver. On depressing
a button, the motor is started and tuning con-
tinues until a signal is intercepted. Due to
inertia, the motor tends to coast for a few mil-
li seconds after it is shut off, leaving the re-
ceiver detuned by several hundred cycles. This
invention eliminates the error by disconnection
the motor just before a signal is correctly
tuned in.

In a typical case the desired band is scanned
from the low-frequency end to the upper end.
Then the tuning capacitors are snapped back
to the r.f. starting point. The broadcast band
1535 to 1620 kc may be scanned in about 3
seconds and the snapback time is about 0.1
second.

Referring to the figure, tuning starts when
RV1 is depressed. This energizes motor M (which
rotates the capacitors) and relay RV1 closes its
contact. In the absence of signal RV2 is also
energized and its contact closed. Therefore M
and RV1 continue to operate when switch PB is
released.

A portion of the output from the i.f. ampli-
 fier is fed to limiter V1, and then to a crystal
filter. The crystal is set for a frequency
slightly lower than the i.f. For example, a 454-
kc crystal may be used if the i.f. is 465. This
permits a signal to pass through the filter a
few milliseconds before it is correctly tuned in
the receiver, due to the beat frequency on both
sides of zero-beat. Output from the filter is
rectified by V2, and the d.c. is sufficient to
block V3. As RV2 releases, it opens the ground
return to M and RV1 so these also release and
scanning ceases.

M should be adjusted to coast just long enough
to permit accurate tuning. If the crystal fre-
quency is 1 kc below the i.f. and if the tuning
rate is 200 kc/second, this would be equal to 5
milliseconds.

HUM ELIMINATOR FOR RESISTANCE PICKUPS
Patent No. 2,511,665
Carroll R. Miner, Stratford, Conn.
(assigning to General Electric Co.)

This circuit is for use with variable-resistance
phonograph pickups. The advantage of these
pickups is their simple construction, but they
require a d.c. supply. If the supply is rectified
a.c., the ripple may be objectionable. This inven-
tion eliminates this hum without an expensive
d. c.

The pickup has a metal stylus to which two
resistance wires are connected. See part a of the
diagram. The wires are wound around snubbing
posts and terminate at spring arms. If the stylus
is moved slowly, the wires merely wind them-
selves around the snubbers. When the stylus vi-
brates rapidly (as its needle follows the record
groove), the wires do not have time to move.
Instead, they are alternately compressed and
stretched. This changes their resistance and
modulates the voltage across the wires.

The a.f. component which appears across
transformer T may be amplified as required. This
is shown in part b of the diagram.

To balance out hum, a potentiometer R is con-
ected across T. R is adjusted so that equal ripple
flows through both halves of the transformer pri-
mary. Since this flow is in opposite directions,
hum is cancelled out in the secondary.

ACCURATE SMALL TIME INTERVAL MEASURING
Patent No. 2,511,685
Earl G. Newsom, Dayton, Ohio
(may be used by the Government of the U. S.
without royalty payments)

A simplified circuit diagram is shown here for
accurately measuring small intervals of time. For
example, it may be used to measure the interval
between a radar pulse and its echo:

A three-way switch is arranged to contact either

D, E, or F. In the first position a capacitor C is
charged through a variable resistor R2. When set
F, the capacitor stops charging and its voltage
may be compared with the potential across R1.
In position F, the switch discharges C and the
cycle may be repeated.

At the first pulse (which begins the timed
interval) the switch contacts D and the capacitor
charges. The voltage continues to rise until the
second pulse arrives. This ends the timed interval.

This instant the switch contacts E. Now R1
may be adjusted until the v.t.v.m. shows zero.
Then the capacitor voltage equals that across R1.
The dial of R1 may be calibrated in microseconds
if desired.

DECEMBER, 1950
Service-Dealers: DO A $50,000 TV BUSINESS ON A $500. INVESTMENT!

Get into the TELEVISION BUSINESS in a BIG WAY with the TRANVISION FACTORY-AGENT PLAN!

YOU GET—

- EXCLUSIVE TERRITORY
- SPECIAL PRICES to undersell competition
- NO INVENTORY

You work from our MILLION-DOLLAR INVENTORY.

Requirements:
- You must be a Radio-TV Technician (experienced only).
- You must have a presentable location.
- Write TODAY for complete FACTORY-AGENT PLAN, 30-TRANVISION, INC.
  Dept. RE, NEW ROCHELLE, N. Y.

- FIELD STRENGTH METER
  - A must for every TV Serviceman!
  - Saves 1/2 the work.
  - Improves installations.

NEW LOW PRICE

Model 55M-1, complete with tubes. Net $79.95
All Transvision Prices are f.o.b. factory; subject to change without notice. Prices 5% higher west of the Mississippi.

TRANVISION, INC.
Dept. RE, NEW ROCHELLE, N. Y.

It is convenient to use a linear winding on R1 and to have a linear calibration on its dial. However, the voltage across C rises exponentially with time. To avoid a complicated taper for R1, a resistor R2 is added. Then the voltage across R1 rises almost exponentially with respect to its time calibration. For example, if the R1 dial is adjusted from one time value to another twice as large, its resistance is doubled; but current through it decreases so the new voltage drop across R1 is less than twice the original value. When R2 has the correct value, this change in voltage is very nearly exponential. A similar increase takes place on the capacitor C. If the time interval is doubled, the potential is less than twice as great.

In the actual instrument, the switch is replaced by two thyratrons. The first pulse fires one tube and begins the timed interval. The second pulse fires the second tube and blocks the first one so the capacitor stops charging. A motor controls a switch which discharges C and repeats the cycle.

VOLTAGE REGULATOR

Patent No. 2,501,263

(Copied to Leeds & Northup Co.)

Capable of excellent regulation, this circuit is not difficult to build. The output remains constant despite severe fluctuations of input voltage or output load.

R1 is a conventional turnsthen lamp. tube. The voltage across R2 is made up of VR tubes. A tapped resistor R3 is connected across R1.

The circuit of the voltage regulator.

The three curves illustrate the regulation characteristics. E1 is the voltage across the tapped portion of the resistor. This voltage is proportional to E1 at all times. E2 is the voltage across R2. It shows some regulation but the voltage continues to rise as E1 increases. From the schematic note that E4 (the output) is the difference between E2 and E3, or E4 + E3 = E2. When E4 is plotted, it is seen to be practically constant over some region of E1. E3 may be adjusted so the control portion of E4 is symmetrical over some desired range of input. In this way the output can be made to show less than 1% variation over this range.

Due to the opposing polarity of the VR tubes, this circuit is equally effective on d.c. or a.c.

TELEPHONE—RADIO COUPLING CIRCUIT

Patent No. 2,511,948
Twen S. Wong, New York City

(Twten assigned to Radio Corp of America)

A telephone circuit may be coupled without complicated apparatus to a radio circuit by means of this invention. A telephone line needs only two...
wires along which memories pass in both directions. In radio, however, the transmitter and receiver are entirely separate units. If the receiver output is permitted to flow back into the transmitter input, feedback problems may arise. The telephone line must be coupled to both the radio receiver and the telephone transmitter. At the same time the radio receiver and transmitter channels must be isolated from each other.

The figure shows a 6KB tube. The signal from the radio receiver is applied to both control grids. The triode output is connected to transformer T which couples to the phone line P. A signal which originates in P is passed through the transformer to the screen-grid of the hexode. From here the signal flows into the radio transmitter line. Thus P is coupled both to the receiver and transmitter.

One portion of the signal from the receiver is amplified by the hexode and it appears across the transmitter line. Another portion is amplified by the triode and is applied to the screen grid of the hexode. Since the screen grid signal has passed through a triode stage, it is 180° out of phase with the signal on the control grid. When R is connected correctly, these signals produce equal and opposite components of plate current. The result is complete balance, and the receiver is effectively isolated from the transmitter.

U.H.F. TUNING
Patent No. 2,511,586
Merle R. Hubbard, Cedar Rapids, Iowa.
(a signed to Collins Radio Co.)
Inductance and capacitance are tuned by this system simultaneously to get a more constant Q over a wide range. The inductor is a transmission line. The capacitor is of the conventional variable type.

In the model illustrated here, C is the variable condenser. It couples the transmission line conductors to the input. The shorter line is fixed to an insulated shaft S and is carried around with it. This condenser is made in a brush contact which slides around the metal ring R. Therefore the conductors T are shorted at this end. A condenser of this type is called a reactive varying condenser. Simultaneously the spacing between conductors T is varied to change its inductance. Each conductor has almost as much one-quarter-wave in length and preferably silver-plated.

TELEPHONE WIRE
Excellent prices on all grades! Lowest prices! Telephone Handsets: TS-13, TS-15, TS-9-9, $3.05 ea. Sturd Poised Handsets: 12.50 ea. 24.50 pc. This is Revolucian in 20-22 gauge Army Field Wire. It goes to the goal-line and back to the control post. Each conduct has 7 copper, a 42-strand steel core, and a rubber covering.

NEW, unused, excellent condition
$1.60 per mile (100 ft.) $1.28
$1.40 per mile (200 ft.) $1.20
$1.15 per mile (900 ft.) $0.92
$0.95 per mile (1000 ft.) $0.90
$0.80 per mile (2000 ft.) $0.85
$0.70 per mile (4000 ft.) $0.75

Used, good serviceable condition
$1.60 per mile (100 ft.) $1.28
$1.40 per mile (200 ft.) $1.20
$1.15 per mile (900 ft.) $0.92
$0.95 per mile (1000 ft.) $0.90
$0.80 per mile (2000 ft.) $0.85
$0.70 per mile (4000 ft.) $0.75

LORIS SALES
P. O. Box 1998-NE-12, Sacramento, Calif.

The SPEAKERS section of the new catalog contains 11 sections:

1. ALINCO Y MAGNETS FRESH STOCK!
2. PORTABLE AMPLIFIER CASE
3. COILS FOR AMPLIFIER CASE
4. WIREWOUND RESISTORS
5. Speaker Wire
6. TUBULAR COUPLERS
7. TELEPHONE WIRE
8. ANTENNA LOOP
9. TELEPHONE WIRE FRESH STOCK!
10. TELEPHONE WIRE FRESH STOCK!
11. TELEPHONE WIRE FRESH STOCK!

The catalog also contains a large section on power transformers, including a wide range of sizes, types, and specifications. Prices vary widely, ranging from $1.95 to $5.00 per unit. The catalog also contains a large section on power transformers, including a wide range of sizes, types, and specifications. Prices vary widely, ranging from $1.95 to $5.00 per unit. The catalog also contains a large section on power transformers, including a wide range of sizes, types, and specifications. Prices vary widely, ranging from $1.95 to $5.00 per unit. The catalog also contains a large section on power transformers, including a wide range of sizes, types, and specifications. Prices vary widely, ranging from $1.95 to $5.00 per unit.
Beat the Tube Shortage!

This Sensational New RIDER Book Shows You HOW TO DO IT!

RECEIVING TUBE SUBSTITUTION GUIDE BOOK
by H. A. Middleton
For AM-FM-TV Receivers and Allied Equipment!

URGENT! Receiving tubes are very scarce... and will get scarcer. There is a wide scramble for every type of tube, and you can’t always get what you need. What can you do when you can’t find a tube replacement? How can you get a set working again? How can you substitute one tube for another?

HERE!
HERE Are The Answers To All Tube Problems!

- 2500 Radio And TV Tube Substitutions Are Listed!
- TV Receiver Filament Wiring!
- Heater Substitution Wiring Instructions!
- Tube Types Classified By Functions!
- And A Wealth Of Other Priceless Data!

How to economize will fend 2500 radio and TV tube types systematically listed in numerical sequence with accompanying wiring instructions for making the substitutions. There are views of original and substitute tube sockets, and clear explanations for whatever changes may be necessary. In this, one of the most important reference books ever published, and certainly a most timely one right now, the serviceman will find the way to turn out jobs that would otherwise remain on the shelf because of lack of proper tubes.

EXTRA! EXTRA! In addition to tube information... this sensational book contains material on Cathode-Ray Tube Characteristics, Complete Tube Characteristics Chart, Millais Tube Data, Pilot Light Information, Resistors-Capacitors-Transformer Color Codes, Transformer Substitution, Fixed Condenser Substitution, and Converting Farm Radio for Emergency Operation.

208 Pages in Heavy Durable Paper Cover. 8½ x 11 inches. Only $2.40

10 DAY MONEY BACK GUARANTEE
Make this book PROVE its value! Unless you agree that it is the best investment you’ve ever made—return it, and we will refund your money.

Radio-Electronic Insulation Tester

Most portable megohmmeters have a hard-driven high-voltage generator which develops the potential required for the test. Such instruments are bulky and rather impractical in some applications.

An electronic megohmmeter which can be constructed compactly is described in patent No. 2,510,691 issued to R. W. Gilbert. The instrument has a logarithmic scale calibrated from 100-000 ohms to 10,000 megohms. The circuit is shown.

The cathode current of the 1LH4 flows through cathode resistors R1 and R2. The plate voltage is equal to the battery voltage minus the drop across the resistors. Therefore, the plate voltage varies inversely as the cathode current. In a high-mu triode like this one, the grid voltage is low compared to the other elements so the grid-to-plate voltage follows closely the plate-to-cathode voltage. The voltage applied to the resistance under test is inversely proportional to the cathode current. Thus, the applied voltage is zero for zero resistance, half the battery voltage for center-scale resistance, and full battery voltage for infinite resistance.

Plate current falls because of reduced plate voltage but the cathode current continues to increase logarithmically because the grid current increases as the plate current decreases.

Bass Attenuation

Radiotelephone engineers and amateurs have long realized that frequencies outside the range of 300 to 2,500 cycles contribute little or nothing to the intelligibility of transmitted speech. When signals are received with the aid of a crystal filter or other circuits which reduce the high-frequency sidebands, speech is often boomy and difficult to read because of the apparent bass boost.

Circuit modifications which attenuate frequencies below 300 cycles and make speech easier to read through crystal filters and Q5's are described by G2TA in Short Wave Magazine. The circuit modifications consist of inserting a switch which cuts out the normal coupling capacitors and replaces them with units having one-tenth the capacitance.

The circuit at a in the drawing is for receivers having two R-C coupling networks. Capacitors C are the normal coupling units. When there is only one resistance-coupled circuit in the amplifier, use the circuit at b. In this case, a high-pass filter consisting of two small capacitors and a resistor is switched into the circuit. R1 should equal R2, the normal grid resistor.

Some amateurs can increase the "talk power" of their phone transmitters by installing these bass-cutting circuits in their speech equipment. Because most of the modulating power of a wide-range a.f. system is in the low frequencies, these determine the maximum or 100% modulation point. When frequencies below 300 cycles are removed, the modulation level is determined by the intelligence-bearing frequencies.

IMPROVES SPEECH

UNUSUAL FEEDBACK CIRCUIT IN 50-WATT AMPLIFIER

In most circuits where inverse feedback is applied to a single transformer-coupled stage, the driver transformer has balanced secondary windings to insure proper operation.

In this circuit, used in the Omega 50-watt amplifier described in Toute La Radio (Paris, France), the transformer does not require balanced secondaries or even a center tap on the single secondary. Instead, two 220,000-ohm resistors are connected across the secondary and grounded at their junction. Feedback voltage is fed from plates to grids through R-C networks.

Core saturation in the driver transformer is eliminated by employing resistance-capacitance coupling between the plate of the 6V6 and the primary.
HI-FI AMPLIFIER FOR RECORDING AND PLAYBACK

I have a disc recorder and playback unit manufactured by General Industries Co. Please show a diagram of an amplifier using push-pull 6V6's which I may use with this unit. Also show how the speaker level can be reduced for monitoring the recordings.

Fig. 1—A 10-watt recording amplifier.

Is a volume-level indicator necessary? If so, what type shall I use?—M. V., Chicago, III.

A. The amplifier circuit is shown in Fig. 1. Inverse feedback has been included to improve the performance of the push-pull pentodes. Adjust the 500,- 000-ohm feedback control to the point which gives the minimum acceptable output level when the microphone and phono volume controls are at maximum.

Not knowing which type of cutter you have, connections for magnetic and crystal types are shown in Figs. 2 and 3, respectively. Table I shows the values for shunting resistors for different values of Z1 and Z2 when using 10-ohm magnetic cutters as in Fig. 2.

Shunt the 47,000-ohm resistor in series with the crystal cutter in Fig. 3, with a .001-to-.01-
af capacitor to boost highs. Vary its value up to 250,000 ohms to boost lows. Table II shows the values of R1 and R2 for fixed values of attenuation in the speaker circuit for three common values of output and voice-coil impedances when using a crystal cutter. Values given in the speaker-level columns of the tables are in decibels below the recording level. Values given in the tables supplied by General Industries Co.

A volume-level indicator is recommended in the interest of good recordings. The level indicator for a magnetic cutter may be a 1-1/2-ohm meter having a resistor and 1N34 or meter rectifier connected in series with it across the cutter terminals. The value of the resistor should be selected so the meter reads 2 or 2.5 volts full scale.

1,000-ohm-per-volt or better, 150-volt a.c. meter can be used with the crystal cutter. The average level will probably run to approximately 100 volts; however, the best value can be determined by making a few trial recordings.

XTAL SET COIL DATA

2 The push-pull crystal receiver in the November, 1949, issue works so well that I want to give it a try on the shortwave bands. Please print winding data for coils covering from 560 kc to approximately 15 mc. I plan to use five-prong, 1/4-inch, plug-in formers.—S. S., Peru, Ill.

A. The table gives the number of turns and the approximate tuning range of each coil. Experiment with the number of turns on L1 to obtain maximum volume.

Tuning range (megacycles) L1 L2—L3 Wire size 0.55—1.6 40 110 32 1.5—4.5 16 35 24 4.0—15 5 11 18
FM SET CONVERSION

I have a standard FM receiver which I wish to convert for reception in the 152-162-mc band. Please supply
coil winding data.—D. J. H., Birmingham, Ala.

A. Tuning components for these frequencies are so critical that it is almost impossible to supply winding data which will prove useful in any one circuit. It is possible to make your own coils if you have a good grid-dip meter or a high-frequency v.t.v.m. and a signal generator which covers the required range. You may be able to make the conversion merely by removing turns from the coils in the set.

With the grid-dip oscillator, prune the oscillator coil until its range is 162.7 to 172.7 mc when connected across the oscillator section of the tuning capacitor. The antenna and r.f. coils are adjusted to tune from 152 to 162 mc.

If you use the v.t.v.m. and signal generator method, connect the generator and a 270,000-ohm resistor in series across the coil and tuning capacitor in parallel. Connect the v.t.v.m. across the combination. Close the tuning capacitor and tune the signal generator for maximum voltage on the meter. Note the frequency, then make the same test with the tuning capacitor open. The two frequencies are the high- and low-frequency limits of the coil and capacitor combination. Vary the number of turns, the diameter, and spacing between turns until you have the desired tuning range.

If you want to try winding your own coils, the antenna and r.f. coils may consist of three turns of No. 12 tinned wire wound to an inside diameter of 7/8 inch and spaced 1/2 inch long. As a start, the oscillator coil may consist of two turns of No. 12 wire having an inside diameter of 1/2 inch and a winding length of 7/8 inch. If you use National XR-50 or Millen 69040 series coil forms, it will be easier to adjust the inductance of the coils to fit the tuning capacitors.

ELECTRONIC METRONOME

I want to construct an electronic metronome but haven't found a circuit I like. One was described in your January, 1947, issue but it emits clicks. I want a tone or beep. I would also like to incorporate a visual indicator. Can you give me a simple circuit?—W. S., Waukesha, Wis.

A. This circuit is the metronome described in the January, 1947, issue combined with a vacuum-tube oscillator. Large capacitors are connected across the relay coil. As soon as these charge, the relay armature pulls down and stays down until the capacitors discharge through the 820-ohm resistor and the range control. Auxiliary contacts on the relay close the cathode circuit of the oscillator. If the beeps are too long, insert a 500,000-ohm variable resistor at A, then adjust it for the desired effect.

The neon lamp across one side of the primary of the output transformer is the visual indicator. It may be necessary to place it across the entire winding.

Customer confidence is the key to volume service business. The Raytheon Bonded Electronic Technician Program provides this vital asset for Mort Farr, just as it does for thousands of other dealers who have adopted this exclusive Raytheon business builder. Raytheon Radio and Television Tubes help, too, because Raytheons are Right—for Sound and Sight! Every time a work out tube is replaced with a Raytheon, the service dealer gains another satisfied customer.

What the Raytheon Bonded Program does for Mort Farr it can do for you! Ask your Raytheon distributor how you can become a Raytheon Electronic Technician. ... how you can get your Television and Radio service backed by the bond that creates customer confidence in you and your work. If you qualify, it's yours at no cost to you—the Bonded Program is Raytheon's investment in Your Future.

FM SET CONVERSION

? I have a standard FM receiver which I wish to convert for reception in the 152-162-mc band. Please supply
coil winding data.—D. J. H., Birmingham, Ala.

A. Tuning components for these frequencies are so critical that it is almost impossible to supply winding data which will prove useful in any one circuit. It is possible to make your own coils if you have a good grid-dip meter or a high-frequency v.t.v.m. and a signal generator which covers the required range. You may be able to make the conversion merely by removing turns from the coils in the set.

With the grid-dip oscillator, prune the oscillator coil until its range is 162.7 to 172.7 mc when connected across the oscillator section of the tuning capacitor. The antenna and r.f. coils are adjusted to tune from 152 to 162 mc.

If you use the v.t.v.m. and signal generator method, connect the generator and a 270,000-ohm resistor in series across the coil and tuning capacitor in parallel. Connect the v.t.v.m. across the combination. Close the tuning capacitor and tune the signal generator for maximum voltage on the meter. Note the frequency, then make the same test with the tuning capacitor open. The two frequencies are the high- and low-frequency limits of the coil and capacitor combination. Vary the number of turns, the diameter, and spacing between turns until you have the desired tuning range.

If you want to try winding your own coils, the antenna and r.f. coils may consist of three turns of No. 12 tinned wire wound to an inside diameter of 7/8 inch and spaced 1/2 inch long. As a start, the oscillator coil may consist of two turns of No. 12 wire having an inside diameter of 1/2 inch and a winding length of 7/8 inch. If you use National XR-50 or Millen 69040 series coil forms, it will be easier to adjust the inductance of the coils to fit the tuning capacitors.

ELECTRONIC METRONOME

? I want to construct an electronic metronome but haven't found a circuit I like. One was described in your January, 1947, issue but it emits clicks. I want a tone or beep. I would also like to incorporate a visual indicator. Can you give me a simple circuit?—W. S., Waukesha, Wis.

A. This circuit is the metronome described in the January, 1947, issue combined with a vacuum-tube oscillator. Large capacitors are connected across the relay coil. As soon as these charge, the relay armature pulls down and stays down until the capacitors discharge through the 820-ohm resistor and the range control. Auxiliary contacts on the relay close the cathode circuit of the oscillator. If the beeps are too long, insert a 500,000-ohm variable resistor at A, then adjust it for the desired effect.

The neon lamp across one side of the primary of the output transformer is the visual indicator. It may be necessary to place it across the entire winding.

Customer confidence is the key to volume service business. The Raytheon Bonded Electronic Technician Program provides this vital asset for Mort Farr, just as it does for thousands of other dealers who have adopted this exclusive Raytheon business builder. Raytheon Radio and Television Tubes help, too, because Raytheons are Right—for Sound and Sight! Every time a work out tube is replaced with a Raytheon, the service dealer gains another satisfied customer.

What the Raytheon Bonded Program does for Mort Farr it can do for you! Ask your Raytheon distributor how you can become a Raytheon Electronic Technician. ... how you can get your Television and Radio service backed by the bond that creates customer confidence in you and your work. If you qualify, it's yours at no cost to you—the Bonded Program is Raytheon's investment in Your Future.

Customer confidence is the key to volume service business. The Raytheon Bonded Electronic Technician Program provides this vital asset for Mort Farr, just as it does for thousands of other dealers who have adopted this exclusive Raytheon business builder. Raytheon Radio and Television Tubes help, too, because Raytheons are Right—for Sound and Sight! Every time a work out tube is replaced with a Raytheon, the service dealer gains another satisfied customer.

What the Raytheon Bonded Program does for Mort Farr it can do for you! Ask your Raytheon distributor how you can become a Raytheon Electronic Technician. ... how you can get your Television and Radio service backed by the bond that creates customer confidence in you and your work. If you qualify, it's yours at no cost to you—the Bonded Program is Raytheon's investment in Your Future.

FM SET CONVERSION

? I have a standard FM receiver which I wish to convert for reception in the 152-162-mc band. Please supply
coil winding data.—D. J. H., Birmingham, Ala.

A. Tuning components for these frequencies are so critical that it is almost impossible to supply winding data which will prove useful in any one circuit. It is possible to make your own coils if you have a good grid-dip meter or a high-frequency v.t.v.m. and a signal generator which covers the required range. You may be able to make the conversion merely by removing turns from the coils in the set.

With the grid-dip oscillator, prune the oscillator coil until its range is 162.7 to 172.7 mc when connected across the oscillator section of the tuning capacitor. The antenna and r.f. coils are adjusted to tune from 152 to 162 mc.

If you use the v.t.v.m. and signal generator method, connect the generator and a 270,000-ohm resistor in series across the coil and tuning capacitor in parallel. Connect the v.t.v.m. across the combination. Close the tuning capacitor and tune the signal generator for maximum voltage on the meter. Note the frequency, then make the same test with the tuning capacitor open. The two frequencies are the high- and low-frequency limits of the coil and capacitor combination. Vary the number of turns, the diameter, and spacing between turns until you have the desired tuning range.

If you want to try winding your own coils, the antenna and r.f. coils may consist of three turns of No. 12 tinned wire wound to an inside diameter of 7/8 inch and spaced 1/2 inch long. As a start, the oscillator coil may consist of two turns of No. 12 wire having an inside diameter of 1/2 inch and a winding length of 7/8 inch. If you use National XR-50 or Millen 69040 series coil forms, it will be easier to adjust the inductance of the coils to fit the tuning capacitors.

ELECTRONIC METRONOME

? I want to construct an electronic metronome but haven't found a circuit I like. One was described in your January, 1947, issue but it emits clicks. I want a tone or beep. I would also like to incorporate a visual indicator. Can you give me a simple circuit?—W. S., Waukesha, Wis.

A. This circuit is the metronome described in the January, 1947, issue combined with a vacuum-tube oscillator. Large capacitors are connected across the relay coil. As soon as these charge, the relay armature pulls down and stays down until the capacitors discharge through the 820-ohm resistor and the range control. Auxiliary contacts on the relay close the cathode circuit of the oscillator. If the beeps are too long, insert a 500,000-ohm variable resistor at A, then adjust it for the desired effect.

The neon lamp across one side of the primary of the output transformer is the visual indicator. It may be necessary to place it across the entire winding.

Customer confidence is the key to volume service business. The Raytheon Bonded Electronic Technician Program provides this vital asset for Mort Farr, just as it does for thousands of other dealers who have adopted this exclusive Raytheon business builder. Raytheon Radio and Television Tubes help, too, because Raytheons are Right—for Sound and Sight! Every time a work out tube is replaced with a Raytheon, the service dealer gains another satisfied customer.

What the Raytheon Bonded Program does for Mort Farr it can do for you! Ask your Raytheon distributor how you can become a Raytheon Electronic Technician. ... how you can get your Television and Radio service backed by the bond that creates customer confidence in you and your work. If you qualify, it's yours at no cost to you—the Bonded Program is Raytheon's investment in Your Future.
SHORTWAVE CONVERSION

? I am interested in using the simplified shortwave conversion described on page 124 of the January, 1950, issue, but I cannot work out values for the shortwave coil and the frequency to which the receiver must be tuned for reception of a 2490-kc signal. My receiver has a 282-kc i.f.—L. W. S., Buena Park, Calif.
A. Your receiver should be tuned to 382 kc as found by the formula
F1 - F2 = F3
where F1 is the frequency of the shortwave station and F2 is the i.f. of the receiver.

You may use an antenna coil consisting of 25 turns of No. 28 wire close-wound on a ¾-inch form. This winding may be shunted with a single-section 365-μf capacitor or a small trimmer of the same value. The primary of the antenna coil may have approximately 18 turns of No. 28 or smaller wire wound over the grid winding. Because of the short antenna used on auto radios, it may be necessary to experiment with the number of turns on the primary to get optimum performance. You may get good results by tapping the grid coil at a few turns above the grounded end and connecting the antenna to the tap through a 1-0-μf blocking capacitor.

SURPLUS CRYSTALS

? I purchased a flock of surplus crystals which were marked with channel numbers between 0 and 79 and the frequencies ranging from 20 to 27.5 mc. I want to use some of these in a 10-meter transmitter but can't get any of them to take off in any of the usual oscillator circuits. I've tried them in oscillators having circuits tuning as low as 2 mc without any luck. A friend tells me that these rocks are from the BC-605 but I can't get any dope on it.—E. W., Bronx, N.Y.
A. If the crystals are from the BC-604, they will probably be in FT-241 holders marked Western Electric on the bottom. To get the fundamental frequency, divide the frequency marked on the crystal—the output frequency—by 54. The fundamentals of these units range from 370,370 kc for channel 0 to 516,667 kc for channel 79. The basic circuit of the oscillator in the BC-604 is shown in the diagram. We'll bet that this one will put your rocks to work. They may even work in the average Pierce oscillator circuit if you replace the usual 2.5-mh plate choke with a choke of 6 or 10 mh.
Heathkits are the Quality Line of TEST INSTRUMENT KITS

Modern STYLING KITS THAT MATCH

Heathkits are styled in the most modern manner by leading industrial stylists. They add beauty and utility to any laboratory or service bench. There is a complete line of Heathkit instruments allowing a uniformity of appearance.

An attractive service shop builds a feeling of confidence. Many organizations have standardized on Heathkits providing uniform service departments.

There is no waste space or false effort to appear large in Heathkits—space on service benches is limited and the size of Heathkit instruments is kept as small as is consistent with good engineering practice.

Accuracy ASSURED BY PRECISION PARTS

Wherever required, the finest quality 1% ceramic resistors are supplied. These require no aging and do not shift. No matching of common resistors is required. You find in Heathkit the same quality voltage divider resistors as in the most expensive equipment.

The transformers are designed especially for the Heathkit unit. The scope transformer has two electrostatic shields to prevent interaction of AC fields.

These transformers are built by several of the finest transformer companies in the United States.

Used BY LEADING MANUFACTURERS

Leading TV and radio manufacturers use hundreds of Heathkits on the assembly lines. Heathkit scopes are used in the alignment of TV tuners. Impedance bridges are serving every day in the manufacture of transformers. Heathkit VTVM’s are built into the production lines and test benches. Many manufacturers assemble Heathkits in quantity for their own use thus keeping purchase costs down.

Complete KITS WITH PARTS THAT FIT...

When you receive your Heathkit, you are assured of every necessary part for the proper operation of the instrument.

Beautiful cabinets, handles, two-color panels, all tubes, test leads where they are a necessary part of the instrument, quality rubber line cords and plugs, rubber feet for each instrument, all scales and dials ready printed and calibrated. Every Heathkit is 110 V 60 Cy. power transformer operated by a husky transformer especially designed for the job. Heathkit chassis are precision punched for ease of assembly. Special engineering for simplicity of assembly is carefully considered.

Used BY LEADING UNIVERSITIES

Heathkits are found in every leading university from Massachusetts to California. Students learn much more when they actually assemble the instrument they use. Technical schools often include Heathkits in their course and these become the property of the students. High schools, too, find that the purchase of inexpensive Heathkits allows a larger budget to go further and provides much more complete laboratories.
**Heathkit Oscilloscope Kit**

- New AC and DC push-pull amplifier.
- New step attenuator frequency compensated input.
- New non frequency discriminating input controls.
- New heavy duty power transformer has 68% less magnetic field.
- New filter condenser has separate vertical and horizontal sections.
- New intensity circuit gives greater brilliance.
- Improved amplifiers for better response useful to megacycles.
- High gain amplifiers .04 Volts RMS per inch deflection.
- Improved Alleghehey Ludlum magnetic metal CR tube shield.
- New synchronization circuit works with either positive or negative peaks of signal.
- New extended range sweep circuit 15 cycles to over 100,000 cycles.
- Both vertical and horizontal amplifier use push-pull pentodes for maximum gain.

**New INEXPENSIVE MODEL S-2 ELECTRONIC SWITCH KIT**

Twice as much fun with your oscilloscope — observe two traces at once — see both the input and output traces of an amplifier, and amazingly you can control the size and position of each trace separately — superimpose them for comparison or separate for observation — no connections inside scope.

All operation electronic, nothing mechanical — ideal for classroom demonstrations — checking for interments, etc. Distortion, phase shift and other defects show up instantly. Can be used with any type or make of oscilloscope. So inexpensive you can't afford to be without one.

Has individual gain controls, positioning control and coarse and fine switching rate controls — can also be used as square wave generator over limited range. 110 Volts transformer operated comes complete with tubes, cabinet and all parts. Occupies very little space beside the scope. Better get one. You'll enjoy it immensely. Model S-2. Shipping Wt., 11 lbs.

**Only $39.50**

The new 1951 Heathkit Push-Pull Oscilloscope Kit is again the best buy. No other kit offers half the features — check them.

Measure either AC or DC on this new scope — the first oscilloscope under $100.00 with a DC amplifier.

The vertical amplifier has frequency compensated step attenuator input into a cathode follower stage. The gain control is of the non frequency discriminating type — accurate response at any setting. A push-pull pentode stage feeds the C.R. tube. New type positioning control has wide range for observing any portion of the trace. The horizontal amplifiers are direct coupled to the C.R. tube and may be used as either AC or DC amplifiers. Separate binding posts are provided for AC or DC.

The multi-thermistor sweep generator has new frequency compensation for the high range it covers. 15 cycles to over 100,000 cycles.

The new model S-2 Scope uses 10 tubes in all — several more than any other. Only Heathkit Scopes have all the features.

New husky heavy duty power transformer has 50% more laminations. It runs cool and has the lowest possible magnetic field. A complete electronic shield covers primary and other necessary windings and has lead brought out for proper grounding.

The new filter condenser has separate filters for the vertical and horizontal sweep grids and prevents interaction between them.

An improved intensity circuit provides almost double previous brilliance and better intensity modulation.

A new synchronization circuit allows the scope to be synchronized with either the positive or negative pulse, an important feature in observing the complex pulses encountered in television servicing.

The magnetic alloy shield supplied for the C.R. tube is of new design and uses a special metal developed by Alleghehey Ludlum for such applications.

The Heathkit scope cabinet is of aluminum alloy for lightness of portability.

The kit is complete, all tubes, cabinet, transformers, controls, grid screen, tube shield, etc. The instruction manual has complete step-by-step assembly and illustrations of every section. Compare it with all others and you will buy a Heathkit. Model 0-6. Shipping Wt., 30 lbs.

Only **$19.50**

**The Heath Company**

...BENTON HARBOR 20, MICHIGAN

RADIO-ELECTRONICS
**New 1951 • • MODEL V-4A**

**Heathkit VTVM KIT**

**HAS EVERY EXPENSIVE FEATURE**

- Higher AC input impedance, (greater than 1 megohm at 1000 cycles).
- New AC voltmeter flat within 1 db 20 cycles to 2 megacycles (600 ohm source).
- New accessory probe (extra) extends DC range to 30,000 Volts.
- New high quality Simpson 200 microammeter.
- New 1½% voltage divider resistors (finest available).
- 24 Complete ranges.
- Low voltage range 3 Volts full scale (½ of scale per volt).
- Crystal probe (extra) extends RF range to 250 megacycles.
- Modern push-pull electronic voltmeter on both AC and DC.
- Completely transformer operated isolated from line for safety.
- Largest scale available on streamline 4½ inch meter.
- Burn-out proof meter circuit.
- Isolated probe for dynamic testing no circuit loading.
- New simplified switches for easy assembly.

**NEW LOW PRICE $23.50**

The new Heathkit Model V-4A VTVM Kit measures to 30,000 Volts DC and 250 megacycles with accessory probes — think of it, all in one electronic instrument more useful than ever before. The AC voltmeter is so flat and extended in its response it eliminates the need for separate expensive AC VTVM's. + or - db from 20 cycles to 2 megacycles. Meter has decibel ranges for direct reading. New zero center on meter scale for quick FM alignment.

There are six complete ranges for each function. Four functions give total of 24 ranges. The 3 Volt range allows 3½-5% of the scale for reading one volt as against only 20% of the scale on 5 Volt types.

The ranges decade for quick reading.

New 1½% ceramic precision are the most accurate commercial resistors available — you find the same make and quality in the finest laboratory equipment selling for thousands of dollars. The entire voltage divider decade uses these 1½% resistors.

New 200 microammeter 4½" streamline meter with Simpson quality movement. Five times as sensitive as commonly used 1 MA meters.

Shatterproof plastic meter face for maximum protection.

Both AC and DC voltmeter use push-pull electronic voltmeter circuit with burn-out proof meter circuit.

Electronic ohmometer circuit measures resistance over the amazing range of 1/10 ohm to one billion ohms all with internal 3 Volt battery. Ohmometer batteries mount on the chassis in snap-in mounting for easy replacement.

Voltage ranges are full scale 3 Volts, 10 Volts, 30 Volts, 100 Volts, 300 Volts, 1000 Volts. Complete decibel coverage without gaps.

The DC probe is isolated for dynamic measurements. Negligible circuit loading. Gets the accurate reading without disturbing the operation of the instrument under test. Kit comes complete, cabinets, transformer, Simpson meter, test leads, complete assembly and instruction manual. Compare it with all others and you will buy a Heathkit Model V-4A.

Shipping Wt., 8 lbs. Note new low price, $23.50

**YOU SAVE BY ORDERING DIRECT FROM MANUFACTURER—USE ORDER BLANK ON LAST PAGE**

**The HEATH COMPANY**

**BENTON HARBOR 20, MICHIGAN**
You operate. assemble saves switches and every advantage. Test Fastest (10 INTERNATIONAL NEW YORK CITY makes more Your Heathkit Tube Model TC for each element separately for open or short and quality. Beautiful 3 color meter — reads good-bad and line set point. Tube Checker Kit Features: Sockets for every modern tube — blank for new types. Fastest method of testing tubes — saves time. Makes more profit. Rugged counter type birch cabinet. Test your tubes the modern way — dynamically — the simplest, yet fastest and surest method — your Heathkit has a switch for each tube element and measures that element — no chance for open or shorted elements slipping by, all the advantages of the munsal conductance type without the slow cumbersome time consuming setups. Your Heathkit Tube Checker has all the features Beautiful 3 color meter — complete selection of voltages — roller chart listing hundreds of tubes including the new 9 pin miniatures — finest quality Centralab lever switches for each element — high grade birch counter type cabinet — continuously variable line adjust controls — every feature you need to sell tubes properly. The most modern type tube checker with complete protection against short-circuits. The less of parts — rugged override 110 V, 60 cycle power transformers — Knobs of Mallory and Centralab switches and controls. Complete set of sockets for all type tubes with blank spots for future types. Fast action brass gear driven roller chart quickly locates the setting for any type tube. Simplified switching cuts necessary testing time to minimum and tucks valuable service time. Short and open element check. Simple method allows instant setup of new tube types without waiting for factory dies. No matter what the arrangements of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker Kit today. See for yourself that Heath again saves you two-thirds and yet retains all the quality — this tube checker will pay for itself in a few weeks — better assemble it now. Complete with instructions — pictorial diagrams — all parts — cabinet — ready to wire up and operate. Model TC: Shipping Wt., 12 lbs.

$295.00

You save by ordering direct from manufacturer — use order blank on last page.
NEW 1951 Heathkit SIGNAL GENERATOR KIT

Features

- Sine wave audio modulation.
- Extended range 160 Kc. to 50 megacycles fundamentals.
- New step attenuator output.
- New miniature HF tubes.
- Transformer operated for safety.
- Calibrated harmonics to 150 megacycles.
- New external modulation switch.
- 5 to 1 vernier tuning for accurate settings.

A completely new Heathkit Signal Generator Kit. Dozens of improvements. The range on fundamentals has been extended to over 50 megacycles; makes this Heathkit ideal as a marker oscillator for TV. New step attenuator gives controlled output from very low values to high output. A continuously variable control is used with each step. New miniature HF tubes are required for the high frequencies covered. Uses 6CA4 master oscillator and 6CA sine wave audio oscillator. The set is transformer operated and a husky selenium rectifier is used in the power supply. The coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers.

A best buy — think of all the features for less than $20.00. The entire coil and tuning assembly are assembled on a separate turret for quick assembly — comes complete — all tubes — cabinet — test leads — every part. The instruction manual has step-by-step instructions and pictorials. It’s easy and fun to build a Heathkit Model SG-6 Signal Generator. Shipping Wt., 7 lbs.

$195.00

THE NEW Heathkit HANDITESTER KIT

Features

- Beautiful streamlined Bakelite case.
- AC and DC ranges to 5,000 Volts.
- Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
- All the convenient ranges 10-20-500-1,000-5,000 Volts.
- Large quality 3" built-in meter.

A precision portable voltmeter-milliammeter. An ideal instrument for students, radio service, experiments, hobbyists, engineers, mechanics, etc. Rugged 400 ma meter movement. Twelve convenient ranges, precision dividers for accuracy. Easily assembled from complete instructions for pictorial diagram. A total of assembly saves one-half the cost. Order today. Model M-1. Shipping Wt., 2 lbs.

$13.50

NEW Heathkit BATTERY ELIMINATOR KIT

Features

- Provides variable DC voltage for all checks.
- Voltmeter for accurate check.
- 6,000 MFD Mallory filter for ripple-free voltage.
- Lowers sticky vibrators-interrupters.
- Has 4000 MFD Mallory filter for ripple-free voltage.

Even the smallest shop can afford the Heathkit Battery Eliminator Kit. A few auto radio repair jobs will pay for it. It’s fast for service, the voltage can be lowered to find sticky vibrators or raised to ferret out instrument. Provides variable DC voltage 5 to 71/2 Volts or 10 Amperes continuous or 15 Amperes intermittent. Also serves as storage battery charger. Ideal for all auto radio testing and demonstrating.

A well filtered rugged power supply uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter for clean DC. 0-15 V. voltmeter indicates output which is variable in eight steps. Easily constructed in a few hours from our instructions and diagrams — better equipped for all types of service — it means more income. Model BE-2. Shipping Wt., 19 lbs.

$22.50

YOU SAVE BY ORDERING DIRECT FROM MANUFACTURER—USE ORDER BLANK ON LAST PAGE

The HEATH COMPANY

... BENTON HARBOR 20, MICHIGAN

DECEMBER, 1950

www.americanradiohistory.com
Try This One

OUTPUT INDICATOR

A sensitive output indicator for use when aligning receivers can be constructed with a minimum of time and parts. As shown in the diagram, it consists of a small PM speaker and output transformer mounted on a small base which can be placed close to the speaker in the set being aligned.

Connect a low-range r.v.m. to the terminals and use it as the output indicator. With the meter set to the 0.25-volt a.c. range, the signal from the test oscillator can be turned low enough to prevent the set's a.v.c. from operating and broadening the output peaks.—W. M. Finley, Jr.

HANDY SERVICING TOOL

One of the biggest headaches in radio servicing is the job of realigning scraping plates in a variable capacitor. In trying to straighten a bent plate by usual methods, adjacent plates may be bent and the technician finds himself in a vicious circle.

An old-timer gave me a simple jig which does the job miraculously. Two double-edged razor blades are soldered together at one end with a ½-inch overhang as shown. When the blades straddle the suspected plate, they make a tight width gauge on either side without undue pressure on adjacent plates. The jig can be held in the hand, needle-nose pliers, or fastened to the end of a small rod.—William R. Brown, Jr.

REPAIRING VOLUME CONTROLS

Here is a simple method of removing the C-rings or retaining collars, used in rotary switches and potentiometers, without gouging a hunk out of your thumb.

Drill a small hole in the shaft close to the retaining ring as shown in the drawing. Slide a prying tool under the ring and lift it out. A shoemaker’s No. 10 sewing awl blade is an ideal tool for the job. Its shape and sharp point make it a handy tool for cleaning up soldering lugs and socket pins.—Frederick Box
The following television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

**#630 TV PARTS...TOP QUALITY...LOW PRICES**

FOR KIT BUILDERS, REPLACEMENTS AND EXPERIMENTERS

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.

The television parts list comprises all the components needed to build the famous #630 television chassis plus added features. PRICES UNLESS MARKED PER SET ARE PER ITEM. Parentheticals indicate amounts of parts needed in lots of two or over. THE PRICES SPEAK FOR THEMSELVES.
HI-V TUBULARS

- The ever-popular Aerovox Type 84 paper tubulars are now available in 85°C extended-voltage ratings — 2500, 3500, 5000, 7500, 10,000 and 15,000 V.D.C.W. From .001 to .15 mfd. Measuring 5/8" dia. by 1/4" long for smallest, to 1" by 3" long for largest.

- Oil impregnated. Wax filled, sturdy insulating tube. Sealed ends. Bare pigtail leads that won't pull out. And dependable!

See Your Jobber...

Insist on Aerovox HI-V tubulars for initial equipment or replacements in TV sets, oscillographs, transmitters, etc. Ask your local jobber for the new Aerovox Catalog.

BATTERY-DRAIN REBUTTAL

In the “Try This One” column of the July, 1950 issue, Mr. Cohn suggested replacing 300-ma tubes with their 150-ma equivalents to reduce drain on automobile batteries. I have found that 150-ma tubes do not last long in vehicular service because their heaters are too fragile to take the pounding and vibration. On the other hand, 150-ma tubes are fine for a.c.-operated equipment.

If you must save heater current in a battery set, do not replace a 6X5 or similar rectifier with an OZ4. Use smaller pilot lamps and economize elsewhere. These tubes generate a hash which defies description. It starts shortly after a new tube is placed in service.

If an auto radio comes in with a complaint of odd-sounding whistles, hisses, or hash; check to see if it uses an OZ4. If so, a new one will provide temporary relief. For a more effective cure, try shunting each of the filter capacitors with a 500-µµf, 1,000-volt capacitor and connect a hash filter—a parasitic choke and 500-µµf capacitor in series—with each plate of the OZ4. The choke may be made by winding No. 18 enameled wire over a 10,000-ohm, 2-watt resistor.—James Charles Soukup

SELF-Locking RELAY

If you need a special locking relay with electrical release, you can make one from two surplus relays. Mount the relays side by side and connect their armatures together with a mechanical linkage. If the armatures do not carry current, they can be linked by a metal strip soldered to each. If either carries current, then you can use a plastic rod drilled for short lengths of bus bar or metal strips which are soldered to the armatures.

The drawings show the construction of the relay and a typical circuit.RY1 may be a s.p.s.t. sensitive relay in the output of a capacitance relay, photocell, etc. When a pulse is applied to the coil of RY1, it pulls in and closes the holding circuit to the coil of RY2. The contacts of both relays will stay closed until the circuit is opened with the normally closed push-button switch.

The coil of RY2 may match any convenient source of current for the holding current. It should have enough contacts to handle the controlled circuits. Use this system as a push-to-start, push-to-stop control for your transmitter.—O. C. Vidden
PHASING LOUDSPEAKERS

Having enjoyed reading the article "Connecting Loudspeakers" in the June 1950 issue, I would like to add a few words on the subject.

When a number of speakers are mounted on a common baffle or close to each other, it is necessary that they be phased or connected so that they work as one unit. Before connecting each speaker, momentarily connect a 1.5-volt dry cell across the voice coil. Note the polarity of the battery and the direction the cone moves.

If matching transformers are used with the speakers, connect a high-resistance voltmeter across the secondary. Touch the leads of a 22.5-volt battery to the primary and note which direction the meter reads. In either case, connect the speakers so the cone movements or meter deflections are in the same direction.—C. J. Laughlin

MORE USE FOR WELLER IRON

Weller-type soldering irons are useful in determining which parts of a radio or amplifier are sensitive to 60-cycle hum. Hold the tip of the iron close to transformers, chokes, and any other components suspected of picking up hum. (The radio and iron must be on for this test.) Not only will the strong magnetic field around the tip show which parts are sensitive to hum, it will also show which side of the component is most sensitive. Thus it is simple to orient transformers and other components for minimum pickup.

We worked on a phono amplifier which had a low-level a.c. hum which resisted all the standard hum-elimination practices. By using the method outlined above, we traced the hum to a small iron-cored choke in the scratch-filter assembly. A grounded metal shield around the assembly cleared up the trouble.—O. C. Vanden

E V E R Y R A D I O M A N
Can Use These

SERVICE HINTS!

Valuable Manual Yours—FREE!

Every page of "How to Simplify Radio Repairs" packed with solid-bunch, practical ideas! Contains no huff-n-puff vague theory. In one easy step-by-step method it gives you practical suggestions that are based on years of experience. A must in all service shops. Here's the secret of successful service Simplification: How to Test Transformers and Chokes; How to Test Loudspeakers; How to Test Radio Parts—and it's FREE!

Send coupon or penny postcard for your FREE COPY TODAY!

FEILER ELECTRIC SERVICE

1601 S. Federal St., Chicago 24, Illinois

Price: 50c by Postage Stamp "How to Simplify Radio Repairs"

Name

Address

City Zone State

D E C E M B E R, 1950

Hickok Leads!!

WITH

NEW

TELEVISION

VTVM

MODEL 209A

ELECTRONIC VOLT OHM CAPACITY MILLIAMMETER

- Now even more sensitive—Especially designed to save you time in television servicing. Measures any resistance, capacitance, voltage or current you would ever encounter in AM, FM or TV receivers.

- New Peak-to-Peak voltage measurements—An absolute necessity for TV servicing.

- Zero-center DC scale increases speed and accuracy of TV and FM readings.

Model 209A is a quality instrument built to the high HICKOK standard, with lasting accuracy for years to come.

The most used instrument on the technician's bench, where top-quality is the most economical buy.

See the 209A at your jobber's or write for literature today!

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

Dupont Avenue, Cleveland 8, Ohio

F E A T U R E S

- Easy to read, long scale 9" meter.
- Zero-center DC scale for faster alignment.
- Uniform resistance measurement as low as 1/10 ohm.
- New 1200 Volt AC range.
- Low capacity, high frequency probe.
- Peak-to-peak or RMS—Flat frequency response to 300 megacycles.

BUILD 15 RADIOS...Only $14.75

- ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY
- NO ADDITIONAL PARTS NEEDED
- EXCELLENT BACKGROUND FOR TELEVISION

The progressive radio educay will help you. If you want an interesting and rewarding hobby. Or you can use the radio to further your knowledge of radio. Assuming no knowledge of radio is necessary. The progressive radio educay is the answer. It is a complete course in radio, including instruction in the fundamentals and technicalities needed to construct and repair radios. The course is divided into five sections. Each of these sections is broken down into a group of lessons, with exercises in between. The exercises are designed to give you practical experience in construction and repair. The course is designed to be self-contained and is suitable for laymen as well as for those who have had some training in radio. The course is divided into five sections: "The Radio and its Components," "The Amplifier," "The Receiver," "The Transmitter," and "The Television Equipment." Each section is divided into a number of lessons, with exercises in between. The exercises are designed to give you practical experience in construction and repair. The course is designed to be self-contained and is suitable for laymen as well as for those who have had some training in radio. The course is divided into five sections: "The Radio and its Components," "The Amplifier," "The Receiver," "The Transmitter," and "The Television Equipment." Each section is divided into a number of lessons, with exercises in between. The exercises are designed to give you practical experience in construction and repair. The course is designed to be self-contained and is suitable for laymen as well as for those who have had some training in radio. The course is divided into five sections: "The Radio and its Components," "The Amplifier," "The Receiver," "The Transmitter," and "The Television Equipment." Each section is divided into a number of lessons, with exercises in between. The exercises are designed to give you practical experience in construction and repair. The course is designed to be self-contained and is suitable for laymen as well as for those who have had some training in radio. The course is divided into five sections: "The Radio and its Components," "The Amplifier," "The Receiver," "The Transmitter," and "The Television Equipment." Each section is divided into a number of lessons, with exercises in between. The exercises are designed to give you practical experience in construction and repair. The course is designed to be self-contained and is suitable for laymen as well as for those who have had some training in radio. The course is divided into five sections: "The Radio and its Components," "The Amplifier," "The Receiver," "The Transmitter," and "The Television Equipment." Each section is divided into a number of lessons, with exercises in between. The exercises are designed to give you practical experience in construction and repair. The course is designed to be self-contained and is suitable for laymen as well as for those who have had some training in radio.
HELP FREDDIE WALK FUND

It is most pleasing to state this month that the Freddie Fund has reached almost $3500.00 in contributions to Freddie, the Arkansas radio technician's two-year-old son born without arms or legs.

Freddie returned South last month after a stay of several months in West Orange, N. J. where he was fitted with his artificial legs. This, as previously reported, is the first stage in rehabilitating the child so he can become a useful citizen and, we hope, an excellent raclanman in due time.

The artificial legs so far have enabled him only to balance himself, which for a person born without legs is a task in itself. It should always be remembered that Freddie is only two years old. His father reports that Freddie is doing fine at this particular point and believes that with just a little more practice he will be able to take a step. This he will be able to do by twisting the lower part of his body. It will take a lot of patience on the part of his parents and others, but his doctors believe that it won't be long before he will learn how to walk. It will be several years before any attempt will be made to fit Freddie with artificial arms as he must first learn how to use his legs which will be quite a task to master.

In the meanwhile we hope that our readers will do their utmost with contributions which are badly needed to rehabilitate the boy so that he will be able to take care of himself.

The Editor was particularly pleased to receive a letter from a young college student who is organizing a Help-Freddie-Walk Fund through his college. We hope to report more on this particular effort in the near future.

Keep up the good work by sending your contributions—even the smallest one will be highly welcome.

Make all checks, money orders, etc., payable to Herschel Thomason. Please address all letters to:

Help-Freddie-Walk Fund

c/o RADIO-ELECTRONICS

25 West Broadway

New York 7, N. Y.

RADIO-ELECTRONICS
Balance as of September 22...$3134.21
Willard M. Abel—Lowpoint, Ill...5 75.00
Ask Radio Supply Co.—Birmingham, Ala...10.00
E. H. Allain—Belmont, Mass...1.00
Anonymous—Elson City, Calif...2.00
Anonymous—Los Angeles, Calif...2.00
Anonymous—Redwood City, Calif...10.00
Anonymous—Washington, D. C...10.00
Anonymous—Bellewood, Ill...1.00
Anonymous—Indianapolis, Ind...2.00
Anonymous—Rutherford, N. J...5.00
Anonymous—Brooklyn, N. Y...10.00
Anonymous—Brooklyn, N. Y...1.00
Anonymous—Buffalo, N. Y...2.00
Anonymous—New York, N. Y...1.00
Anonymous—Philadelphia, Pa...1.00
Anonymous—Roscoe, Pa...5.00
Anonymous—Memphis Tenn...2.00
Anonymous—Houston, Texas...1.00
Anonymous—Seattle, Wash...1.00
Barbara and Ernie Baker—Wellesley, Mass...1.00
B. R. Battle—Bayside, N. Y...3.00
Virgil E. Beck—Omaha, Neb...3.00
Polly Box—Downey, Calif...1.00
Ernest E. Case K7WV—Vocoville, Calif...5.00
Charles W. Calam—Newark, N. J...1.00
Peter Ceresoli—South Plainfield, N. J...1.00
L. D. Clemens—Pittsburgh, N. C...3.00
Communications Equipment Co.—New York, N. Y...20.00
F. M. Conroy—Conway Radio & Television—Detroit, Mich...10.00
R. W. D.—Short Hills, N. J...5.00
J. C. W. Dick—Detroit, Mich...2.00
Eddie Eiffel—Brussels, Belgium...1.00
Laurence M. Eugene—Chicago, Ill...1.00
Friends from Yankers—Yankers, N. Y...5.00
Dr. William H. Grace—Bronxville, N. Y...15.00
N. E. Harm—San Diego, Calif...5.00
Louis H. Hippe—W&APD—No. Hollywood, Calif...10.00
Roy Johnston—Detroit, Mich...1.00
Stanley C. Kukul—Honolulu, T. H...5.00
Jim Kurnik—Lebanon, Mo...1.00
W. W. Ledil—Battlesville, Okla...1.00
D. B. Lones—Los Angeles, Calif...1.00
Mr. & Mrs. Robert M. Morckelough, Grove City, Pa...1.00
H. McF.—Longmont, Colo...10.00
Mrs. June Madden—Detroit, Mich...2.00
Johnny and Billy Martin—Jeffersonville, Pa...2.00
William G. Martin—Cincinnati, Ohio...5.00
Mid-West Associated—Rockford, Ill...10.00
Alice Solly Miller—Rooster, N. Y...1.00
W. Mosher—Chariotte, N. C...2.00
D. Nestor—Detroit, Mich...10.00
John J. Pauk—Pittsburgh, Pa...10.00
J. F. Pepl—Framingham, Mass...2.00
J. C. Pop—Philadelphia, Pa...1.00
P. E. Barrett—New York, N. Y...15.00
John Rebuse—Brooklyn, N. Y...1.00
C. S. Rasmussen—Evensville, Ind...3.00
Roessler Radio Service—Hilliowood, N. Y...2.00
R. C. Rastri—Sunshine Circle—Dayton, Ohio...1.00
J. Raster—Fordham, Pa...1.00
San Francisco Radio & Supply Co.—San Francisco, Calif...5.00
Hans E. Saxon—Queens Village, N. Y...1.00
E. Schoenheit—Cedar Rapids, Ia...3.00
Sears, Roebuck & Co.—Cleveland, Ohio...10.00
Maurice and Donald Shipton—Placentia, N. J...2.00
Swift All-Steel Body Company, Inc.—Saginaw, Mich...25.00
Elbert L. Taylor W2EWD—Marine, N. Y...5.00
George M. Tod—Philpadenphia, Pa...2.00
F. Tomesken—Bronx, N. Y...5.00
J. C. Varga—Cleveland, Ohio...4.00
W050—Fergus Falls, Minn...1.00
Burton W. Williams—Seattle, Wash...5.00
Paul York—Detroit, Mich...5.00
Mrs. J. W. Wastlock—Rock Island, Ill...1.00
Total Contributions received up to October 31, 1950...$3491.56

Radio Thirty-Five Years Ago
In Gernsback Publications

HUGO GERNSTOCK
Founder

Modern Electries...1906
Electric Experimenter...1907
E SupplEx...1908
Radio News...1918
Radio...1919
Electrical Experimenter...1920
Radio-Craft...1920
Modern Electrics...1920
Short-Wave Craft...1921
Telegraphy News...1921
Wireless Association of America...1922

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

DECEMBER, 1950

STANCOR
TRANSFORMERS

Using Stancor replacement transformers for your radio, TV and sound service jobs is the sure way to fatten your bank account. Here's why—

- Quality comes first with Stancor. Ability to "take it" cuts down call-backs—keeps your customers happy with a good job.
- Stancor has the largest line in the industry. A choice of 450 part numbers, in some 30 mounting and terminal styles, enables you to get exactly the right unit for almost any application.
- Easy-to-read instruction sheets and clearly marked terminals make your job quicker and easier. Saves valuable shop time.

New Stancor units are coming out all the time. Keep posted. Ask your Stancor distributor for our latest catalog.

The PROFIT-WISE
Serviceman Speaks...

4800 POWER SERIES

A comprehensive line of 35 part numbers designed for replacement and new construction. Wide range of applications based on a thorough study of today's power transformer needs. Most ratings available in a choice of vertical or horizontal mountings.

OUTDOOR LINE TO VOICE COIL

Two new units designed to fit most needed outdoor applications. Primary impedances of 3000/1500/1000/500 ohms, secondary impedances of 3500/2000/1500/1000 ohms, respectively. Amperages of 16/8/4 amhs. Port Number A-3333 rated at 14 watts. A-2334 rated at 25 watts.

STANDARD TRANSFORMER CORPORATION
1592 ELSTON AVE., CHICAGO 18, ILL.

DECEMBER, 1916, ELECTRICAL EXPERIMENTER

Eyes and Ears for the Sub-Sea Fighter, by Thomas W. Benson

Transmitting Your Photo Over a Wire, by Jacques Boyer

Western Radio Amateurs Offer Their Stations to Army

The Arlington Radio Station (NAA), by Capt. W. H. G. Ballard, U.S.N.

The Revolving Mirror for Protecting Spark Characteristics, by Samuel Cohen

Anent the Audion, by Dr. Lee deForest

Efficient and Economical Method of Utilizing the Armstrong Regenerative Audition System for Damped and Undamped Waves, by Samuel Curtis, Jr.

Electrolytic Rectifiers and How They Work

An Adjustable Fixed Condenser, by Raymond Sutcliffe

A Sounding Board Microphone, by Len K. Wright

Standard Radio Terms Defined
TECHNICIAN'S EXHIBIT

Philadelphia radio technicians held their second annual show and exhibit in that city's Broadwood Hotel September 25-27. Technical sessions were held throughout the second two days, and a number of excellent technical papers were read.

Attendance was disappointing, due apparently to last-minute publicity difficulties, though some blamed the rush of sets being repaired for important parts events for keeping technicians away. In any event, not more than 3,000 of the expected 8,000 technicians registered for the affair, and a number of important papers were read to small audiences.

A number of interesting exhibits were entered by manufacturers, representatives and publications. Most impressive was the very complete demonstration of the use of electronics in defense by the Armed Forces.

The technical lectures were on a higher plane than most of those previously presented at service technicians' meetings. Highlight of the convention was possibly the paper on color television systems by Charles J. Hirsch of the Hazeltine Research Corp. Illustrated with color slides which showed exactly how the "mixed high" principle is applied, and with tables comparing the more common color systems as to efficiency, spectrum use, and detail, it was the most educational lecture that has been delivered to radio technicians for some time. Second only to it was John Rider's discussion "Radio or TV" in which he proved that AM and FM radio will be with us for a considerable number of years to come. A film which drove home the correct methods of television installation by showing how not to install a receiver also obtained the convention's unqualified approval.

NEW GUILD FORMED

A new organization, the Electronic Technicians' Guild of Pennsylvania, has been formed in Philadelphia. The organization is the first of its type, in that it takes in all phases of the servicing industry. The Guild comprises four groups: employees, employers, "neutral members" and student members. All individuals and organizations that are members of the Guild are classified as to the membership group to which they belong.

The purpose of the Electronic Technicians' Guild may be best summed up in the words of its constitution: "The Guild exists for the purpose of aiding its members in improving and elevating their social, professional and economic status in life through cooperation, registration and informative advertisements; the adoption of an enlightened educational program; the classification of employees according to their skills, talents and qualifications; the establishment of a recommended wage schedule consistent with the skills involved; the encouragement of the adoption of fair trade pricing policies;
the elimination of sweat shops and unfair and cut-throat competition, securing the compliance with statutory, federal, state and local laws and regulations as they pertain to labor, business and health and fire underwriter policies; the amicable settlement of disputes between Guild members and the public or between Guild members and outside organizations; legal aid services and such other benefits as programs or policies the membership of the Guild may adopt for the purpose of securing the individual and collective interests of the membership."

The Philadelphia Section of the Guild has already begun to function. The present officers are: Paul Lau, president; Karl Vogelsang, vice-president; John Zagury, corresponding secretary; Stan Myers, secretary-treasurer; and Frank Gerhard, recording secretary.

**SHORTAGES DISCUSSED**

Labor and parts shortages were discussed at the October meeting of the Television Contractors Associations in Philadelphia. Two methods to help ease these problems were approved.

A central employment bureau will be established to make it easier to get labor, particularly qualified television technicians. The facilities of this bureau will be open to potential employees without charge and it will operate for the benefit of TCA membership.

The failure of manufacturers to set aside sufficient parts and tubes to meet service needs was severely criticized. To reduce the problem in Philadelphia, the association will establish a cooperative buying agency. In the beginning, association members will band together to buy large offerings of much needed items that could not be handled by individual contractors. If this meets with success, the cooperative buying plan will be expanded. The association hopes that this scheme will reduce the cost of servicing and help the contractor to stay in business.

**N. Y. TECHNICIANS MEET**

The Empire State Federation of Electronic Technicians Associations held their fall meeting at Kingston, N. Y., September 24. Twenty-four delegates, representing ten local associations, were present, as well as 20 guests.

Discussion centered around the fall educational program, in connection with which the following resolution was adopted:

"Any local association so requesting, shall have the educational lectures made available to their membership, even if they have only a small membership and can get only a small attendance."

The secretary reported that no answer had been received to letters sent the industry concerning distributor and jobber mailing lists. These letters are being followed up with the idea of obtaining some satisfaction.

The next meeting of ESFETA is scheduled for Binghamton, January 14, 1961.
Howard E. Anthony, president of Heath Manufacturing Co., was awarded an honorary degree of Doctor of Science in Electronics by the University of Hollywood. The degree was conferred upon Mr. Anthony at Dr. Harold, Mich., in recognition of his contributions to the field of industrial electronics.

Charles Odorizzi, former vice president in charge of service for the RCA Victor division, was elected operating vice president. Mr. Odorizzi joined RCA in 1949 as administrative head of service activities. RCA also announced the election of Edward M. Tuft as vice president and director of the personnel department. Mr. Tuft has been with RCA since 1930.

Peter L. Jensen, president of Jensen Industries, Inc., received the Order of the Knight from King Frederick of Denmark on his recent trip to Denmark. Mr. Jensen was presented with his contributions to the field of radio.

Curtis A. Haines, former general manager of the phonograph division of Sylvania Electric Products, was appointed general manager of operations for the radio and television picture tube divisions. Sylvania also announced the appointment of L. R. Werner to the post of plant manager in charge of plastic operations for the parts division.

Dr. Vladimir Zwyorkin, director of electronic research and vice president of RCA Laboratories, will be awarded the 1951 Medal of Honor, the highest award of the Institute of Radio Engineers, at the IRE convention in March, 1951. Dr. Zwyorkin will be given the medal for his outstanding contributions to the development of television.

The Radio-Television Manufacturers Association named several important committees. The committees and their membership are:

- Joint Electronics Industry Committee: F. B. Lack, Western Electric, chairman; Benjamin Abrams, Emerson; C. F. Adams, Raytheon; W. R. Baker, General Electric; M. F. Baldwin, Sylvania; William Baldwin, Fu telephone; W. J. Barry, Colgate-Palmolive; Harold Bettner, L. T. & T.; John W. Craig, Crocker; Allen B. Du Mont, Du Mont; Harry A. Elke, International Research Co.; Walter Evans, Western Electric; Malcolm F. Ferguson, Brown; Frank Folsom, RCA; Paul V. Galvin, Motorola; H. E. Gilmour, Sperry; W. J. Hallinan, Hallcrafters; H. I. Hoffman, General Electric; William L. Johnson, Matsushita; C. E. Leary, Western Electric; H. W. Maloney, Western Electric.

Get the Genuine! GENERAL ELECTRIC TV COMPONENTS

Horizontal Sweep Output and HV Transformer

- RTO-092: For 70 degree tube, such as ECP4, IECP4, IBAP1, TEAP1, Max. HV: $3.57

- RTO-092, For 50 to 60 degree tubes, Max. HV: $5.37

Deflection yoke RLD-024 To sweep 70 degree tubes—$1.17

EM-PM Focus coils—$4.17

RTO-038 for 15"-55" tubes RLF-03B for 15"-55" tubes RLF-03B for 15"-55" tubes

RTO-064 Vertical Sweep Output Transformer (10:1 Ratio) $2.67

Width & Linearity coils—$1c

RLO-024—Width Linear—$1c

RLO-024—Linear—$1.15

RLO-024—Linear—$0.33

HORIZONTAL OSCILLATOR COIL

RLO-024: Fits rev. oscil. coil Beechcraft for use in wide wave oscil. oscillator circ. with A.C.

$1.05

Single ion trap Magnets 87c

RET-003 for 10" and 12" round 11KV and 19" round 11KV, Gauss—$3

RET-005 for 14" and 16" rect 13 KV and 24" from 18 KV, Gauss—$3

Write for Free J. Y. 1. Flyer Address Orders to Dept. BE-12 or call Milwaukee 2124

Whole Sale Radio Supply

111 Baltimore 1, Md.

Let Us Put This New 1951 MidWest TV

relish In Your Home on a Budget—Prices

s away.

Be your own judge! See and hear Midwest Television in your own home. Then decide whether to keep it or have your money refunded. Low Factory Prices.

AM-MAMOUTH 192 -inch Picture Tube

AM-FM Radio and 3-Speed Phonograph

Also Available on 30 DAYS TRIAL

The Sensational New 5-Band World-Renowned 1951 Model

MIDWEST RADIOS

MIDWEST RADIO & TELEVISION CORP.

3501 N. 10th St., Milwaukee, Wisconsin

www.americanradiohistory.com
REAL VALUES!

**TRUETONE RECEIVERS**

When aligning these receivers, don't pass up the r.f. or antenna trimmers if you can't peak them. Most of these sets are designed to have a definite peak with the oscillator and antenna trimmers. Replace the converter (and r.f. tube, if necessary) even when they check O.K. on a test. An aged tube might change its input capacitance so much that the tuned circuits can't be peaked.—David Gnesin

**PHILCO MOPAR SETS**

Lack of volume and distortion often show up after Mopar custom-built sets have been operating for about an hour. These troubles are almost invariably caused by the tiny 47,000-ohm resistors in the plate and cathode circuits of the phase-inverter tube. These resistors are under strain and sometimes open intermittently. Replace them with standard 1/2-watt units.—T. M. Ferreira

**licking an intermittent**

If you are still stuck with an intermittent receiver after trying all the tricks in the book, subject the set to several cycles of heating and cooling. In winter, leave the set near a radiator or furnace for one day, then put it outside for another. Do this several times. In summer, use a sun-rayed and a refrigerator. A few cycles of heating and cooling will almost invariably show up the faulty part.—Leonard Pfeiffer

**Automobile Radios**

Many automobile radios, particularly the 1947 Chevrolet models, have dynamic speakers with the hot 6-volt lead connected to an insulated eyecell which is used as a tie-point. These eyecells invariably twist around and short to the speaker frame, making the fuses blow. This won't happen again if you drill out the eyecell and replace it with a small, one-lug, insulated terminal strip.—Bob Williams

**Electronic Instruments**

Toovers are known to produce more effective and stable results. They are particularly valuable in the production of complex signals, such as those used in radar and other high-frequency applications. Overtons are also useful in the study of the properties of materials, such as their magnetic and electrical characteristics. They are often used in the development of new materials and processes, as well as in the testing of existing ones. Their high frequency and narrow bandwidth make them ideal for studying the effects of small changes in an input signal. Overtons are also used in the calibration of other electronic equipment, such as oscilloscopes and signal generators. Their ability to resolve very fine details makes them a valuable tool for researchers and engineers alike.

**SOUND ENHANCER**

For the best results, the Sound Enhancer should be placed as close as possible to the speaker. It is designed to improve the sound quality by reducing distortion and enhancing the clarity of the audio signal. It is particularly effective in improving the sound of vinyl records, where it can help to reduce the background noise and bring out the finer details of the music. The Sound Enhancer can be used with a variety of different types of speakers and amplifiers, and is particularly useful for those who are looking to improve the sound quality of their home audio systems.

**MURDOCH SPECIALTIES CO.**

40 West Broadway, New York 7, N.Y.

**ARRROW SALES, Inc.**

1714-5 S. Michigan Ave., Chicago 36, III.

**PEN-OSCIL-LITE**

Extremely convenient test oscilator for all radio, television, and audio equipment. A complete set of electron tubes for oscillating and measuring purposes, including a small test oscillator, a 500-ohm resistor, test leads, and a signal generator. The Pen-Oscil-Lite is a valuable tool for troubleshooting and calibration, and is particularly useful for those who are looking to improve the performance of their electronic equipment. It is designed to be easy to use and to provide accurate and reliable results, making it a popular choice among hobbyists and professionals alike.

**RADIO-ELECTRONICS for**

www.americanradiohistory.com
ELI’KING PILOT LAMPS
Pilot lamps which blink intermittently in a-c.-d.c. sets can be caused by an intermittent heater in one of the tubes. Locate the faulty tube by connecting a fast-acting a-c. voltmeter across each heater until you come to one which causes the meter to rise above normal when the pilot is off. Replace this tube.—DeLoss Turner

TRAV-LER 5028-A
If this set comes in with an open filament in the 3V4 power amplifier tube, check the filament dropping resistor which is located above the chassis, behind the speaker. Its bottom lug sometimes cuts through the insulation and shorts the red lead going to the top of the resistor. Reinsulate the lead and turn the lug away from it.—Hurley D. Robinson

FORD RADIO MODEL 6MF700
If this set will not play or will not receive stations except at one spot on the dial, the trouble may be traced to the shunt coil in the oscillator circuit. This coil has been found open due to improper soldering and waxing. The connections of the oscillator coil are shown.

To locate the trouble measure the resistance across the 6.2-ohm section of the coil with a low-range ohmmeter. Since the 6-ohm shunt coil parallels this section of the coil, the meter will read approximately 2 ohms if the coil is good. A 6-ohm reading indicates that the shunt coil is open.

Cleaning and resoldering the connections usually clear up the trouble.—Adams Radio Service

KILLING BIRDIES AND OSCILLATION
To determine the source of oscillation in a receiver, tune the set for a good beat note or birdie. Use a metal tool such as a screwdriver to probe around the grid and plate leads of the r.f., mixer, and i.f. stages until there is an abrupt change in the audio note. Verify your findings by detuning the suspected circuit. This will also change the frequency of the beat. Check the alignment, make sure lead dress, bypass capacitors, and decoupling networks for causes of oscillation. Do not overlook possible coupling between a loop antenna and the mixer or i.f. stages.—Charles Bucumbe
TRANSFORMER BARGAINS!

ORDERS FOR TUBES IN THIS LISTING will be honored at these prices if postmarked no later than Jan 1st 1951.

SEND IN YOUR ORDER TODAY!

RECEIVING TUBES

Plate
750-0-750—300 MA. $ 7.50
1022-0-1025—500 MA. 17.25
2500 V—4 MA. 3.95

Filament
2.5V-5A, 7.5V-4A. $2.60
2.5V-10A cases. 4.95
5 V.C.T.-3A. 1.35
5 V.C.T.-15A. 1.85
5.3V-3A. 2.15
6.3V-3A. 5.95
6.3 V.C.T.-3A. 1.29
Three 6.3 V.C.T.-1A each. 1.80
6.3 V.C.T.-6A. 1.85
6.4V-8A. 2.50
7.5V-5A. 2.49

Power
40-0-40—250 MA. —5V-3A. $1.25
55-0-55—250 MA.—5 V.C.T.-3A, 5 V.C.T.-3A. 1.35
175-0-175—150 MA.—63V-6A. 2.15
275-0-275—70 MA.—5V-3A, 2.5V-10A. 3.00
325-0-325—40 MA.—5 V.C.T.-2A, 2.5V-10A. 2.25
325-0-325—70 MA.—63V-12A, 5V-3A. 2.95
350-0-350—70 MA.—63V-3A, 63V-3A. 3.05
350-0-350—100 MA.—63V-6A, 63V-2A. 3.25

Modulation
807 to P.P. 6L6 $2.49
P.P. 807 to single 6L6, 4032 (2400 ohms) 3.49
From 200 500-ohm to 5.10 6L6 3.98

IMPORTANT NOTICE: Minimum Order 55. Quantity prices on request. All items in stock now subject to prior sale—prices subject to change without notice. 20% Deposit with orders unless otherwise noted. All prices F.O.B. our N.T.C. Warehouse.

GE MODEL G61

This set came in with the complaint that it would play when push-button tuning was used but could not be tuned manually on the broadcast or shortwave bands. Checking the oscillator circuit with a dynamic analyzer, we found it to be operating properly on manual and push-button tuning. After setting the receiver for touch tuning, we connected an ohmmeter across the antenna tuning capacitor and found it shorted. The short was cleared by separating the plates, which were touching. The diagram shows the antenna circuit when the set is adjusted for push-button tuning.—Manuel E. Silva

RCA 26X1

Intermittent noises and squealing are frequent complaints on this and similar models. Trouble-free performance can sometimes be had by replacing the 600-volt capacitor between B-minus and the chassis.—Peter Bedrosian

CROSLEY 10-401 AND OTHERS

The horizontal oscillator in the models 10-401, 404, 414, 415, and 10-418 has a tendency to drift, thus causing the receiver to lose horizontal sync after it has warmed up. If the horizontal sync adjustment is made after the set has warmed up, the picture will not fall in sync when the receiver is cold.

This trouble is caused by a molded capacitor C160 (type 487) which may change capacitance with temperature. The capacitance change is sufficient to cause the receiver to lose horizontal sync.

Correct the trouble by replacing it with a 0.1-nf, 600-volt paper capacitor (part No. 09001-13).—Crosley Service Department

Technotes

www.americanradiohistory.com
EXPERIMENTAL ARTICLES

Dear Editor:

Regarding your query in the January issue "Shall we abandon experimental articles?" I feel that it would be a great loss to those readers interested in all phases of electronics. The growth of science is based largely on experiments and without it knowledge and industrial growth would stagnate. Anything that will stimulate thinking is worthwhile.

Here is a short list of some problems that need further working on. None of them are new, but they all are in need of development:

- Simplified, full-color three-dimensional television
- More efficient loudspeakers
- Improved transistors
- Uses for electrets
- Biological signal generators
- Weather forecasting
- Television
- Improved radioactive technique
- Improved television
- Weather forecasting
- Radio transmission
- Weather forecasting
- Television
- Weather forecasting

Dear [Name],

The wealth of knowledge and men available to the armed forces is staggering. The man who can control the vast amount of information that is available to him has a tremendous advantage. The man who can control the vast amount of information that is available to him has a tremendous advantage.

Sincerely,

Santa Barbara, Cal.

VANCE PHILLIPS

SIG GEN TABULATION

Dear Editor:

I have made good use of the tabulation of multitesters you printed in May 1949, comparing the testers shown before buying one. Now I need a standard signal generator and have been

APPROVED FOR VETERANS — New classes start twice a month. High level home study training also available for professional radio men.

CAPITOL RADIO ENGINEERING INSTITUTE
16th Street and Park Road Dept. 3012B, Wash. 10, D. C.

Whether you're in the Armed Services or in Industry

ELECTRONICS TRAINING PAYS OFF

WITH INTERESTING JOBS AND HIGHER EARNINGS

CRIE—Residence School training offers quick promotion in uniform as well as profitable civilian careers.

In or out of the armed services, the best jobs go to the men with technical training. If you are prepared with electronics training, you’re fortified for the future, whether you're headed for a berth in the armed services or a career in essential industry. Because of the critical shortages that exist today in the electronics industry, the qualified technicians and engineers can practically choose their own futures. Because of the dependence of modern armies, navies, and air forces upon electronics—for radio, communications, and navigation—the man with even limited knowledge of electronics gets ahead quickly in uniform. In case you're called to active duty before completion of your CRIE course, you'll still be way ahead, for the armed services will choose you for further electronics training in place of the completely un-trained man.

At CRIE you'll work with the latest equipment—over 120,000 square feet of modern class rooms, TV and radio broadcasting studios, transmitters, control rooms, and experimental labs. Here you're grounded in the fundamentals required for work in guided missiles, TV, and all the other important fields of communications and electronics. CRIE’s experiences in training thousands of men for the Army, Navy and Coast Guard in World War II, coupled with pioneering background in technical education and close industry connections, assure you of the best in technical preparation.

To insure your training ACT RIGHT NOW. Send today for free Residence School catalog.

FOR FREE CATALOG, MAIL COUPON NOW!

CRIE—16th & Park Rd., Washington 10, D. C.
Please send free Residence School Catalog.

Name ____________________________

Street ____________________________

City ____________________________ Zone _______

Veteran __ Non-Veteran __________ Age _______

Send details about Home Study Courses 0 3012 B

FATHER OF RADIO

THE STORY OF LEE DE FOREST — AS HE HIMSELF TELLS IT.

ONLY $5.00 One of the great books on electronics

One of the most remarkable books on radio ever written! The inside story by the man who made modern radio possible—Lee de Forest, the "Grand Old Man" of Radio himself. Facts that he alone could tell, details only he knows—gathered together in one complete, monumental volume!


MAIL THIS COUPON TODAY

WILCOX & FOLLET
1255 S. Wabash Ave., Chicago, III.

By all means send me Lee de Forest's FATHER OF RADIO at once. My remittance for $5.00 is enclosed. Book will be sent postpaid.

NAME ____________________________

STREET ____________________________

CITY ____________________________ ZONE _______ STATE _______

DECEMBER, 1950


And, that's just a few. The FATHER OF RADIO not only describes his technical development but tells the inside personal story behind them. Over and above his unparalleled scientific greatness, Lee de Forest is a fine storyteller from his first word to the final paragraph, the FATHER OF RADIO captures and holds your interest.

This is one of the greatest historical electronics books ever written. For the wealth of invaluable information it presents, the low $5.00 cost of FATHER OF RADIO makes it the greatest book value ever offered in this field.

WILCOX & FOLLET
1255 S. Wabash Ave., Chicago, III.

www.americanradiohistory.com
COMMERCIAL

INSTITUTE

1400
trained
personal,
completed
We have

SERVICE

Every
complete with
$m995

WANTS PORTABLE PURR

Dear Editor:

I like cats: I have a cat. But my cat has a very quiet purr. I like to hear cats purr.

I have thought of putting a throat mike on my cat and hooking it up to an amplifier. But I don't think my cat would like a throat mike or would purr at all.

Would you please print a circuit for a low-variable-frequency oscillator that would sound like a cat's purr? To be really good, it should have a random “long breath” effect.

The best would be a pocket-size portable so that I can carry it around and turn on when I feel like hearing a cat purr. It needn't lap milk.

Philip Walker
Washington, Conn.

We have a number of alert young men who have completed intensive training in Radio and Television Repairing. They learned their trades thorough by working on actual equipment under personal, expert supervision. If you need a trained man, we invite you to write for an outline of our course, and for a prospectus of the graduate. No fees, of course. Address: Placement Manager, Dept. P108-12

COMMERCIAL TRADES INSTITUTE
1400 Greenleaf
Chicago 24

$9.95 Complete
(Ready to be attached to your radio)

- Listen to baby.
- From room to room.
- Answer Doors.
- Between office and warehouse.
- Garage to home.

Select switch allows for talk to remote, listen to remote, or normal radio play. Easily attached in a few minutes—complete with illustrated easy-to-read instruction sheet. All ready to use—includes remote speaker and 25' of wire. Equal to units selling for 5 times the amount!

EVERY RADIO MAN CAN USE THESE SERVICE HINTS!

Every page of “How to Simp- ify Radio Rep- air!” is pack- ed with on-the- bench, practical ideas.

SELECTOR SWITCH INCLUDED!

CERTIFIED TELEVISION LABORATORIES
Dest. C. 5847-11th Ave., Brooklyn 19, N. Y.

STROBOSCOPE

SIMPLIFIES TROUBLE SHOOTING OF ANY ROTATING OR RECIPROCATING PARTS

This is NOT A KIT! Completely assembled ready to use. Operates on 110 V. AC 60 cycles.

Limited Quantity
Order Today!
$34.95 ea.

A. M. RADIO SALES
5 LISLEPAN STR.
NEW YORK 13, N. Y.

HAVE YOU A JOB FOR A TRAINED TECHNICIAN?

We have a number of alert young men who have completed intensive training in Radio and Television Repairing. They learned their trades thorough by working on actual equipment under personal, expert supervision. If you need a trained man, we invite you to write for an outline of our course, and for a prospectus of the graduate. No fees, of course. Address: Placement Manager, Dept. P108-12

COMMERCIAL TRADES INSTITUTE
1400 Greenleaf
Chicago 24

Electronics technicians wanted

The RCA Service Company, Inc., a Radio Corporation of America subsidiary, needs qualified electronics technicians for U.S. and overseas assignments. Candidates must be of good character and qualified in the installation or maintenance of RADAR or COMMUNICATIONS equipment or TELEVISION receivers. No age limits, but must have at least three years of practical experience.

RCA Service Company offers comprehensive Company-paid hospitalization, accident and life insurance programs; paid vacations and holidays; periodic review for salary increases; and opportunity to obtain permanent position in our national and international service organization, engaged in the installation and maintenance of AM, FM and TV transmitters, electronic inspection devices, electron microscopes, theatre and home television, r-f heating equipment, mobile and microwave communications systems, and similar electronic equipment.

Base pay, overseas bonus, payments for actual living and other expenses, and benefits mentioned above add up to $7,000 per year to start for graduates, increasing each year with periodic review of base salary thereafter. Openings also available at proportionately higher salaries for specially qualified technicians with supervisory ability.

Qualified technicians seeking an advantageous connection with a well-established company, having a bread-based, permanent peacetime and wartime service program, write to:

Mr. G. H. Metz,
Personnel Manager,
RCA Service Company, Inc.,
Camden 2, New Jersey

Electronics technicians for

RADIO- ELECTRONICS
NEW INSTRUMENTS AND KITS

NEW 5" PUSH-PULL OSCILLOSCOPE
All-new laboratory-precision scope with all the extra stability and sensitivity for precise servicing of TV, FM & AM sets. Push-pull undistorted vertical and horizontal sweep. Boasted sensitivity, 0.5 to 1 millivolt per inch. Useful to 2.5 Mc. TV-type multiplier-beefer circuits. 15 cm x 15 cm. 2 axis, intensity modulated wav. Dual positioning controls move traces anywhere on screen. Complete with 3631, 5-A57, 5-713, 5671 CRT. 3 color etched rubberized panel, steel case. 115 x 60 cycle AC. 8% x 17 x 13".
Model 425-K, KIT, only $29.95
Model 425, factory wired, $59.95

NEW VACUUM TUBE VOLTMETER
Laboratory-precision VTFM for trouble-shooting operation and lifetime service. 15 different ranges: Large, 415; meter, cat'or-controlled circuit. New type AC for FM & AM dc'ometer alignment. Electronic AC & DC ranges: 0-3, 10, 100, 500, 1000 x 10,000 volts with 1700 MC with HVP F-1, 9295 probes. Oxygen range, 100,000 volts. 2 holes to 100,000 meg. DB scale. New stable double mode balanced bridge circuit—now more intimacy. 20 meg AC output impediment. 3 color etched rubberized, steel case. 115 x 2 x 6 3/4".
Model 221-K, KIT, only $39.95
Model 221, factory wired, $69.95

NEW ELECTRONIC TESTER
Brand new professional tube tester and merchandiser. EICO simplification for unwanted shield. Large 4 1/2" voltmeter. Taps conventional and TV tubes including 9 pin miniature. New screw-cable switch — every tube element. Illuminated "Speed Readout" 2 and 6 volt lamps and open panel test point. Deep sockets for new tubes. Protective overshoot bulb. Electronic rectifier—3 color etched panel, rugged steel case. 115 x 60 cycle AC. 120 x 10 1/4".
Model 625-K, KIT, only $29.95
Model 625, factory wired, $59.95

NEW SWEEP GENERATOR
Contents all TVFM alignment frequencies, 500 KC - 220 KC. Provision driven dials create of each of 12 TV channels marked on front panel. Switcheable output 0-30 MC, with mechanical indication sweep—permits gain comparison of any TV type meter. Crystal oscillator, variable amplitude and permit for generation of correct wave forms. Complete with all tubes: 6BS7, 12AU7 (dual triodes), 12AC7, 1NA9, 1-16 x 6V6; 3 MC Crystal, etc. $39.95
Model 360-K, KIT, only $29.95
Model 360, factory wired, $49.95

NEW BATTERY ELIMINATOR, CHARGER & BOOSTER
For use with radio testing, laboratory. Full-wave bridge circuit, 6 volt, 60 cycle AC. Designed for transformer, variable from 6 to 15 volts. Conditions: 50 - 10 watt transformer, 4000 volt, 10000 volt, 1 scans. Meter measures current and voltage output. Fixed Inductors. Tube eliminator, transformer. Input for transformers. Hemiommetr. case. 113 x 60 cycle AC. 10% x 7% x 6".
Model 1040-K, KIT, only $22.95
Model 1040, factory wired, $42.95

NEW DELUXE SIGNAL GENERATOR
A laboratory-precision generator EICO Servicing Engined with 5% accuracy. Sine waves, stable, frequency 75 KC - 150 MC in 7 calibrated ranges. Hemiommetr. meter tuning, variable from 6 to 15 volts. Includes: 50 - 10 watt transformer, 4000 volt, 10000 volt, 1 scans. Tube eliminator, 656, 777, 644, CV150, 2 color etched panel, rugged steel case. 115 x 60 cycle AC. 12 x 13 x 7".
Model 315-K, KIT, only $35.95
Model 315, factory wired, $62.95

VOLT-OHM-MILLIAMMETER
Permits accurate voltage measurement with select 32 different ranges. diode, reverse polarity, filter section, gain multipliers and capacitors. New range—DC, 0-10, 100, 500, 1000, 2000, 5000; AC Output: 0-10, 100, 500, 1000, 10000, 0-100, 0-1000; DC, 0-10, 100, 500, 1000, 10000 volt, 1-16 x 6V6; 3 MC Crystal, etc. $39.95
Model 511-K, KIT, only $14.95
Model 511, factory wired, $27.95

HIGH VOLTAGE PROBE
New professional EICO-standardized NY probe carefully designed and constructed for extra safety and sensitivity. Extremely range of VTFM and voltages up to 25,000 v. Tapered hub. Large nickel head. Multi-layer, heat-stable, plastic, insulating. Complete with internal 110 volt AC cord. Multi-head probe feature. $6.95

MULTI-SIGNAL TRACER
Highest gain and flexiblty in new-care field. Audibility tops all PF, RF, Video and Audio from AM to SPK or C6tM without switching. Frequency well over 200 MC. Integral test speaker. Provides full vacum testing with VTFM. Complete with 657. 614X, 6J5C. Generous crystal grades. 3 color etched panel, rugged steel case. 115 x 60 cycle AC. 10 x 8 x 4".
Model 145-K, KIT, only $15.95
Model 145, factory wired, $27.95

EICO—SUPER-SIMPLIFIED INSTRUCTIONS
Easy to follow step-by-step EICO pictorial and schematic instructions—most explicit and comprehensive in electronics! supplied with each Kit. Anyone can build the EICO Kits!

ELECTRONIC INSTRUMENT CO., Inc.
276 NEWPORT STREET, BROOKLYN 12, N.Y.
(3) 1950, Electronic Instrument Co., Inc., Brooklyn, N.Y.
BECOME AN

ELECTRONIC TECHNICIAN

IN 12 MONTHS

TRAIN NOW FOR
IMPORTANT
RESPONSIBILITIES

Do you have 12 months to invest in a training program that can bring immediate and life-long opportunities?

Then investigate the Technician courses available at this College of Electrical Engineering. For example, in those valuable 12 months you can earn your Electronic Technician's Certificate. You enter the fascinating field of Industrial Electronics. You are trained for responsibilities of tremendous growing importance to the strength and welfare of the nation.

This world-famous course also supplies the basic fundamentals so that you can progress into studies of radar, television and other branches of Communication Electronics.

Faculty of 85 specialists • 1,555 currently enrolled from 48 states and 25 foreign countries • Over 35,000 alumni

MILWAUKEE
SCHOOL of ENGINEERING

Technical Institute • College of Electrical Engineering

A SPECIAL PREPARATORY program is offered.

MILITARY, ACADEMIC OR PRACTICAL training will be evaluated for advanced credit.

NEXT TERMS OPEN
JANUARY 8 . . . APRIL 2

6 additional months make you a

RADIO-TELEVISION TECHNICIAN

It is academically possible for the Electronic Technician to complete this course in 6 months of study. You are then ready for vital assignments in the fields of Communication Electronics, TV and other branches of advanced Electronics.

In 24 additional months become an

ELECTRICAL ENGINEER

Under this internationally-known educational system, the Technician courses described here are complete in themselves but also serve as units of the College program leading to the B.S. degree with a Major in Electronics. Thus, if you must leave school after completing your Technician course, you are ready for immediate employment or specialized services. Or, you can continue here immediately or at any time and your Technician Course will be credited toward your B.S. degree.

MAIL ORDER SCHOOL

RADIO COURSES

Preparatory Mathematics, Service, Broadcast, Television, Marine Operating, Aeronautical, Frequency Modulation, Radar,

Classes now forming for the
Mid-Year term beginning Feb. 1st
Entrance exam, Jan. 15th
Veterans, Literature,
COMMERCIAL RADIO INSTITUTE
38 West Bidde Street, Baltimore 1, Md.

IMPORTANT
NEXT TERMS

NOW

JANUARY

WANTED

OUTSTANDING

ENGINEERING

RADIO-TELEVISION

TELEVISION

ENSCICRIES-RADIO

MODERN LABORATORY

INSTRUCTION IN

- SERVICING

- BROADCAST

- OPERATING

- ELECTRONIC AND

TV ENGINEERING

WRITE.

ADDED VALUE

ELECTRONICS INSTITUTE, INC.

21 Henry, Detroit 1, Mich.

LEARN DAY AND EVENING CLASSES

TELEVISION

ELECTRONICS-RADIO

YOUR FUTURE IN RADIO-TV

Your future in radio TV begins right now, with proper training. The Don Martien School of Radio Arts, established in 1937, offers the training you want ... for every type of job in Radio TV ... script writer, announcer, disk jockey, newsmaster, technician. Free job placement service for graduates. Day and night classes. . . . Write for our FREE booklet, "YOUR FUTURE IN RADIO." Appraised for veterans.

Don Martien School of Radio Arts
1645 N. Cheesecake, Hollywood 28, Calif. Hudson 23301

A SPECIAL PREPARATORY program is offered.

MILWAUKEE SCHOOL OF ENGINEERING

Milwaukee, Wis.
Dept. RE-1250, N. Broadway and E. State

Without obligation send your NEW RADIO AND TELEVISION BULLETIN.

Name...........................................................................................................

Address.............................................................................................................

City........................................State...........................................

□ Check if Veteran of World War II

RADIO-ELECTRONICS for
RADIO and TELEVISION
Thorough Training in All Technical Phases
APPROVED FOR VETERANS
DAY-EVENINGS FREE SERVICE REPAIR & TELEVISION
WEEKLY RATES
Free for Complete Radio-Television Training at
RCA INSTITUTES, Inc.
A Service of Radio Corporation of America
350 WEST 47TH STREET
NEW YORK 18, N. Y.

RADIO ENGINEERING
FM—Television—Broadcast
Prepare for new high status radio-
enGINEERING Radio Engineering Avia-
tion Radio and Ultra-High mobile appli-
cations. Through training of Radio and Elec-
tronics Modern laboratories and equipped-
tabled school. Ample housing facilities. 7 sem-
inar small. enrollments limited. Enrollment
in demand. Write for catalog.
Approved for Veterans
VALPARAISO TECHNICAL INSTITUTE
Dept. C
VALPARAISO, INDIANA

TRI TELEVISION
TELEVISION SERVICING, by Walter H. Buchsbaum. Published by Prentice-

TV ELECTROMAGNETIC SERVICING COURSE
Practical Shop and Laboratory Training at
F. A. Furnishes Books and Tools
SEND FOR FREE LITERATURE
Baltimore Technical Institute
1405 East Place, Dept. C. Baltimore 17, Md.

TELEVISION
PREPARE FOR A GOOD JOB!
COMMERCIAL OPERATOR (CODE)
RADIO SERVICEMAN

ELECTRONICS
Prepare for new high status area of a good paying
M. J. Kranz
Approved for Veterans
SEE OUR LARGEST AD PAGE 13
Sprayberry Academy of Radio
Dept. 20-W, 132 H. Canal St., Chicago 6, Ill.

VOLMETERS
MODEL 102
(1000 ohms per volt meter)
* 3 SQUARE METER
* 3 CURRENT RANGES
(10/30/100 ma.)
* Same zero adjustment for both resistance
ranges (50,000 ohms.
* 5 DC & 5 AC Voltage Ranges 0 to 300 Volts
* 4.99

MODEL 104
(20,000 ohms per volt meter)
* 4½ SQUARE METER
(50 micro-amperes
* Includes carrying strap
3 DC Voltage Ranges at
20,000 ohms/volt to 3,000
V. 3 AC Voltage Ranges
5 to 3,000 V. 3 Resistance
Ranges 20 to 30 megaf.
* $295

All of the above have round cornered, bakelite meter cases. (Reg. Trade Mark For Univ-Del-Wilman

RED ARROW XMAS BARGAINS
No shortages here—RED ARROW has what it
advertises. If you don't see what you want
listed, please write. We specialize in Ceramic-
istor, Resistors and Condenser manufacturers. Ask for our price list.

FILTER UNIT
This unit is an excellent buy for the parties alone.
Some parts are worth more than we are asking
for the whole unit. Here's what you get:
10 MFD @ .650
2-20 watt Resistors
1-100 MFD @ 12V
3-Filter Chokes
1-5 MFD @ 400V
1-DPS Toggle Switch
2-5 MFD @ 50V
1-21 MFD @ 400V
BRAND NEW, ORIGINAL PACKING $9.95

EE-8 FIELD TELEPHONES
Tested and Guaranteed. Ideal for
TV Installations
$9.95 ea.

MINIMUM ORDER: $2.00. Send 25% deposit with order, balance C.O.D. FOB, N. Y. C. (N. Y. C. residents add 2% sales tax.)

RED ARROW SALES
DEPT. E, 63 EAST BROADWAY, N. Y. 2
PHONE-CORINTH 7-5425

TELEVISION SERVICING
By Walter H. Buchsbaum. Published by Prentice-

TRIPLEX RADIO ELECTRONICS
Prepare for new high status area of a good paying
M. J. Kranz
Approved for Veterans
SEE OUR LARGEST AD PAGE 13
Sprayberry Academy of Radio
Dept. 20-W, 132 H. Canal St., Chicago 6, Ill.

The section on theory in Part I of three; the other two are "Alignment," "Installation" and "Troubleshooting." These two strictly service sections occupy 152 pages of the book. This does not mean that Part I is unimportant to the television technician; indeed, the technician reading chapter 10 on r.f. alignment finds that chapter 11 on television tuners complements it to give as complete a picture of television front ends as he has been able to find in the literature. The same close twinning of theory and practice is observable in other chapters.

Readers of the "Television Clinic" in Radio-Electronics, published by Mr. Buchsbaum, are familiar with his style and approach. The same clear-cut, down-to-earth language is used in this book, especially in Parts II and III.

TRAVELING-WAVE TUBES, by J. R. Pierce. Published by J. Van Nostrand

A thoroughly mathematical and tech-

Special
300 ohm TWIN LEAD TV LINE, per 10 ft.
ZIP CORD per 100 ft. ONLY $2.49
6 ft. LINE CORDS, molded plugs,
per 100 $14.75

The same clear-cut, down-to-earth language is used in this book, especially in Parts II and III.

TRAVELING-WAVE TUBES, by J. R. Pierce. Published by J. Van Nostrand

A thoroughly mathematical and tech-
SHOOTS TROUBLE 
FASTER! 
MAKES MORE MONEY 
FOR YOU ON THE JOB 
OR AT SERVICE BENCH

PRICE 
$5.95

No C.O.D.'s, please. 
Insure Airmail Sts. 
Same Sales Ter.

Sylacine 
MULTI-FREQUENCY GENERATOR

In radio service work, time is money. Lately 
we have found that the MULTI-FREQUENCY 
GENERATOR with the Sylacine is a true 
troubleshooter tool. It costs less money, 
but delivers a much greater volume of work 
with the Sylacine. At a usual starting fee 
for the Radio Analysis Service of $3, the 
Sylacine will pass--in addition to RF, 
AF, and DC list--any test of your 
choice. 

Clippard INSTRUMENT 
LABORATORY, INC.
DEPT. B, 1225 BANK STREET 
CINCINNATI 14, OHIO

FOR BETTER TOWERS 
AT LOWER COST!
Ask about AERO

• COST LESS
Because Aereo Towers are aircraft-de-
signed, lower manufacturing costs offer 
you a lower price. Lower weight and 
lower shipping costs are passed on as 
savings to you.

• LAST LONGER
Coated INSIDE and OUT, DIP-COATED 
process keeps Aereo Towers Bright and 
new. Rust resistant. Will not brown.

• EASY TO CLIMB AND SERVICE
Strong electric aircraft welded of EACH 
joint (not just one or two) prevents 
sway. Provides sturdy, safe, ladder-like 
cross members.

• QUICKER TO INSTALL
Aircraft precision tolerances assure ac-
curate fit of components. Light and easy 
to erect. Strong durability assures cus-
tomer satisfaction.

Jobber Territories Open 
Dealers—Write for FREE booklet

AERO TOWER DIVISION
Knepper Aircraft Service 
1018 Linden Street 
Allentown, Pa.

ADVERTISING INDEX
A. M. Radio Sales 92
Aero Towers and Rotator Division 76
Aerospace Corporation 69
Allied Radio Corporation 45
Almor Radio Corporation 67
American National Corporation 70, 78
Amplifier Corporation of America 70, 78
Artay, Incorporated 88
Arrow Sales Company 88
Atlas Sound Corporation 71
Bell Telephone Laboratories, Inc. 17
Boyle-Rechee Book Company 47
Brooks Radio Dist. Company 79, 97
Bryan-Davis Publishing Co., Inc. 89
Buffalo Radio Supply Co. 86
Ezra Sales 71
Capitol Radio Engineering Institute 71
Central Electronics 71
Certified Television Laboratories 70
Cleveland Institute of Radio Electronics 70
Clipper Instrument Lab., Inc. 70
Commercial Tradas Institute 72
Communications Equipment Company 94
Concord Radio Corporation 81, 82
Diamond's Training, Incorporated 70, 82
DuMont, Allen B., Labs. 86
East Coast Electronics 70, 78, 82
Editors & Engineers 70, 78, 82
Electro-Technical Industries 70
Electronic Instrument Company 83, 87, 92, 93, 97
Electronic Measurements Corp. 95
Falo Radio Sales 81
Feller Engineering Company 81, 92
General Electronic Test Company 53, 54, 85
General Industries Company 70
General Test Equipment Company 70
Grayback Radio Supply 88
Harrision Radio Corp. 88
Health Corporation 71, 72, 74, 75, 76, 77
Hicks Electronic Engineering Company 81
Hudson Radio and Television Corp. 64, 88
Hypertone Radio and Television Corporation 88
Instructograph Company 85
JFD Manufacturing Corporation 85
Jackson Electronic Instrument Company 51
Kalsey Company (The) 82
Keystone Electronics 82
Lark Radio Engineering Company 83
Lars Sales Company 85
Mallory and Co., Inc., P. R. 85
Inside Back Cover
Midway Radio & TV Corporation 96
Midwest Radio & TV Corporation 96
Moore Reproducer 88
Murray Hill Speakers Corporation 61
National Plan Company 97
National Radio Institute 97
National Schenck 97
National Union Radio Corporation 97
Niagara Radio Supply 88
Opportunity Ads 87
Precision Apparatus Company 89
Pres-Probe Company 85
Progressive Electronics Company 87
Quinn-Nichols Company 87

RADIO SCHOOL DIRECTORY
Pages 94-95

Baltimore Technical Institute
Candian System Company
Commercial Radio Institute
Debney Institute
Electro-Mechanical Institute
Hollywood Sound Institute
Hollywood Technical Institute
Indiana Technical Institute
Martin School, Dan
Milwaukee School of Engineering
RCA Institute
Radio-Theater Institute
Sprayberry Academy of Radio
Tri-State Radio
Volkopulos Technical Institute

RCA Service Company 92
RCA, Victor Division (Radio Corporation of 
America) 82
Inside Front Cover, Back Cover 
Radio Academy Corporation 92
Radio City Products 62
Radio Corporation of America 82
Radio Deans Supply 82
Radio Wire Telegraph 49
Ray Manufacturing Company 69
Red Arrow Sales 66
Rider, John F., Publisher 66
Rose Company (The) 82
Sams & Company, Inc., Howard W. 59
Sprague Products 42
Sprayberry Academy of Radio 11
Standard Transformer Corporation 83
Sutton's Wholesale Electronic, Inc. 81
Swedag Radio, Incorporated 45
Syvillo Electric Products 87
Technocal, Inc. 80
Technics
Tel-A-Ray Enterprise, Inc. 15
Thomas Electric Co. 84
Transcription, Incorporated 64
Trip Manufacturing Co. 68
University Loudspeaker, Inc. 68
Waller Electric Corporation 86
Walls Sales 98
Wholesale Radio Parts 98
Wilcox & Follett 86

www.americanradiohistory.com
nical treatment of new traveling-wave tubes, with a chapter each on double-stream and magnetron amplifiers. Of interest to advanced students or tube engineers who wish to understand the new tube, or to design engineers who may wish to apply it in their work.


Written by the author of the standard text on storage batteries just before his retirement as a physicist with the National Bureau of Standards, this work may become as authoritative as the earlier Storage Batteries.

The whole field is covered, from the voltaic pile to the mercury and vanadium cells. Other new types discussed are silver and lead primary cells, each of which receives a chapter.

A historical introduction opens the book, followed by a chapter on the elementary theory of electric cells. Materials and production of dry cells, their operating characteristics, and effects of temperature are discussed in separate chapters. Standard cells, air-cells, and other batteries with special polarizers, and copper oxide cells also receive a chapter each.

Characteristics of various types of primary batteries are given in 87 tables scattered throughout the book, and there is an extensive index.

SERVICING TV RECEIVERS, compiled and published by Sylvania Electric Products Inc. New York, N. Y. 5 x 7 inches, 119 pages, plus a few end papers and large fold-in schematic. Price $2.00.

A handy little work of the ring binding, open-flat type. The characteristic page has a photograph of an abnormal test pattern, with a statement of the probable causes and the remedies.

The list of illustrations can be used as a handy trouble-shooting chart. Altogether the screen patterns number 50. There are also several schematic drawings, including the large fold-in.


Nearly twice the size of the first edition, this new edition closely follows the pattern of the previous two. A new chapter discusses the principles of intercarrier television and the chapter on color television includes the latest material on the CBS, RCA, and CTI systems.—MW

500 FORMULAS TO SUCCESS

ANY million dollar firm started within a wire and a phone and has made a big profit. Here are 500 new test and design formulas that will make things more simple and easy.

Here is your opportunity to start a business with $5,000 or less. After one year you can pay yourself $5,000 a week. The simplest profit is really 90% and with only 10% effort you can make $50,000 a year. You can also use these formulas to calculate batteries, tubes, crystals, and transistors. You can pay you taxes and still make a fortune. You can put a business together in your own home to make $50,000 a year in just one year.

You will find out that you are making thousands of dollars by selling many dollars in small savings accounts, mutual funds, and dealers. You can make the most of your time and money by paying attention to the formulas in this book. You can put a business together in your own home to make $50,000 a year in just one year.

500 Formulas to Success

NATIONAL PLANS COMPANY
1965 Broadway, New York 23, N. Y.

DECEMBER, 1950

HOT off the press!

See this Month's Book Reviews

Easy to understand, practical, up-to-date "Know How" on TELEVISION SERVICING! No Knowledge of Higher Mathematics Needed! Covers the newest designs and servicing techniques. Check full of illustrations, diagrams and schematics. Very latest circuit data.

If you are interested in television servicing YOU NEED THIS BOOK. All your questions answered. Walter H. Burkbaum, your author of Television Service Line. NO RISK. Send for your postpaid copy today. If not satisfied, return within 10 days and your money refunded. Free descriptive folder giving full details available.

Published by Prentice-Hall, Inc.

MAIL COUPON TODAY 10 DAY MONEY-BACK GUARANTEE

TWIN LEAD, TELEVISION LIGHTNING ARRESTER

No. AT102

U. S. Patent Nos. 2,466,442

APPROVED for OUTDOOR-INDOOR Use $2.25

Protects Television Sets Against Lightning and Static Charges Twin Lead

SAFE TV GUARD

Simple to install everywhere and anywhere... no stripping, cutting or spreading of wires. More than 300,000 in use today.

SEE YOUR JOBBER OR WRITE TO

JFD MANUFACTURING CO., Inc. 6127 15th Avenue, Brooklyn 4, N. Y.

First in Television Antennas & Accessories

Your Choice of 4 RADIO KITS

HOUSED IN THIS BEAUTIFUL BAKELITE CABINET

They look wonderful—they sound wonderful!

LUXURIOUS CABINET is made of fine quality, sturdy bakelite with handy slide-rule dial 6" long and magnificently finished in a most beuatiful design that is distinct, attractive and practical. A striking beauty that looks much more expensive than it actually is! Weight: 4 lbs., (approx.). Price: $6.00.


Model P-33X: 4-Tubes, Battery Pack, 3-Bands, 550 KC to 750 KC, 1.5 MC to 6.0 MC, 12 MC to 18 MC. Skillfully engineered for perfect reception with tremendous power and amazing clarity. Sensational value! Price: $12.00.

Model P-AC2X: 2-Tubes, AC, 2-Bands, 110 or 220 Volts, $50 KC to 1000 KC, 3.5 MC to 7.5 MC to 15 MC. Skillfully engineered for top performances on all bands. Payload weight: 15 oz. Price: $20.00.

Model P-SX: 5-Tubes, AC, 2-Bands, AC/DC, 110 or 220 Volts, 550 KC to 1500 KC, 3.5 MC to 7.5 MC to 15 MC, Uses miniatures tubes. Precision engineered to give terrific reception on short waves. Price: $25.00.

Write TODAY for attractive LOW PRICES!

ARKAY—By: Radio Kits, Inc. 120 Cedar St., New York 6, N. Y.

THE THINGS A TV SERVICEMAN DREAMS ABOUT!

• 6310C CIRCUIT DIAGRAM WITH MODIFICATIONS
• HINTS FOR BETTER PERFORMANCE ON YOUR 6310 TV
• ILLUSTRATED TELEVISION CONVERSION MANUAL
• PULSE KEYED S-VIDEO CIRCUIT DIAGRAM
• RMS HANDBOOK AND MICA CODE CHARTS

BROOKS RADIO & TELEVISION CORP. 84 Vesey St., Dept. A, New York 7, N. Y.

$1.00 POSTPAID

Send for "500 FORMULAS AND RECIPES" today. Exclusive free bonus offer...A must for every serviceman, cent new or later. Sold on a money-back guarantee.

www.americanradiohistory.com
Special Relays -
OVER A MILLION IN STOCK!

Whether you require large quantities of relays for production runs or single units for laboratory or amateur work, Wells can make immediate delivery and save you a substantial part of the cost.

This list represents only a few types of Special Relays. We also have huge stocks of Standard D.C. Telephone Relays, Midget Relays, Contactors, Keying Relays, Rotary and Slow Acting Types as well as many others. Write or wire us about your requirements.

Write for New Wells Catalog

MANUFACTURER & NUMBER      PRICE
C.E. Antl. Keying 500W 266353-653AHI  $2.25
Allen Bradley B160 Dashpot  5.95
Culler Hammer 261173A3A Contactor  3.50
Westinghouse MN Overload  12.96
Adlake 60 Sec. Thermo Delay  6.95
Edison 60 Sec. Thermo Delay  4.25
Leach 1135T-5 20 Sec. ADJ. Delay  4.95
Cramer 2 Min. ADJ. Time Delay  8.95
Cramer 2 Min. Adj. Time Delay  8.95
Duralay BF-63  4.25
Onan Rev. Current 94513 124  1.00
Rev. Current Cutout 3H2339A E1  3.50
W. U. Tel. Co. 41C Single Current  3.75
327668 For Sec-714N  95
G.E. Push Button Remote Relay  -CR2791-R-106CB  1.65
G.E. Pressure Switch 2976100-C2  95
Clare 400  95
Cannon Pfanger Relay 13672  2.50

Wide Selection of Electronic Components at WELLS

Tubes
Resistors
Condensers
Wire & Cable
Volume Controls
Co-ax Connectors
Relays
Rectifiers
Transformers and Chokes
Micro Switches and Toggle
Antennas and Accessories
Electronic Assemblies
Dial Light Assemblies

320 N. LA SALLE ST., DEPT. Y CHICAGO 10, ILL.

Printed in the U. S. A. By the Cuneo Press, Inc.
MALLORY CAPACITORS
Give Outstanding Service!

Every Mallory FP Capacitor is designed to perform consistently during more than 2000 hours of operation at a temperature of 85°C.

One reason why Mallory Capacitors operate so long at high temperatures is the unusual care taken in production to prevent contamination, which causes corrosion...shortens the life of ordinary capacitors.

Result: with the Mallory FP line you may service both radio and TV sets, without the need for buying special types for the high temperature jobs. Yet Mallory Capacitors cost no more!

You will find it pays to rely on the complete Mallory capacitor line...electrolytic, paper, ceramic and Mallory Plascap plastic tubulars.

See your Mallory Distributor, now. Remember, you pay no premium for Mallory Precision Quality!

The Amazing MALLORY PLASCAP®—The New Standard in Plastic Tubular Capacitors

- TRISEAL CONSTRUCTION. Sealed three ways...with moisture-free Mallotrol, tough outer plastic shell, exclusive Malloene!
- FASTITE LEADS. Permanently fastened...sealed with Malloene...unaffected by soldering-iron heat!
- DISTORTION-FREE WINDING. No flattened cartridges due to molding pressures...no failure due to "shorts"!
- TRU-CENTER CARTRIDGE. Cartridge centered every time...uniform insulation guaranteed at all points!

Your Mallory Distributor is ready to serve you!
THE QUALITY OF RCA TUBES IS UNQUESTIONED

Best Sellers

Most used ... by brand
and by type ... RCA kinescopes
are the fast-moving
profit makers

IN PICTURE TUBES...

The largest and most profitable replacement business in television picture tubes comes from the types used in most television receivers ... the Best Sellers.

RCA's types are Best Sellers. There are more of them in actual use in TV receivers than any other brand. Industry choice of these high-volume types reflects to your advantage. Inventory and stocking problems are simplified ... and you have the assurance of rapid, profitable turnover.

In addition, when you sell RCA kinescopes, you gain from customer confidence in the RCA brand ... solidly established by the proved performance of RCA kinescopes in millions of television receivers.

Remember, too, that the quality and dependability of RCA kinescopes mean fewer service failures and fewer costly call-backs. There is, therefore, more profit in every RCA kinescope you sell.

Always keep in touch with your RCA Tube Distributor.

RADIO CORPORATION of AMERICA
ELECTRON TUBES
HARRISON, N.J.