NOVEMBER 1953

RADIO — ELECTRONICS

LATEST IN TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK Ed tor

n this issue:

30¢

U. S. and CANADA

Wiring Up a High-Quality Phonograph Kit

(See page 4)

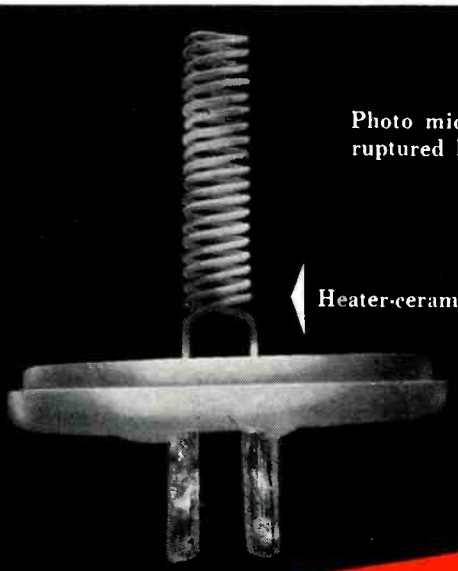
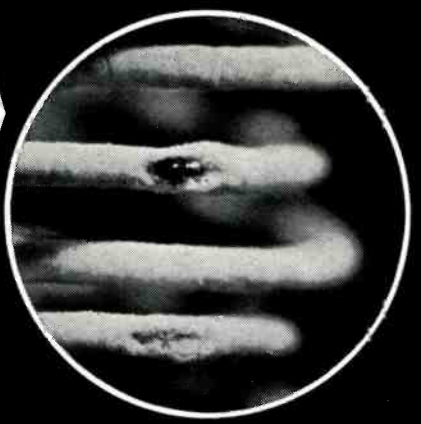


Photo micrograph of ruptured heater coating

Heater-ceramic assembly



DECIDE ON DU MONT

on the basis of...

Product Superiority

Exclusive construction of the Teletron Heater virtually eliminates heater-cathode shorts resulting from ruptured heater coating as shown above.

By accurately centering the heater helix within the cathode of the Bent-Gun, the Teletron heater-ceramic assembly avoids abrasion of the delicate heater coating against the cathode wall.

Only when you decide on Du Mont for your replacement needs, do you get this extra insurance against costly call-backs due to heater-cathode shorts.

FREE—For your copy of the 8th edition of the Picture Tube Data Chart send a postcard with your address and the name of this publication.

*TRADE MARK

REPLACEMENT SALES, CATHODE-RAY TUBE DIVISION • ALLEN B. Du MONT LABORATORIES, INC., CLIFTON, N. J.

ADVANCE! Raise your earning power—learn RADIO-TELEVISION-ELECTRONICS by SHOP-METHOD HOME TRAINING

GOOD JOBS AWAIT THE TRAINED RADIO-TV TECHNICIAN

There is a place for *you* in the great Radio-Television-Electronics industry when you are trained as National Schools will train you at home!

Trained technicians are in growing demand at good pay—in manufacturing, broadcasting, television, communications, radar, research laboratories, home Radio-TV service, and other branches of the field. National Schools Master Shop-Method Home Training, with newly added lessons and equipment, trains you in your spare time, right in your own home, for these fascinating opportunities. OUR METHOD IS PROVED BY THE SUCCESS OF NATIONAL SCHOOLS TRAINED MEN, ALL OVER THE WORLD, SINCE 1905.

EARN WHILE YOU LEARN

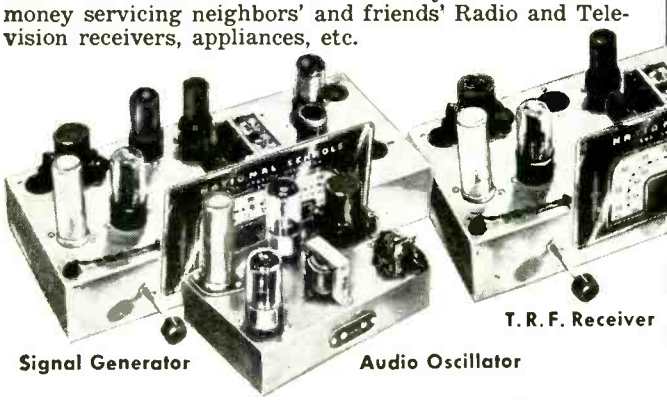
Many National students pay for all or part of their training with spare time earnings. We'll show you how you can do the same! Early in your training, you receive "Spare-time Work" Lessons which will enable you to earn extra money servicing neighbors' and friends' Radio and Television receivers, appliances, etc.

MASTER ALL PHASES!

Get Master Shop-Method Home Training from an Established Practical Resident School with its own Training Shops, Laboratories, Studios — almost 50 Years of Successful Experience in Training Ambitious Men.

We Bring National Schools To You!

Superheterodyne Receiver



T.R.F. Receiver

Signal Generator

Audio Oscillator

National Schools Training is All-Embracing

National Schools prepares you for your choice of many job opportunities. Thousands of home, portable, and auto radios are being sold daily—more than ever before. Television is sweeping the country, too. Co-axial cables are now bringing Television to more cities, towns, and farms every day! National Schools' *complete* training program qualifies you in all fields. Read this partial list of opportunities for trained technicians:

Business of Your Own • Broadcasting
Radio Manufacturing, Sales, Service • Telecasting
Television Manufacturing, Sales, Service
Laboratories: Installation, Maintenance of Electronic Equipment
Electrolysis, Call Systems
Garages: Auto Radio Sales, Service
Sound Systems and Telephone Companies, Engineering Firms
Theatre Sound Systems, Police Radio
And scores of other good jobs in many related fields.

TELEVISION TRAINING

You get a complete series of up-to-the-minute lessons covering all phases of repairing, servicing and construction. The same lesson texts used by resident students in our modern and complete Television broadcast studios, laboratories and classrooms!

FREE! RADIO-TV BOOK AND SAMPLE LESSON!

Send *today* for National Schools' new, illustrated Book of Opportunity in Radio-Television-Electronics, and an actual Sample Lesson. No cost—no obligation. Use the coupon now—we'll answer by return airmail.

This course also offered in Spanish and Portuguese

APPROVED FOR VETERANS AND NON-VETERANS
Check coupon below

Both Resident and Home Study Courses Offered!

LEARN BY DOING

You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA • ESTABLISHED 1905
IN CANADA: 193 E. HASTINGS STREET, VANCOUVER, B.C.

GET FACTS FASTEST! MAIL TO OFFICE NEAREST YOU!

(mail in envelope or paste on postal card)

NATIONAL SCHOOLS, Dept. RG-113

4000 S. Figueroa Street, Los Angeles 37, Calif. or **323 West Polk Street, Chicago 7, Ill.**

Send FREE Radio-TV Electronics book and FREE sample lesson. No obligation, no salesman will call.

NAME_____ BIRTHDAY_____ 19____

ADDRESS_____

CITY_____ ZONE____ STATE_____

☐ Check here if interested in Resident School Training at Los Angeles.

VETERANS: Give Date of Discharge_____

RADIO — ELECTRONICS

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

ON THE COVER (Story on page 53)
Jerome Kass, Associate Editor of RADIO-ELECTRONICS, in an early stage of wiring up his Heathkit record player kit.

Color original by Avery Slack

CONTENTS

NOVEMBER, 1953

MEMBER Audit Bureau of Circulations

Vol. XXIV, No. 11

RADIO-ELECTRONICS, November 1953, Vol. XXIV, No. 11. Published monthly at Erie Ave., F to G Sts., Philadelphia 32, Pa., Gernsback Publications, Inc., Entered as Second Class matter September 27, 1948, at the Post Office at Philadelphia, Pa., under the Act of March 3, 1879.
SUBSCRIPTION RATES: In U. S. and Canada, in U. S. possessions, Mexico, South and Central American countries, $3.50 for one year; $6.00 for two years; $8.00 for three years; single copies 30¢. All other foreign countries $4.50 a year, $8.00 for two years; $11.00 for three years.
EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 25 West Broadway, New York 7, N. Y. Telephone REctor 2-8630. Gernsback Publications, Inc. Hugo Gernsback, President; M. Harvey Gernsback, Vice-President; G. Aliquo, Secretary.
SUBSCRIPTIONS: Address correspondence to Radio-Electronics, Subscription Dept., Erie Avenue, F to G Sts., Philadelphia 32, Pa., or 25 West Broadway, New York 7, N. Y. When ordering a change please furnish an address stencil impression from a recent wrapper. Allow one month for change of address.
BRANCH ADVERTISING OFFICES: Chicago: 7522 North Sheridan Road, Tel. Rogers Park 4-8000. Los Angeles: Ralph W. Harker and Associates, 1127 Wilshire Blvd., Tel. MAdison 6-1271. San Francisco: Ralph W. Harker and Associates, 582 Market St., Tel. GArfield. 1-2481. FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., London E.C.4. Australia: McGill's Agency, Melbourne. France: Brentano's, Paris 2e. Belgium: Agence et Messageries de la Presse, Brussels. Holland: Trilectron, Heemstede. Greece: International Book & News Agency, Athens. So. Africa: Central News Agency, Ltd., Johannesburg; Capetown, Durban, Natal. Universal Book Agency, Johannesburg. Middle East: Steimatzky Middle East Agency, Jerusalem. India: Broadway News Centre, Dadar, Bombay #14. Pakistan: Paradise Book Stall, Karachi 3. POSTMASTER: If undeliverable send form 3578 to: RADIO-ELECTRONICS, 25 West Broadway, New York 7, N. Y. *Trademark registered U.S. Patent Office.

NOW... get EVERYTHING YOU NEED to prepare to earn REAL MONEY in TELEVISION

...one of America's BRIGHTEST Opportunity Fields

Enjoy highly interesting work ...and a wonderfully promising future

America's great billion dollar Television field now offers you a chance of a lifetime to get started toward a good job or your own profitable business. With so many new TV stations coming on the air, Television is expected to grow as never before! Millions of TV sets must be produced, tested, installed and serviced. And Television is only *one branch* of this vast opportunity field of Electronics—for which D.T.I.'s amazingly effective training prepares you.

Right in your own home you may now get one of today's most interesting . . . PRACTICAL WAYS to prepare for your start in TELEVISION, including Radio and Electronics. No previous experience or advanced education are needed—because D.T.I. brings you a 3-WAY COMBINATION method that speeds your understanding and progress. You (1) Learn from well illustrated lessons, you (2) Learn by Seeing from D.T.I.'s wonderfully effective home movies and (3) you Learn by Doing from electronic parts that provide the practical experience you need.

You get and KEEP the same type of basic electronic equipment used in our modern Chicago Training Laboratory. You get home training that includes the knowledge and experience gained from training thousands of students first hand. In other words, you get LABORATORY TYPE TRAINING . . . RIGHT IN YOUR OWN HOME. But why not get the whole exciting story. Mail coupon today.

If preferred, you can get ALL of your training in D.T.I.'s CHICAGO LABORATORY . . . one of the nation's finest. Write for details

EMPLOYMENT SERVICE

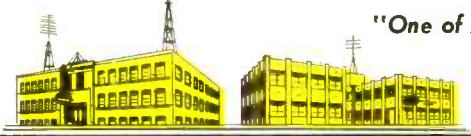
Get an honest-to-goodness EMPLOYMENT SERVICE to help you get a good job after graduating — or assistance in starting your OWN TV-RADIO SALES & SERVICE BUSINESS.

MILITARY SERVICE

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

EARN AS YOU LEARN

After you get part of D.T.I.'s training, with equipment at home, you may then, in your spare time, begin to earn real money servicing Radio and TV sets.

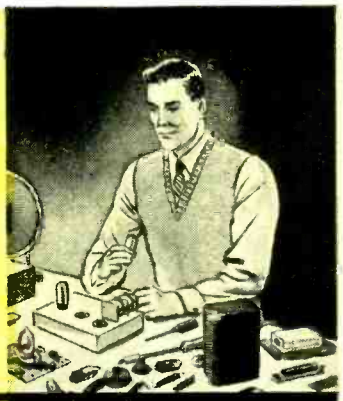


"One of America's Foremost Television Training Centers"
- Established 1931-

DeFOREST'S TRAINING, INC.
AFFILIATED WITH
DeVRY *Technical* INSTITUTE
CHICAGO 14, ILLINOIS

300 EXPERIMENTS

Build over 300 fascinating experiments from 16 BIG SHIPMENTS of Electronic-Radio parts which you KEEP. You build and operate Television circuits, Radio receiving circuits, a wireless microphone and many other major projects — all designed to provide outstanding practical experience at home.



HOME MOVIES

Thanks to this exclusive D.T.I. home training aid, many important Television-Radio fundamentals quickly become "movie clear." Now you can actually see electrons on the march and other "hidden actions" — a wonderful advantage that's almost like having a teacher in your home.

BUILD YOUR OWN TEST EQUIPMENT

As part of your home laboratory project you build and keep a quality 5-INCH oscilloscope and a jewel-bearing Multimeter. You will find this equipment ideal for helping you earn in your spare time while a student — and later when working full time in the field.

BUILD AND KEEP A BIG 21″ TV SET

For added practical experience, you build and keep this top quality 21 INCH TV Set that provides TV reception at its finest (D.T.I. offers another home training but without the TV set.)

89 WAYS TO EARN MONEY in TELEVISION • RADIO ELECTRONICS

SEND FOR FACTS TODAY!

DeFOREST'S TRAINING, INC., RE-11-J
2533 N. ASHLAND AVENUE,
CHICAGO 14, ILLINOIS

I would like your Opportunity Bulletin showing "89 Ways To Earn Money In Television-Radio-Electronics"; also, complete facts about the training opportunities made possible by your organization.

Name_____ Age_____

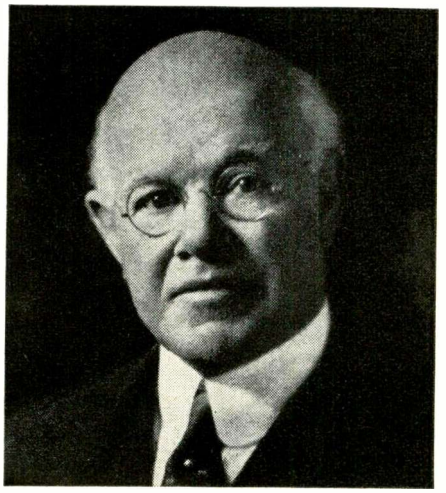
Address_____ Apt._____

City_____ Zone_____ State_____

THE RADIO MONTH

EDWARD JULIAN NALLY, the first president of the Radio Corporation of America, passed away on September 22 at the age of 94.

Mr. Nally in association with the Marconi Wireless and Telegraph Co.



Edward Julian Nally

arranged the opening of the first trans-Atlantic wireless telegraph service and established the first commercial wireless circuit between the U.S. and Japan and between the U.S. and Great Britain.

Although he retired in 1925, Mr. Nally remained a director of RCA, RCA Communications, and the National Broadcasting Co. until 1950.

SATELLITE SYSTEMS have become a matter of Congressional Record. Representative Bush, Pennsylvania, urged establishment of unattended satellite TV stations in communities too small for regular TV broadcast stations. He stated that Sylvania Electric Products has developed such a system and will propose it for FCC approval soon.

For the past year, Sylvania has been searching for a satisfactory method of making TV available to small, isolated communities, particularly those in hilly or mountainous areas. The unattended satellite stations can be built for a cost of about $15,000, and operated automatically with low power requirements and maintenance costs.

Satellite stations are better than booster stations, Rep. Bush stated, since they are not restricted to rebroadcasting the signals of a single mother station, and being locally controlled, are free to select programs of any station whose signal is available. The satellite stations would not create the interference booster stations cause.

Experimental satellite stations have been successfully operated in the high and low portions of the u.h.f. band—specifically on channels 22 and 82.

WOR-FM New York was surprised to learn that its quiz show, *Take a Number*, reportedly has been heard by a man in Antwerp, Belgium. The station noted that the Belgian listener even submitted a question to be used on the quiz show. He wrote that he would monitor his FM receiver every Friday night in the hope of hearing his question used.

COMPATIBLE COLOR television has made its debut on a country-wide basis. NBC has announced that the August 31 "Kukla, Fran, and Ollie" show was broadcast across the country in color and was received and seen in black and white on standard receivers.

Sylvester L. Weaver, vice-chairman of the NBC board, said the network has plans for regular commercial color telecasting to be started if the FCC approves. The color system was developed by RCA, of which NBC is a part. The RCA system is generally accepted as being synonymous with color standards filed with the FCC by the NTSC. (See Page 30).

Mr. Weaver emphasized that quantity production of color receivers cannot be achieved for many months after FCC approval. He estimated that color sets, with 14-inch picture screens, would cost between $800 and $1,000.

RADIO KITS constitute radio receiving sets within the meaning of the tax law, even though they are not assembled when sold. The Internal Revenue Service decision, in Revenue Ruling 167, was rendered in answer to a request as to whether the excise tax was applicable to the sale by a manufacturer of radio kits which contain all the necessary components for the assembly of a crystal radio receiving set, except antenna and ground wire, or for the assembly of a 1-tube radio receiver, except A and B batteries and antenna and ground wires.

IRS pointed out, however, that credit against tax due on the sale of such kits may be taken by the manufacturer of the kits for tax paid by the manufacturer of the tubes or other taxable components purchased and used in assembling the kits.

RADAR SPEED CHECK is proving effective. Sergeant William Hamil of the Rochester, N. Y. police said that motorists are using various odd devices, including tinfoil, steel marbles in their hub caps, and steel chains dragging behind their cars, in an effort to foul up the radar speed-clocking meters which in the last 14 months have obtained about 2,000 speeding convictions.

Sergeant Hamil said that Rochester motorists had not yet discovered anything to jam the device which registers almost instantaneously the speed of a car passing across its microwave beam and also makes a graph of the speed for permanent record.

A representative of the company manufacturing the radar speed timer said that the only way to jam the radar is to install in a car a transmitter using the same frequency (2,455 mc) as the radar apparatus, and then flip the sending switch as you pass the radar station.

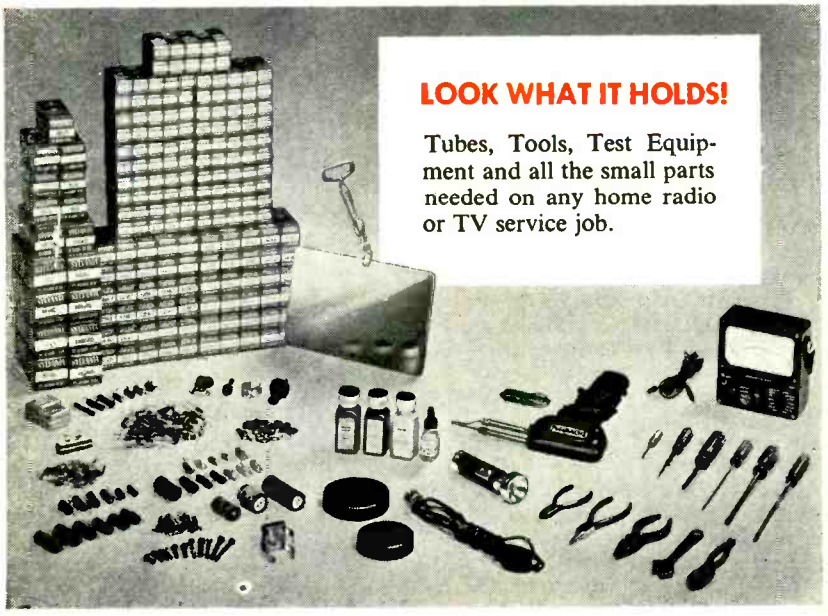
Incidentally, the transmitter might cost about $1,000 and would violate regulations of the FCC.

Servicemen! Here's Your Sylvania

T-N-T CHEST

(TUBE AND TOOL)

The Most Valuable Service Aid You've Ever Seen!



Talk about a useful servicing aid . . . this Sylvania T-N-T (Tube and Tool) Chest is really it! Carries more tubes, tools and parts than any chest on the market!

LOOK AT THESE FEATURES:

- Bass and fir plywood case
- Waterproof Du Pont Fabrikoid cover
- Holds 187 receiving tubes
- Lightweight folding aluminum tool and parts tray
- Unbreakable plastic handle
- Brass-plated hardware
- Room for mirror and ohmmeter
- It's a complete, portable service shop!

ACT NOW . . . Offer Limited!

This chest is now yours for only $5.00 and 30 Sylvania Premium Tokens. Offer good only between August 1st and November 15th. See your Sylvania Distributor who has these kits now.

Remember, you get 1 Sylvania Premium Token with every 25 receiving tubes or with every picture tube you buy.

SYLVANIA

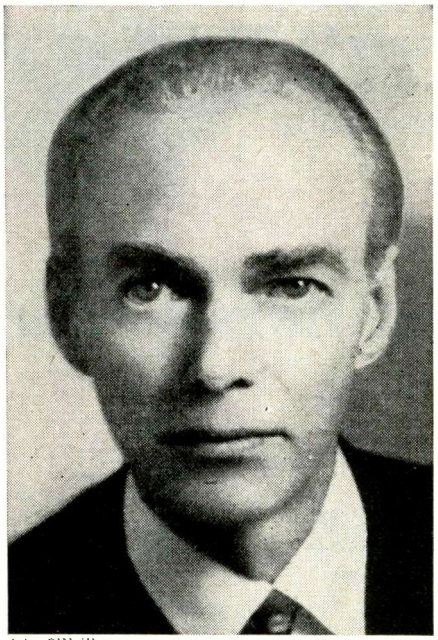
Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

LIGHTING · RADIO · ELECTRONICS · TELEVISION

In Canada: Sylvania Electric (Canada) Ltd.
University Tower Building, St. Catherine St., Montreal, P. Q.

JOHN JOSEPH O'NEILL, science editor of the *New York Herald Tribune*, died August 30, at the age of 64.

In 1937 he shared with four others the Pulitzer Prize in journalism for good reporting. An article written by O'Neill in 1940 was one of the first to inform the public of the successful release of atomic energy and its potentialities.



John O'Neill

Among his books were: "Enter Atomic Energy," "Almighty Atom, The Real Story of Atomic Energy," "Prodigal Genius: The Life of Nicola Tesla," and "Engineering the New Age."

THE IRE MEDAL OF HONOR, highest technical award of the radio engineering profession, was bestowed upon Dr. William L. Everitt for the year 1954. Dr. Everitt, renowned radio authority and dean of the College of Engineering, University of Illinois, was given the award "for his distinguished career as author, educator, and scientist; for his contributions in establishing electronics and communications as a major branch of electrical engineering; for his unselfish service to his country; for his leadership in the affairs of the IRE."

In 1940, Dr. Everitt became a member of the Communications Section of the National Defense Research Committee and during World War II served as director of operational research in the Office of the Chief Signal Officer. In 1950 he served as a member of the Senate Advisory Committee on Color Television.

GERMAN TELEVISION is seriously considering a new approach to video, the aim of which is to have all the advantages of sponsored TV and none of the annoyances.

Under the German proposal, early each evening there would be thirty or sixty minutes devoted to nothing but advertisements. After all the commercials were out of the way, the evening's regular programs would continue without further interruptions until sign-off time.

END

CREI prepares you quickly for success in

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

The future is in your hands!

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

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

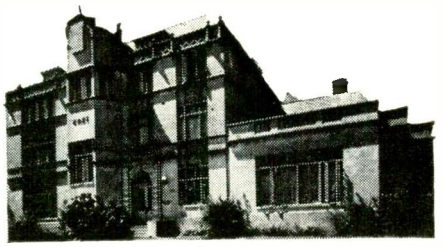
Since 1927, CREI has given thousands of ambitious young men the technical knowledge that leads to more money and security. The time-tested CREI procedure can help *you*, too—if you really want to be helped. CREI lessons are prepared by experts in easy-to-understand form. There is a course of instruction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

Industry Recognizes CREI Training.

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

Benefits Felt Right Away.

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



CREI also offers Resident Instruction

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

INFORMATION FOR VETERANS

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

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

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

CAPITOL RADIO ENGINEERING INSTITUTE

An Accredited Technical Institute • Founded in 1927

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

MAIL COUPON TODAY

CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 1411, 3224 16th St., N.W., Washington 10, D.C.

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

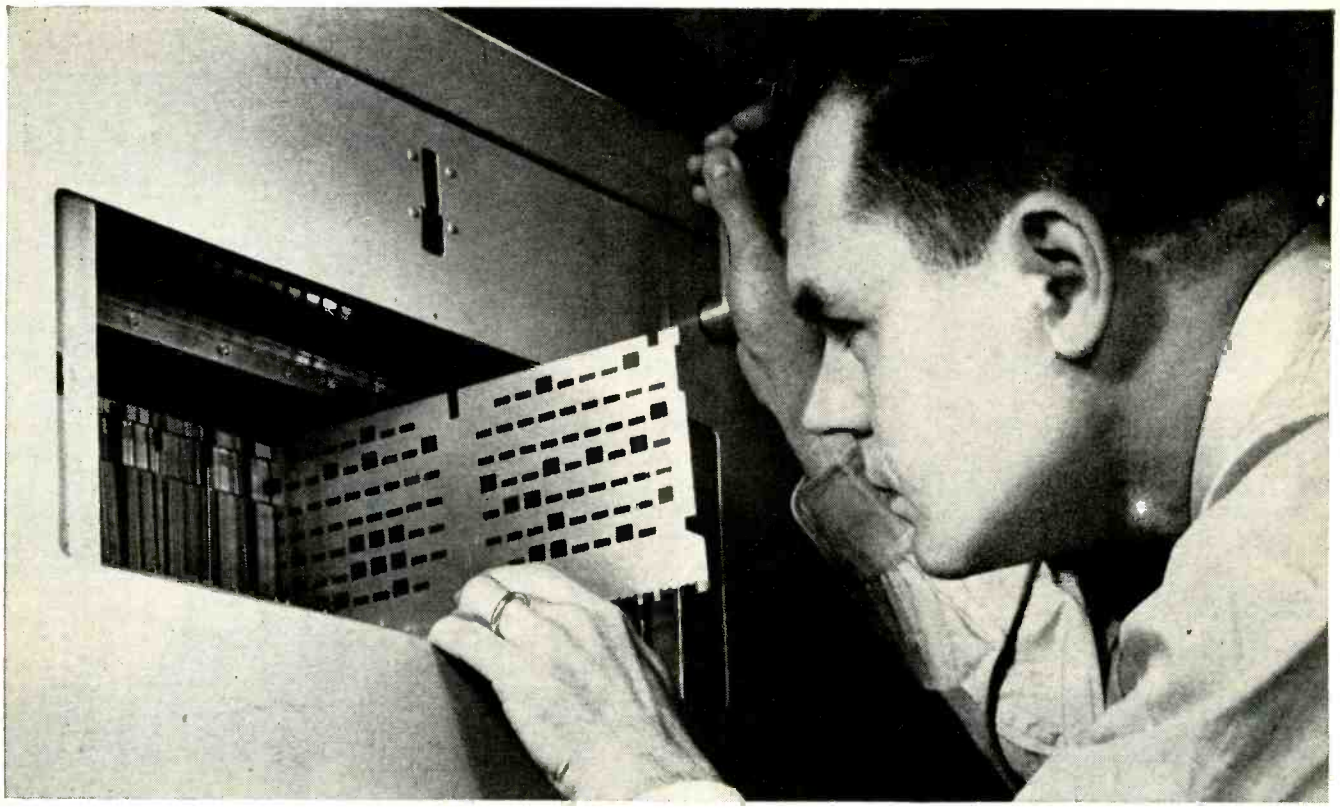
CHECK FIELD OF GREATEST INTEREST
- ☐ TV, FM & Advanced AM Servicing
- ☐ Practical Radio Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Television Engineering
- ☐ Aeronautical Radio Engineering

Name.....

Street.....

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

Check—☐ Residence School ☐ Veteran



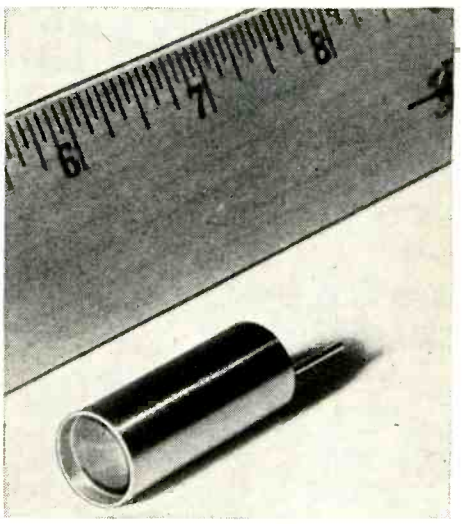
Checking perforated metal card in Bell's new "card file" which uses Phototransistors to help route Long Distance telephone calls along the best routes. If the first voice-way is in use, a "detour" is swiftly found. The equipment is known in telephony as a "card translator."

CARDS FOR CONVERSATION

To find out how to route Long Distance calls a dial system needs lots of information—fast. To provide it Bell Laboratories engineers developed a new kind of card file—one that dial systems can read.

Punched holes on metal cards tell how calls should be handled. When a call arrives the dial system "asks" the "card file" how to proceed to a particular area. Instantly the appropriate instruction card is displaced so that its pattern of holes is projected by light beams on a bank of Phototransistors. In a flash the Phototransistors signal switches to set up the best connection. Cards are quickly changed when new instructions are needed.

The "card file" will have its widest use in speeding Long Distance calls that are now dialed by a telephone operator and may one day be dialed by you personally. It is another example of how Bell Telephone Laboratories helps telephony to grow, as costs are kept down.



New Phototransistor unit. Light entering the cylinder is focused by the lens on a piece of germanium that responds by generating current. Like the Transistor, the Phototransistor was invented in Bell Telephone Laboratories.

BAROMETER of the PARTS INDUSTRY

During September, 61 of the leading 400 manufacturers of Radio-Electronic-Television parts and equipment made changes in their lines. There was a decrease in "change activity" as compared to August.

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

	No. of Manufacturers	
	August	September
Increased prices	32	19
Decreased prices	16	9

	No. of Products	
	August	September
Increased prices	350	789
Decreased prices	65	40

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

Product Group	Increased Prices		Decreased Prices		New Products		Discontinued Products	
	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products
Antennas & Access.	5	11**	2	6**	11	80**	4	19**
Capacitors	1	1*	0	0	1	2**	1	4*
Controls & Resistors	0	0**	0	0	1	21**	0	0**
Sound & Audio	7	70**	2	6**	16	50**	9	25**
Test Equipment	1	4**	0	0	5	44*	3	16*
Transformer	2	161*	0	0**	0	0**	1	8*
Tubes	5	542*	4	15*	7	147*	3	38**
Wire & Cable	0	0	1	13*	0	0**	1	1**

* Increase over August
** Decrease from August

* Increase over August
** Decrease from August

Comment: For the first time in several months, a marked decrease in the number of manufacturers reporting changes in their line is noted. Activity among Sound & Audio manufacturers has declined since last month, while activity among Tube manufacturers has increased for the same period.

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

Merchandising and Promotion

Alliance Manufacturing Co., Alliance, Ohio, is under way with what it calls the biggest fall advertising-merchandising program in the history of any television accessory. According to John Bentia, Alliance vice-president, the campaign features the introduction of two new Alliance Tenna-Rotors.

I.D.E.A., Inc., Indianapolis, designed a colorful counter display rack for use

by distributors of its Regency boosters. The brilliantly striped display asks the question, "How many Regency boosters do you need today?"

Westinghouse Electric Electronic Tube Division, Elmira, N. Y., launched a new sales promotion campaign designed to acquaint the public with the potential of u.h.f.

Cannon Electric Co., Los Angeles, is featuring a new combination package display for its XL-type straight plug socket contacts.

General Electric Tube Department is pushing a TV picture tube promotion package for service technicians, to tie in with G-E's national advertising for tubes. Window streamers, a display mirror, direct-mail pieces, and newspaper mats are being used.

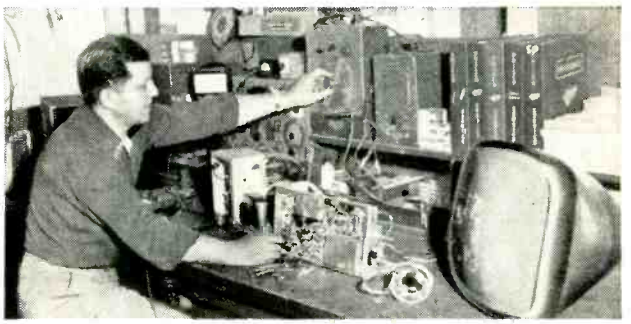
Vaco Products Co., Chicago, is offering its personalized X-4 screwdriver set in an effective gift package. Manufacturers, distributors, or others may imprint their names on the handle of the screwdriver and on the plastic case and use the kit as a Christmas gift or premium.

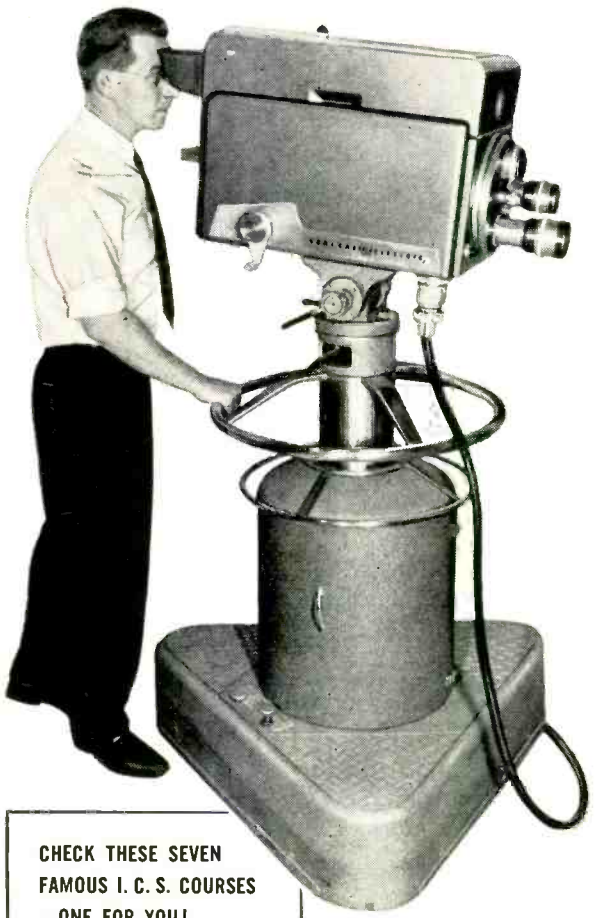
Electronic Instrument Co., Inc., Brooklyn, N. Y., designed a new decal which radio and TV service technicians may attach to windows or vehicles.

Stromberg-Carlson, Rochester, N. Y., is running a series of institutional ads in leading business publications. Each ad will feature one product of the

Quick TV Success can be yours

if you act now!





- ***Prepare now for the new Radio-TV-Electronics boom. Get in on VHF and UHF . . . aviation and mobile radio . . . color TV . . . binaural sound! The International Correspondence Schools can help you!***

If you've ever thought about Radio or Television as a career . . . if you have the interest, but not the training . . . if you're waiting for a good time to start . . . NOW'S THE TIME!

No matter what your previous background, I.C.S. can help you. If Radio-TV servicing is your hobby, I.C.S. can make it your own profitable business. If you're interested in the new developments in Electronics, I.C.S. can give you the basic courses of training you need. If you have the job but want faster progress, I.C.S. can qualify you for promotions and pay raises.

I.C.S. training is *success-proved* training. Hundreds of I.C.S. graduates hold top jobs with top firms like R.C.A., G.E., DUMONT, I.T.&T. Hundreds of others have high ratings in military and civil service. Still others have successful businesses of their own.

With I.C.S., you get the rock-bottom basics and theory as well as the all-important bench practice and experimentation. You learn in your spare time—no interference with business or social life. You set your own pace—progress as rapidly as you wish.

Free career guidance: Send today for the two free success books, the 36-page "How to Succeed" and the informative catalog on the course you check below. No obligation. Just mark and mail the coupon. With so much at stake, you owe it to yourself to act—*and act fast!*

CHECK THESE SEVEN FAMOUS I. C. S. COURSES —ONE FOR YOU!

- ☐ **PRACTICAL RADIO-TELEVISION ENGINEERING**—Foundation course for radio-television career. Basic principles plus advanced training. Radio. Sound. TV.
- ☐ **TELEVISION TECHNICIAN**—To qualify you for high-level technical positions in television. Camera, studio, transmitter techniques. Manufacture, sale and installation of TV equipment.
- ☐ **TELEVISION RECEIVER SERVICING**—Installation, servicing, conversion. Dealership. For the man who knows about radio and wants TV training.
- ☐ **RADIO & TELEVISION SERVICING**—Designed to start you repairing, installing and servicing radio and television receivers soon after starting the course.
- ☐ **RADIO & TELEVISION SERVICING WITH TRAINING EQUIPMENT**—Same as above but with addition of high-grade radio servicing equipment and tools.
- ☐ **RADIO OPERATING COURSE**—Special course to help you pass the Government examination for operator's licenses. Code. TV. FM. Radio regulations.
- ☐ **INDUSTRIAL ELECTRONICS**—Broad, solid background course devoted to the electron tube and to its many applications.

INTERNATIONAL CORRESPONDENCE SCHOOLS

ICS

BOX 2881-J, SCRANTON 9, PENNA.

Without cost or obligation, send me "HOW to SUCCEED" and the booklet about the course BEFORE which I have marked X:

ART
- ☐ Commercial Art
- ☐ Magazine and Book Illustrating
- ☐ Cartooning
- ☐ Show Card and Sign Lettering
- ☐ Fashion Illustrating

AUTOMOTIVE
- ☐ Automobile, Mechanic
- ☐ Auto-Elec. Technician
- ☐ Auto Body Rebuilding and Refinishing
- ☐ Diesel—Gas Engines

AVIATION
- ☐ Aeronautical Engineering Jr.
- ☐ Aircraft Engine Mechanic
- ☐ Airplane Drafting

BUILDING
- ☐ Architecture
- ☐ Arch. Drafting
- ☐ Building Contractor
- ☐ Estimating
- ☐ Carpenter and Mill Work
- ☐ Carpenter Foreman
- ☐ Reading Blueprints
- ☐ House Planning
- ☐ Plumbing
- ☐ Heating
- ☐ Steam Fitting
- ☐ Air Conditioning
- ☐ Electrician

BUSINESS
- ☐ Business Administration
- ☐ Certified Public Accountant
- ☐ Accounting
- ☐ Bookkeeping
- ☐ Stenography and Typing
- ☐ Secretarial
- ☐ Federal Tax
- ☐ Business Correspondence
- ☐ Personnel and Labor Relations
- ☐ Advertising
- ☐ Retail Business Management
- ☐ Managing Small Business
- ☐ Sales Management
- ☐ Salesmanship
- ☐ Traffic Management

CHEMISTRY
- ☐ Chemical Engineering
- ☐ Chemistry
- ☐ Analytical Chemistry
- ☐ Petroleum—Nat'l Gas
- ☐ Pulp and Paper Making
- ☐ Plastics

CIVIL, STRUCTURAL ENGINEERING
- ☐ Civil Engineering
- ☐ Structural Engineering
- ☐ Surveying and Mapping
- ☐ Structural Drafting
- ☐ Highway Engineering
- ☐ Reading Blueprints
- ☐ Concrete Construction
- ☐ Sanitary Engineering

DRAFTING
- ☐ Aircraft Drafting
- ☐ Architectural Drafting
- ☐ Electrical Drafting
- ☐ Mechanical Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Mine Surveying and Drafting

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Electrician
- ☐ Electrical Maintenance
- ☐ Electrical Drafting
- ☐ Electric Power and Light
- ☐ Lineman

HIGH SCHOOL
- ☐ High School Subjects
- ☐ College Preparatory
- ☐ Mathematics
- ☐ Commercial
- ☐ Good English

MECHANICAL AND SHOP
- ☐ Mechanical Engineering
- ☐ Industrial Engineering
- ☐ Industrial Supervision
- ☐ Foremanship
- ☐ Mechanical Drafting
- ☐ Machine Design-Drafting
- ☐ Machine Shop Practice
- ☐ Tool Design
- ☐ Industrial Instrumentation
- ☐ Machine Shop Inspection
- ☐ Reading Blueprints
- ☐ Toolmaking
- ☐ Gas—Electric Welding
- ☐ Heat Treatment—Metallurgy
- ☐ Sheet Metal Work
- ☐ Sheet Metal Pattern Drafting
- ☐ Refrigeration

POWER
- ☐ Combustion Engineering
- ☐ Diesel—Electric
- ☐ Electric Light and Power
- ☐ Stationary Steam Engineering
- ☐ Stationary Fireman

RADIO TELEVISION, COMMUNICATIONS
- ☐ General Radio
- ☐ Radio Operation
- ☐ Radio Servicing—FM
- ☐ Television
- ☐ Electronics
- ☐ Telephone Work

RAILROAD
- ☐ Locomotive Engineer
- ☐ Diesel Locomotive
- ☐ Air Brakes ☐ Car Inspector
- ☐ Railroad Administration

TEXTILE
- ☐ Textile Engineering
- ☐ Cotton Manufacture
- ☐ Rayon Manufacture
- ☐ Woolen Manufacture
- ☐ Loom Fixing
- ☐ Finishing and Dyeing
- ☐ Textile Designing

YEAR OF THE SIX MILLIONTH STUDENT

Name_____ Age_____ Home Address_____

City_____ Zone_____ State_____ Working Hours_____ A.M. to_____ P.M.

Occupation_____

Special tuition rates to members of the U. S. Armed Forces. Canadian residents send coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada.

SPEEDS SERVICE—MAKES MONEY—PLEASES CUSTOMERS

How'd you like to know what's wrong with a customer's TV receiver *before you make your service call?* You do with the new RAYTHEON TV SERVICE SAVER plan.

Here's how this wonderful new Raytheon servicing method works:

Both you and your customer have booklets in which are photographs showing 40 different picture conditions that may occur on the screen of a defective TV receiver. From 90 to 95% of all the troubles that may develop in a TV receiver are covered by these pictures. Illustrations are numbered and when a set falters, the customer simply finds the picture in the booklet that matches the condition on the screen and then calls you and tells you what number it is, and which of 5 sound conditions exist.

Your booklet and a wall chart which you can place near your phone show the same set of numbered picture patterns, and in addition the booklet explains exactly what tubes, components or circuits may be causing the trouble and suggests what and where to test.

This pre-call knowledge of what ails a receiver helps you to greater profit in three ways: (1) You can go on a job with complete technical information about the required repair; (2) You can go on the job with all necessary parts and tubes; (3) You can clean up nuisance calls and avoid many needless call-backs by telephone. Then, too, it means satisfied customers — customers who see you go right to the root of the trouble and make repairs quickly and expertly.

Be sure to ask your Raytheon Tube Distributor how you can get in on this exclusive servicing asset — the RAYTHEON TV SERVICE SAVER plan. Act now, and be the first in your locality.

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

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

RAYTHEON MAKES ALL THESE

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

Pre-sold to Millions!

Custom Music Ensemble

G-E DUAL COAXIAL SPEAKER
Model A1-400

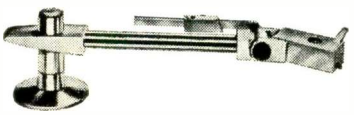
New approach to coaxial speaker design—high sensitivity at low cost. Exceptional balance between speakers with G-E Acoustic Balancer. Newly developed Pressure Equalizer . . . a wavefront shaping plug . . . provides smooth tweeter response.

G-E POWER AMPLIFIER
Model A1-300

A medium power, compact amplifier designed to provide needed speaker power. Essential element in the new General Electric "Custom Music" Ensemble. Delivers high-fidelity performance at very low cost.

G-E PREAMPLIFIER-CONTROL UNIT
Model A1-200

Combines functions of equalized preamplifier plus adjustable record compensation, program input selection, tone controls and volume control. Matching unit for the "Custom Music" amplifier. Self-powered for use with any installation.

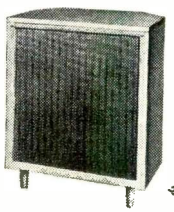


G-E *DELUXE* TONE ARMS
A1-500 (12″) **A1-501 (16″)**

For home or broadcast station use. Compatible with the exceptional quality of G-E cartridges. Calibrated stylus pressure adjustment . . . 4 to 14 grams. They were developed to improve record reproduction in every installation.

G-E SPEAKER ENCLOSURE
Model A1-406 (6 cu. ft.)

Attractive corner or wall cabinet in hand-rubbed blond or mahogany veneers. "Distributed port" design provides full low frequency response. Tonal range with G-E Coaxial Speaker—40 to 15,000 cycles.



1878 75 1953 YEARS OF ELECTRICAL PROGRESS

FOR SUPERIOR PERFORMANCE...
LOW COST...MINIMUM SERVICE...
INSTALLATION ECONOMY!

● Through the pages of nine top consumer magazines...in display rooms...on FM broadcasts...and at shows millions are discovering —indicating a preference for—the unique features of a G-E Custom Music Ensemble. Here is the single package of *matched high-fidelity equipment* you need to expand your audio business, assure satisfied customers. Get in tune today with the growing popularity of custom audio installations...add to your net profit ...with complete General Electric equipment!

Individual components or the complete ensemble now available! Call a local G-E distributor or write for information.

SEND FOR COMPLETE INFORMATION

General Electric Company, Section 45113
Electronics Park, Syracuse, N. Y.

Please send me specifications and other data on the new G-E Custom Music Ensemble.

NAME.....

ADDRESS.....

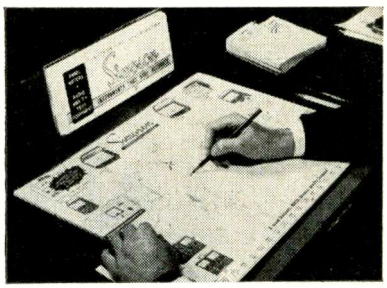
CITY.....STATE.....

You can put your confidence in—

GENERAL ELECTRIC

company's several divisions, explaining how this product contributes to the advancement of communications.

Simpson Electric Co., Chicago, devised a new king-size "doodle pad." Printed in two colors, the pads measure



17 x 22 inches. They are being distributed to Simpson customers by the company's representatives.

Production and Sales

RETMA reported that 269,622,417 receiving tubes and 5,831,271 cathode-ray tubes were sold by manufacturers during the first seven months of 1953. The association also reported the manufacture of 4,150,525 TV sets and 7,941,001 radio sets for the same period. TV output for this period set a new record and radio production was nearly 2,000,000 above the first seven months of 1952.

Business Briefs

. . . The RCA Tube Department, Harrison, N. J., has made two components for use with 90-degree, 27-inch TV picture tubes available to TV service technicians for replacement purposes. They are a deflection yoke (219D1) and a horizontal output and high-voltage transformer 235T1.

. . . General Electric, Syracuse, N. Y., has begun production on new all-welded metal hermetically sealed junction transistors. The new transistors have essentially infinite life expectancy and power ratings up to three times those of any previously announced transistors. Pilot production is now under way at the General Electric plant at Electronics Park. Engineers there are also engaged in the development of a small transistorized portable radio.

. . . United Motors Service Division of General Motors, Detroit, is now marketing its u.h.f. and v.h.f. antennas through electronics parts distributors. The line consists of a dual-V antenna, bow tie, bow tie with reflector, conical, two-bay conical, four-bay conical, u.h.f. corner reflector, u.h.f rhombic and indoor antenna.

. . . The Board of Directors of the Radio Parts & Electronic Equipment Shows, Inc., voted to allocate $15,000 to match a similar amount already provided by NEDA to sponsor a comprehensive educational program for electronic parts distributors through a series of seminars in centrally located cities throughout the country.

. . . Raytheon Manufacturing Co., Waltham, Mass., won the 1953 engineering award of the Society of Hearing Aid Audiologists for its achievement in transistor design and production.

. . . Scott Radio Laboratories' president John S. Meck asked the Federal Trade Commission to provide a standard for high-fidelity performance and to take steps to protect the public from pseudo products. He urged that the term "high-fidelity" be used only for bona fide high-fidelity equipment.

. . . RETMA executive vice-president James D. Secrest, in a talk before the Radio and TV Service Clinic and Electronics Fair in Fort Worth, Texas, said that both TV sets and servicing were much better today than they were a few years ago.

. . . Pioneer Electronics Corp., Santa Monica, Calif., conducted a survey which indicated that the Western market would have upward of 4,000,000 TV sets and a picture-tube replacement business of about 1,000,000 annually within a few years. The company is preparing for production of 1,000 picture tubes per day.

. . . Ampex Corp. was selected as the new name of Ampex Electric Corp., Redwood City, Calif.

. . . Radio City Products, New York City, introduced a plan whereby its distributors would be able to finance carrying a sufficiently large stock of its test equipment.

. . . Sylvania Electric Products, announced the production of its 5,000,000th TV picture tube by its two tube plants in Seneca Falls, N. Y. and Ottawa, Ohio.

. . . Erie Resistor Corp., Erie, Pa., developed a new method for producing copper-foil printed circuits. It involves embossing copper foil in laminated bakelite sheets.

. . . Radio Apparatus Corp. states that its *Monitoradio* two-way communications equipment is being used in the 44-vehicle General Motors "Parade of Progress" caravan touring the nation.

. . . Transvision, Inc., New Rochelle, N. Y., is now building coin-operated TV sets for hotel use.

New Plants and Expansions

Audio-Master Corp. moved to larger quarters at 17 E. 45th St., New York City.

Berlant Associates, Los Angeles, Calif., manufacturer of tape recorders, completed an extensive expansion and renovation program which more than doubles existing floor space.

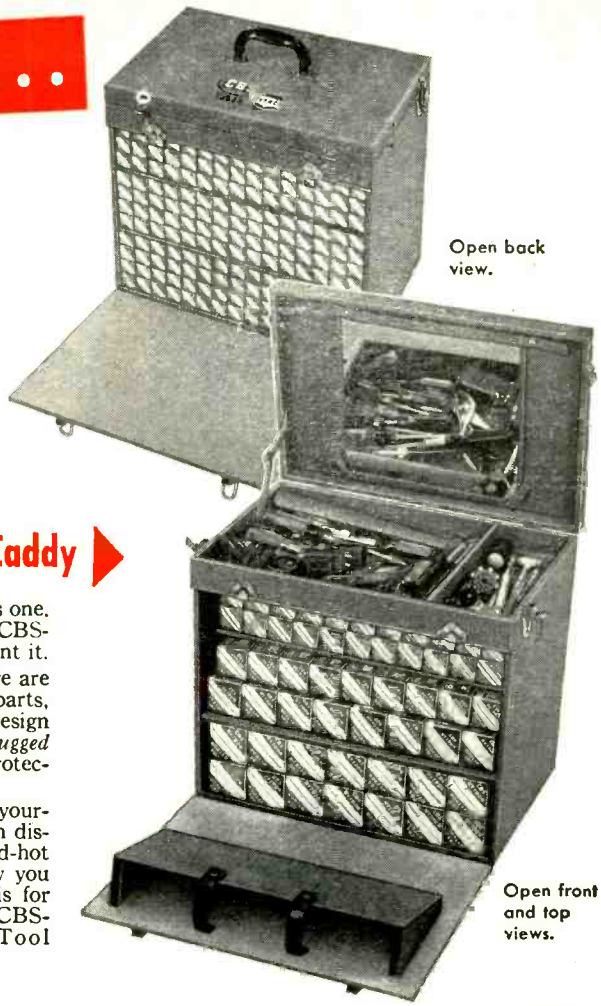
Bradford Components, Inc., a new electronic component manufacturing firm, was formed with headquarters in Bradford, Pa. The new company is headed by F. G. Schermerhorn, formerly with Aerovox and Speer Resistor Corp. The company will specialize in wire-wound resistors, precision coils, and subassemblies of all types.

General Electric expects to increase production of its aluminized TV tubes by 50% with a multi-million-dollar retooling project now under way at its Buffalo and Syracuse plants.

Simpson Electric Co., Chicago, has doubled its production facilities within the past year, following the expansion of its Lac du Flambeau, Wis., plant and the opening of a new plant adjacent to the Chicago plant. END

2 NEW SERVICE AIDS . . .

DESIGNED BY AND FOR YOU!



Open back view.

Open front and top views.

New CBS-HYTRON Tube-and-Tool Caddy

Another Tube Caddy? Yes, but *you* service-dealers helped us design this one. Helped us throw out a dozen almost-right designs. Stayed with us until the CBS-Hytron Tube-and-Tool Caddy became *your* Caddy. Built the way *you* want it.

Your new Caddy has literally dozens of features . . . many unique. Here are only a few: *Roomy* . . . holds 218 tubes! Also all your necessary tools, small parts, volt-ohmmeter, flashlight, and reference data. *Compact* . . . functional design wastes not one inch of space. *Accessible* . . . everything in sight and reach. *Rugged* . . . strong, tip-proof — used safely as seat. *Test Mirror* . . . reversible for protection — mounted in cover supported by adjustable friction hinge.

Sorry, there's just not enough space to tell all. But *see* your new Caddy yourself at your CBS-Hytron distributor's. He has a red-hot deal for you. He'll show you how *amazingly easy* it is for you to own this unique CBS-Hytron Tube-and-Tool Caddy. See him today.

New CBS-HYTRON Twin Pin Straightener

Ever wished you had a combination 7-Pin and 9-Pin Straightener? One that was handy, compact, light? But also a precision job, just like CBS-Hytron's original 7-Pin and 9-Pin Straighteners?

Here it is: The new CBS-Hytron Twin Pin Straightener, SH79. Same life-time, wear-and-corrosion-resistant steel dies. Same individually drilled, precision pin-circle holes. Same absence of guide-posts, permitting that final touch of sidewise straightening. The "Twin" is also roll-proof.

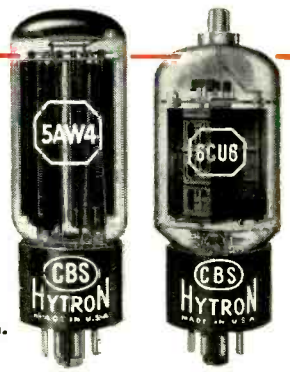
And the Twin is only 98¢ net. Get at least two . . . for pocket, tool kit, bench. Call your CBS-Hytron distributor today. Yes, he still has the famous individual CBS-Hytron 7-Pin and 9-Pin Straighteners at only 65¢ each net. Get them, too.

CUTTING YOUR CALL-BACKS WITH CBS-HYTRON CTS-RATED* 5AW4 and 6CU6?

They're the most talked-about tubes in TV today. CBS-Hytron CTS-Rated 5AW4 and 6CU6 are both rated for dependable *C*ontinuous *T*elevision *S*ervice. Heavy-duty work horses, they replace the 5U4G and 6BQ6GT respectively.

Brand new designs, not just improved tubes, the 5AW4 and 6CU6 have big safety factors. Give you long . . . long trouble-free life. Loaf in those hard-working, heavily loaded rectifier and horizontal amplifier sockets . . . even in 21-inch jobs.

Start slashing your call-backs with these tubes right now. 5AW4 and 6CU6 are available only from your CBS-Hytron distributor. See him today. Ask for complete 5AW4 and 6CU6 data. Or write direct. Above all, don't let another day slip by without trying these wonderful, new CBS-Hytron CTS-Rated tubes.



*Rated for Continuous Television Service

P. S. Yes, more CBS-Hytron CTS-Rated tubes are coming. Watch for them.

CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

A MEMBER OF THE CBS FAMILY: CBS Radio • CBS Television • Columbia Records, Inc. CBS Laboratories • CBS-Columbia, Inc. • and CBS-Hytron

RECEIVING TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

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

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

Practice Broadcasting with Equipment I Send

As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience putting a station "on the air," performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build.

Practice Servicing with Equipment I Send

Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester which you use to help fix sets while training. Many students make $10, $15 a week extra fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build.

Television is Growing Fast Making New Jobs, Prosperity

More than 25 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets. About 200 television stations on the air with hundreds more being built. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity get started now learning Radio-Television at home in spare time. Cut out and mail postage free card. J. E. Smith, President, National Radio Institute, Washington, D. C. OUR 40TH YEAR.

AVAILABLE TO VETERANS UNDER G.I. BILL

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

CUT OUT AND MAIL THIS CARD NOW

Sample Lesson & 64-Page Book

Both FREE

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

NO STAMP NEEDED! WE PAY POSTAGE

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

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

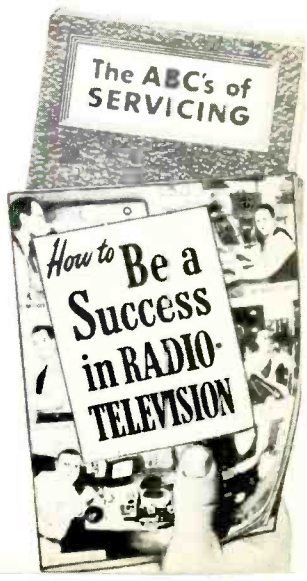
NAME ..... AGE .....

ADDRESS .....

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

VETS write in date of discharge .....

B C D E F G



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

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

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

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Then add Television. Television Broadcast Stations extend from coast to coast now with over 25 million Television sets already in use. There are channels for 1,800 more Television Stations. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc. is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

NRI Training Leads to Jobs Like These

BROADCASTING
Chief Technician
Chief Operator
Power Monitor
Recording Operator
Remote Control Operator

SERVICING
Home and Auto Radios
P. A. Systems
Television Receivers
Electronic Controls
FM Radios

IN RADIO PLANTS
Design Assistant
Transmitter Design Technician
Service Manager
Tester
Serviceman
Research Assistant

SHIP AND HARBOR RADIO
Chief Operator
Assistant Operator
Radiotelephone Operator

GOVERNMENT RADIO
Operator in Army, Navy, Marine Corps, Coast Guard
Forestry Service Dispatcher
Airways Radio Operator

AVIATION RADIO
Plane Radio Operator
Transmitter Technician
Receiver Technician
Airport Transmitter Operator

TELEVISION
Pick-up Operator
Voice Transmitter Operator
Television Technician
Remote Control Operator
Service and Maintenance Technician

POLICE RADIO
Transmitter Operator
Receiver Serviceman

My Training is Up-to-Date You Learn by Practicing

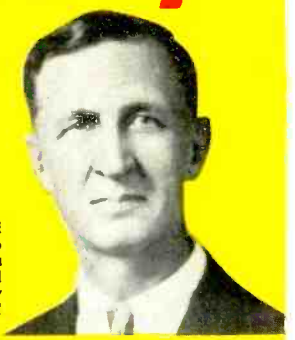
Get the benefit of my 40 years experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other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

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

Find Out About the Tested Way to Better Pay

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

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



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

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

I TRAINED THESE MEN

Handicapped but Successful
"I am now Chief Engineer at WHAW. My left hand is off at the wrist. A man can do . . . if he wants to." R. J. Bailey, Weston, W. Va.

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

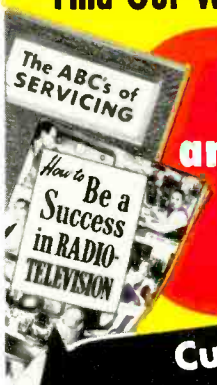
Control Operator, Station WEAN
"I received my license and worked on ships. Now with WEAN as control operator. NRI course is complete." R. Arnold, Rumford, R. I.

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

Has Growing Business
"Am becoming expert Teletrician as well as Radiotrician. Without your course this would be impossible." P. Brogan, Louisville, Ky.

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

Find Out What RADIO-TV Offers You



SAMPLE LESSON and 64-PAGE BOOK Both FREE

Cut out and mail postage-free card today!

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

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

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE

16th and U Sts., N.W.

Washington 9, D. C.

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

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

Do You Want Your Own Business?

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

NEW HOME OF ALLIED RADIO

ultra-modern facilities **TO SERVE YOU BEST**

FREE!

get your value-packed 1954 ALLIED 268-PAGE CATALOG

the only COMPLETE catalog for everything in TV, Radio and Industrial Electronics

The World's Largest Stocks

- TV and Radio Parts
- Test Instruments
- High-Fidelity Equipment
- Custom TV Chassis
- AM, FM Tuners and Radios
- Recorders and Supplies
- P. A. Systems, Accessories
- Amateur Station Gear
- Builders' Kits, Supplies
- Equipment for Industry

Fastest Service in Electronic Supply

Send for it today!

You'll want the *one* complete Buying Guide to *Everything in Electronics*—268 pages packed with the world's largest selection of quality equipment at lowest, money-saving prices. See all the latest releases in custom TV chassis, TV antennas and accessories; AM and FM tuners and radios; *everything* in High-Fidelity custom components; latest P.A. Systems and accessories; recorders and supplies; Amateur receivers, transmitters and station gear; specialized industrial electronic equipment; test instruments; builders' kits; huge listings of parts, tubes, tools, books —your choice of the world's *most complete stocks* of quality equipment. ALLIED gives you *every* buying advantage: speedy shipment, expert personal help, lowest prices, liberal terms, assured satisfaction. Get the 1954 ALLIED Catalog. Keep it handy—and save time and money. Send for your FREE copy today.

SAVE ON EVERYTHING IN ELECTRONICS

SEND FOR THE LEADING ELECTRONIC BUYING GUIDE free

ALLIED RADIO

World's Largest Electronic Supply House

EASY-PAY TERMS

Use ALLIED'S liberal Easy Payment Plan—anly 10% down, 12 months to pay—no carrying charge if you pay in 60 days. Available on Hi-Fi and P. A. units, recorders, TV chassis, test instruments, Amateur gear, etc.

TV and HI-FI SPECIALISTS

To keep up with developments in High-Fidelity and TV, look to ALLIED. Count on us for *all* the latest releases and largest stocks of equipment in these important fields. If it's anything in High-Fidelity or Television—we have it *in stock!*

ALLIED RADIO CORP., Dept. 2-L-3
100 N. Western Ave., Chicago 80, Illinois

☐ Send FREE 268-Page 1954 ALLIED Catalog.

*Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

CHANNEL MASTER

introduces a

basically *new type* of VHF antenna

CHAMPION*

the highest gain all-channel VHF antenna ever developed!

Featuring the unique new "Tri-Pole"

TRIPLE-POWERED DIPOLE

The "Tri-Pole" is a new antenna system in which the Low Band folded dipole also functions as three folded dipoles tied together in phase on the High Band. This is the heart of the Champion, the secret of its phenomenal performance on all 12 VHF channels.

The CHAMPION is another great development of the world famous Channel Master laboratories.

*Pat. Pending

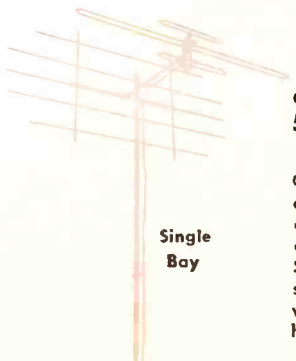
the CHAMPION *is the most sensitive all-channel VHF antenna ever designed!*

Stacked *CHAMPION* provides:
11-13 D B High Band gain
6½-7½ D B Low Band gain

Here is a totally NEW kind of antenna, completely different — in principal and performance — from any VHF antenna you've ever seen! Since the lifting of the TV freeze means a gradual disappearance of the single-channel VHF area, the VHF antenna of the future will be a *multi-channel* antenna. Prepare now for outstanding reception on *all* VHF channels — present and future — with Channel Master's super-sensitive CHAMPION! Outperforms every all-channel VHF antenna made today — and many Yagis, too!

COMPARE these features with the antenna you are now using:

- **Folded dipoles throughout — give close to 300 ohms impedance across the entire band.**
- **Screen-type reflector provides high uniform gain on every channel, 2 through 13. *Not* frequency sensitive — this reflector provides more than twice as much extra gain as straight bar reflectors.**
- **Phase-correcting harness is built-in and fully assembled; the only wiring you do is to attach the lead-in.**
- **All-aluminum construction . . . lightweight, durable, non-corrosive.**



MARVEL OF PRE-ASSEMBLY

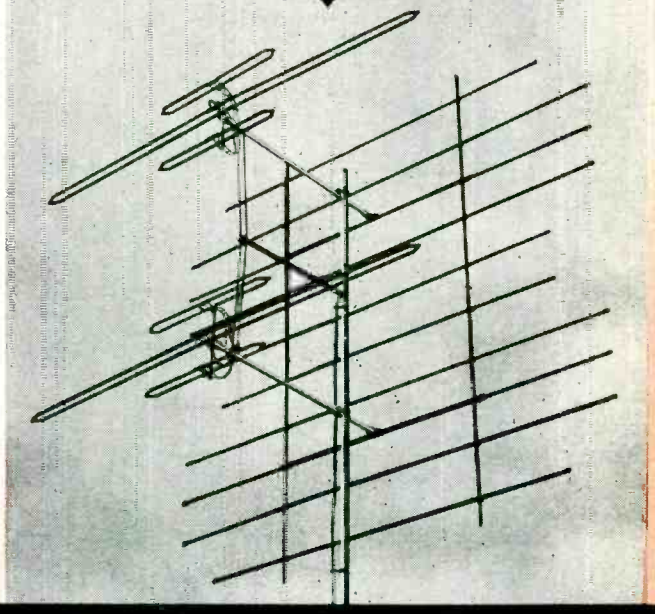
assembles faster than a 5-element yagi!

Collapsed "Pop-Up" screen opens instantly — no loose rods, elements or hardware. "Tri-Pole" assembly features automatic Spring Lock Action — all dipoles snap permanently into place without wing nuts or any other hardware.

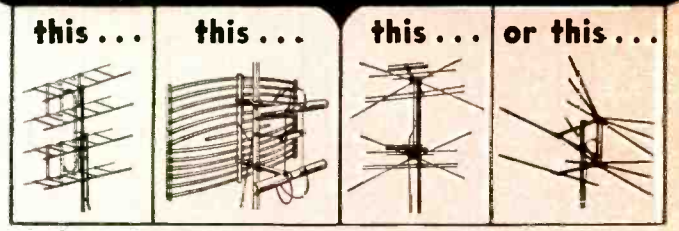
It's a *CHAMPION* in any area!

1-bay—*local areas*
2-bay—*secondary and fringe areas*
4-bay—*super-fringe areas*

THIS ANTENNA...

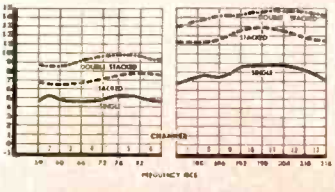


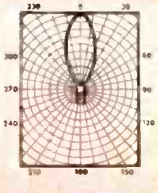
OUT-PERFORMS:



The 2-Bay CHAMPION actually gives you the performance of:

- **Separate 5-element Yagis for every Low Band channel!**
- **Separate 10-element Yagis for every High Band channel!**

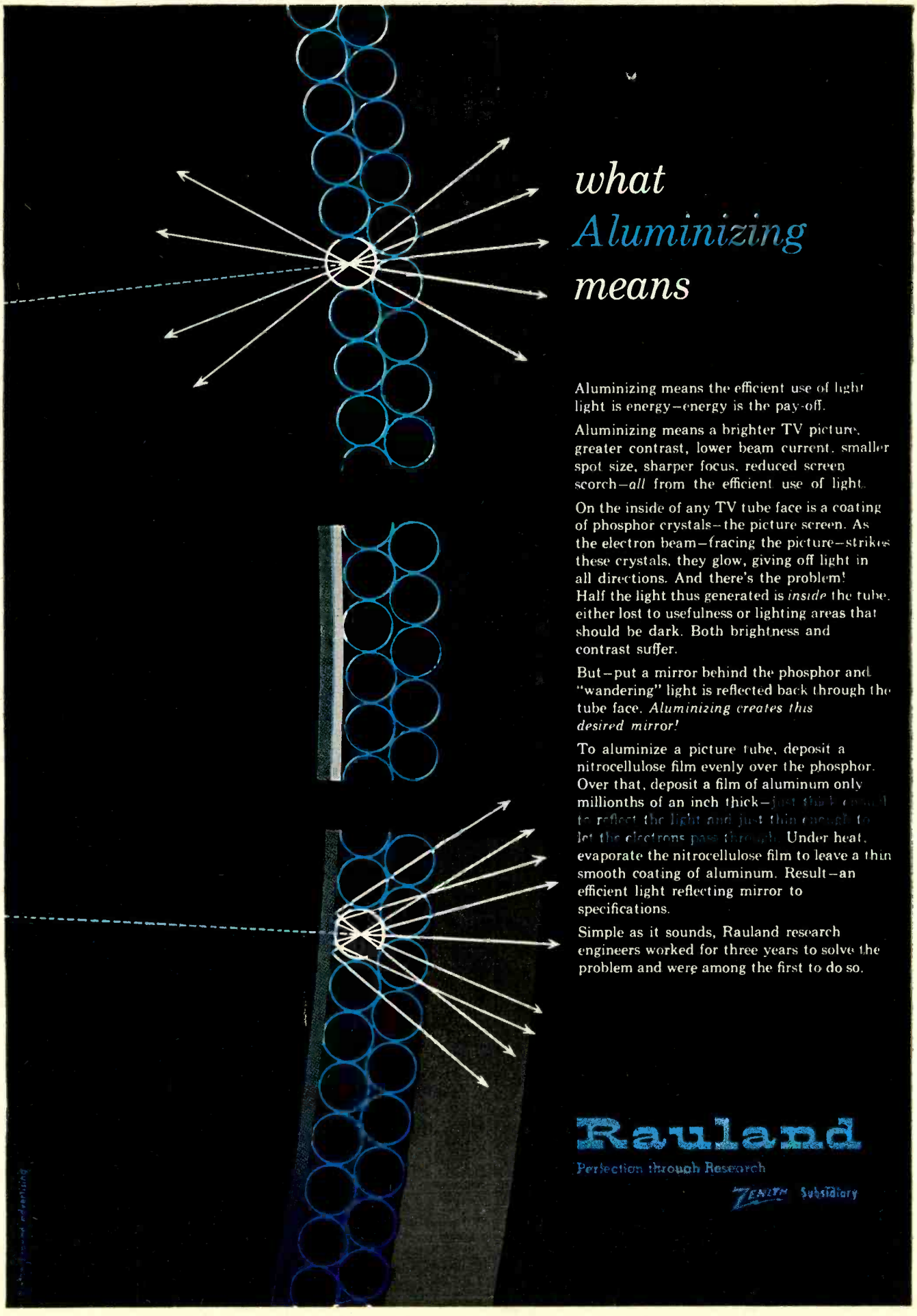




Model No.		List Price
325	Single Bay	$20.83
325-2	2-Bay	$42.36
325-4	4-Bay	$88.89
Separate Stacking Harness		
325-3	2-Bay Harness	$ 2.08
325-5	4-Bay Harness	$ 4.15

Send for complete technical literature.

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.



what Aluminizing means

Aluminizing means the efficient use of light
light is energy—energy is the pay-off.

Aluminizing means a brighter TV picture, greater contrast, lower beam current, smaller spot size, sharper focus, reduced screen scorch—*all* from the efficient use of light.

On the inside of any TV tube face is a coating of phosphor crystals—the picture screen. As the electron beam—tracing the picture—strikes these crystals, they glow, giving off light in all directions. And there's the problem! Half the light thus generated is *inside* the tube, either lost to usefulness or lighting areas that should be dark. Both brightness and contrast suffer.

But—put a mirror behind the phosphor and "wandering" light is reflected back through the tube face. *Aluminizing creates this desired mirror!*

To aluminize a picture tube, deposit a nitrocellulose film evenly over the phosphor. Over that, deposit a film of aluminum only millionths of an inch thick—just thick enough to reflect the light and just thin enough to let the electrons pass through. Under heat, evaporate the nitrocellulose film to leave a thin smooth coating of aluminum. Result—an efficient light reflecting mirror to specifications.

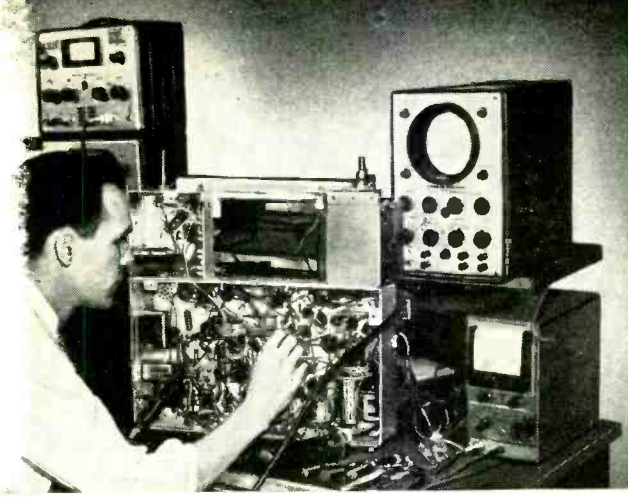
Simple as it sounds, Rauland research engineers worked for three years to solve the problem and were among the first to do so.

Rauland

Perfection through Research

Zenith Subsidiary

For opportunities within your reach



See what the RCA TV Servicing Course offers you

Good-pay jobs. A business of your own.

OPPORTUNITIES FOR GOOD-PAY JOBS in Television are within your reach when you study TV Servicing by the RCA Institutes Home Study Method. Or perhaps you would like to start a TV Service business of your own.

If you are not satisfied with the way your future now stacks up, see how easily you can change the course of your career. RCA Institutes Home Study Course in TV Servicing is helping thousands of other people to better jobs. It can help you. Right now thousands of opportunities are going begging. There is a critical shortage of trained TV servicemen. This is *your* big opportunity.

Easy-to-understand, illustrated lessons

The entire course is divided into ten units of several individual lessons. You study them at home in your spare time. Lesson-by-lesson you learn the theory and step-by-step procedures of installing TV antennas, of servicing and trouble-shooting TV receivers. Hundreds of pictures and diagrams help you understand the how-it-works information and the how-to-do-it techniques. You will be amazed how easily you absorb the knowledge of each lesson, how quickly you train yourself to become an experienced technician.

Experienced engineers and faculty prepared the course, grade your lessons

The RCA Institutes course was written and planned by instructors with years of specialized experience in training men by home-study and resident-school methods. The course embodies RCA's background of television experience plus knowledge gained in training several thousand technicians. A study of the course parallels an apprentice's training. Your lessons are carefully examined and accurately graded by friendly teachers who are interested in helping you to succeed.

One of the leading and oldest Radio-Television training schools

Founded in 1909, RCA Institutes, Inc. has been in continuous operation for the past 44 years. Its wide experience and extensive educational facilities give students, just like you, unsurpassed technical training in the highly specialized field of radio-television-electronics.

RCA Institutes is licensed by the University of the State of New York . . . an affiliate member of the American Society for Engineering Education . . . approved by the Veterans Administration . . . approved by leading Radio-Television Service Organizations.

It costs so little to gain so much

RCA Institutes makes it easy for you to take advantage of the big opportunities in TV Servicing. The cost of the TV Servicing Home Study Course has been cut to a minimum. You pay for the course on a pay-as-you-learn unit lesson basis. No other home study course in TV Servicing offers so much for so little cost to you.

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

SEND FOR FREE BOOKLET—Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.

MAIL COUPON NOW!

RCA INSTITUTES, INC., Home Study Dept. RE 1153
350 West Fourth Street, New York 14, N.Y.

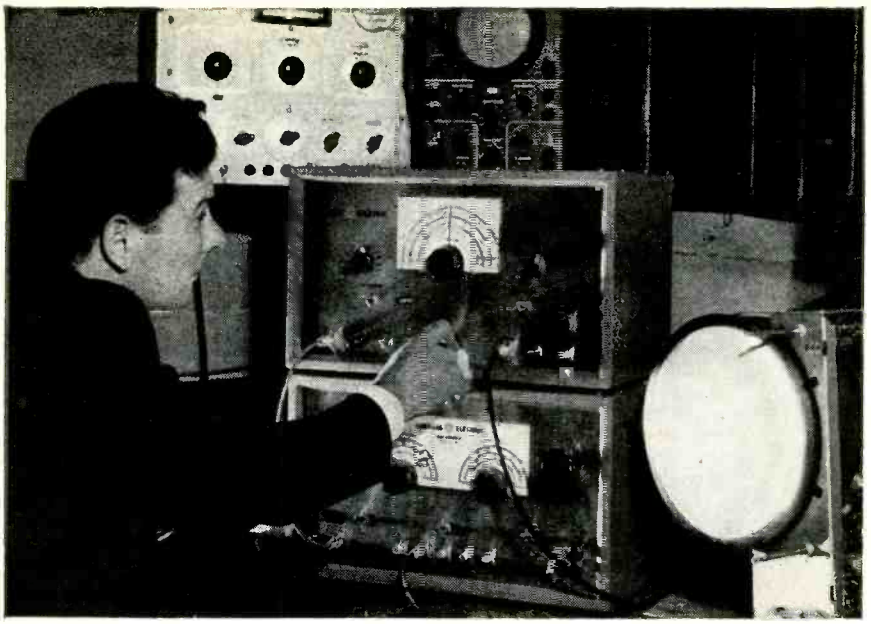
Without obligation on my part, please send me copy of booklet "RCA INSTITUTES Home Study Course in TELEVISION SERVICING." (No salesman will call.)

Name _____
(please print)

Address _____

City _____ Zone _____ State _____

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



"OUR CUSTOMERS TELL US THAT THE PICTURES ARE BETTER THAN WHEN THEIR SETS WERE BRAND-NEW."

Says W. T. Gerlach
Roselle Radio and TV Service
1027 Chestnut St., Roselle, N. J.

"Since the first TV sets were delivered in this area, we've installed almost every type and brand of picture tube, but we've yet to find any that gives a picture like the G-E Aluminized Tube.

"Our tube customers are not only satisfied—they are downright pleased! As a result, **more than two out of every three tubes we are installing are G-E Aluminized Picture Tubes."**

"2 OUT OF EVERY 3 TUBES ARE G-E ALUMINIZED

Give your customers TV's finest picture—and make more money!

"65% OF OUR PICTURE TUBES SOLD ARE G-E ALUMINIZED. ONE OWNER TELLS ANOTHER."

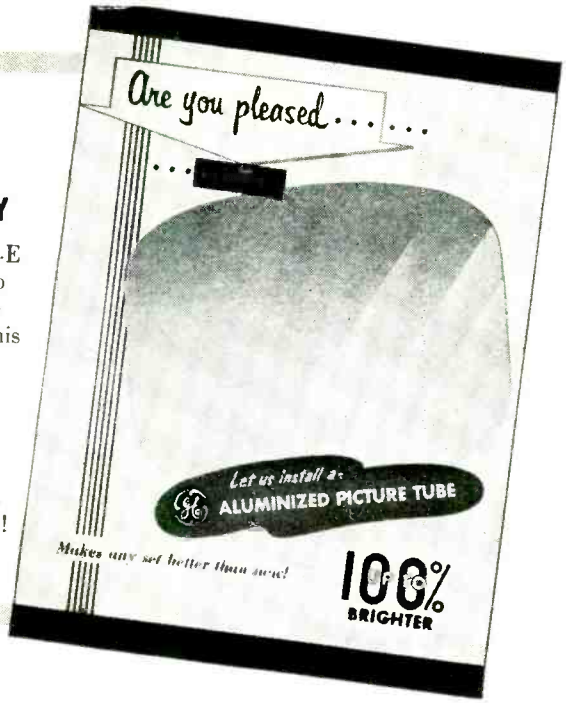
Says Kenneth L. Middleton . . . HILLENS
740 N. Garey Ave., Pomona, Cal.

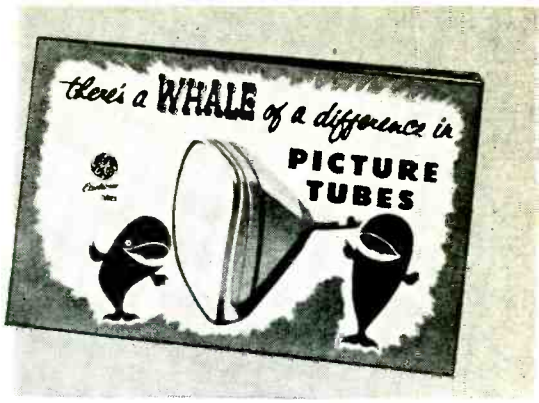
"GENERAL ELECTRIC ALUMINIZED PICTURE TUBES ARE ONE OF MY REAL BIG MONEY-MAKERS!"

Says Norman Foster . . . Foster Television
2922 Milwaukee Ave., Chicago, Ill.

BRAND-NEW MIRROR DISPLAY

Eye-evidence why a G-E Aluminized Tube is up to 100% brighter. The mirror does it! . . . This 3-color display with polished, gleaming mirror sticks front or back to any flat surface—your store-window, door, or wall. A real attention-getter!



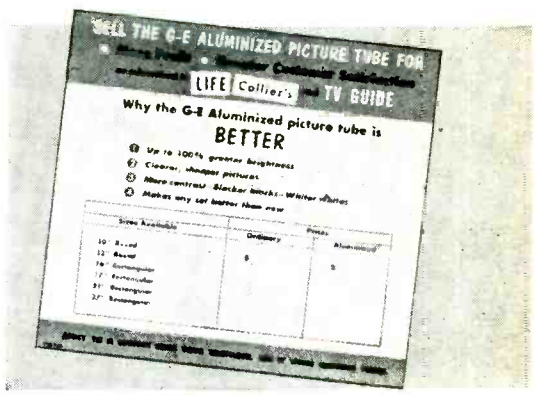


FACT-CRAMMED BOOKLET FOR TV OWNERS

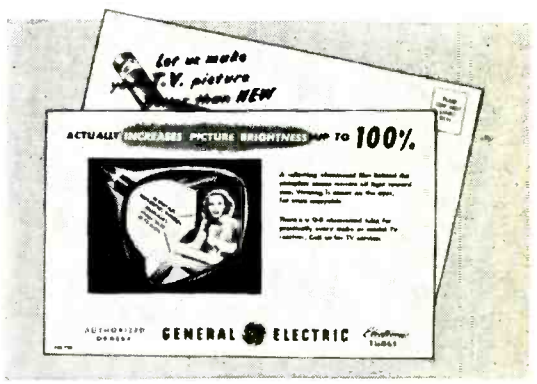
COLORFUL STREAMERS

WE INSTALL PICTURE TUBES!"

Ask for new 6-piece promotion kit!



PHONE-SELLING PRICE GUIDE



MAIL CARD THAT BUILDS INQUIRIES

All these helps are waiting for you at your G-E tube distributor!

GET the full kit of G-E Aluminized Tube sales aids! Use them to sell better-than-new TV! It's a sure-fire way to lick competition from inferior picture tubes offered to your customers.

This mirror, booklet, and other helps will work hard for you, developing *profitable* tube sales. General Electric further supports your efforts by a strong coast-to-coast advertising campaign to TV owners. Ads in LIFE, COLLIER'S, and TV GUIDE, reaching some 40,000,000 readers, tell why the G-E Aluminized Tube is brighter, better, the finest tube any set can have!

Today many leading TV builders are featuring new-model receivers with General Electric Aluminized Tubes. Demand for replacement tubes will skyrocket as the finer performance of the aluminized tube is made known by enthusiastic set owners.

Take a tip from successful service dealers everywhere! Sell TV's finest picture *profitably! Tube Department, General Electric Co., Schenectady 5, New York.*

1878 75 1953
YEARS OF ELECTRICAL PROGRESS
Diamond Anniversary

GENERAL ELECTRIC

161-1A7

NEWSPAPER AD MAT

Now! 7 INCH PUSH-PULL OSCILLOSCOPE

Only EICO Has All These Features:

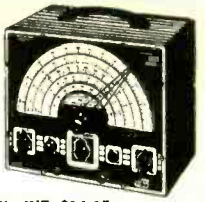
- VERTICAL FREQ. RESPONSE: flat ± 2 db 10 cps — 1 mc
- VERTICAL SENS.: .01 volts rms/inch
- HOR. FREQ. RESP.: flat ± 0 db 10 cps — 200 kc, —4 db at 500 kc
- HOR. SENS.: .3 volts rms/inch
- SWEEP RANGE: 15 cps-100 kc
- 3-STEP FREQ.-COMPENSATED ATTENUATOR eliminates freq. distortion, overloading.
- CATHODE FOLLOWER inputs to both amplifiers
- PUSH-PULL outputs in both amplifiers
- RETURN TRACE BLANKING
- INT. VOLTAGE CALIBRATOR
- V & H TRACE EXPANSION & CENTERING: 1.5X full screen without distortion.
- DIRECT CONNECTION to vert. CRT plates.
- PHASING CONTROL of internal 60 cps sine wave sweep.
- AT FRONT PANEL: intensity mod. input; 60 cps, sawtooth outputs.

MODEL 470K
KIT $79.95. WIRED $129.50

FAMOUS EICO AMAZING FEATURE-PACKED ECONOMY-PRICED
425K 5" PUSH-PULL SCOPE KIT $44.95. WIRED $79.95.

- AC & DC volts: 0-5, 10, 100, 500, 1000 V (30 KV with HVP-1 probe).
- 5 ohm ranges from .2 ohm to 1000 megs.
- DC input Z 26 megs.
- 4½" meter movement in can't-burn-out circuit.
- 1% mult. resistors.

221K VTVM KIT $25.95. WIRED $49.95.



- Continuous coverage of all TV & FM freqs. from 500 kc to 228 mc.
- Sweep width variable 0-30 mc.
- Crystal marker oscillator, variable amplitude.

360K SWEEP GEN. KIT $34.95.
WIRED $49.95.

HIGH VOLTAGE PROBE $6.95
- Extends range of VTVMs & voltmeters to 30 KV.

PIX TUBE ADAPTER for Tube Testers $4.50. Checks TV picture tubes while in set.

- Large 7½" meter, can't-burn-out circuit.
- AC/DC volts: 0-5, 10, 100, 500, 1000 (30 KV with HV Probe).
- 5 ohms ranges from .2 ohm to 1000 megs.
- DC input Z 26 megs.
- 1% mult. resistors.

214K VTVM KIT $34.95. WIRED $54.95.

- Illum. gear-driven "Speed Rollchart."
- New lever-action switches for individual testing of every element.
- Tests all conventional & TV tubes.

625K TUBE TESTER KIT $34.95.
WIRED $49.95.
COUNTER CABINET for above: add $10.00 to Kit or Wired Prices.

- Measures & tests all resistors; .5 ohm to 500 megohms.
- Every type condenser, 10 mmf to 5000 mfd.
- 0-500 DC voltage source for capacitor leakage testing.

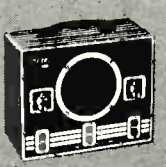
950A-K R-C BRIDGE & R-C-L COMP. KIT $19.95.
WIRED $29.95.

NOW! ONLY EICO® —

the largest manufacturer of its kind in the world — gives you

LIFETIME SERVICE & CALIBRATION GUARANTEE*

...the Industry's greatest protection for your test equipment investment!



- Audibly signal traces all IF, RF, Video & Audio circuits from ANT to SPKR or CRT in all TV, FM, AM, etc. without switching.
- Germanium crystal diode probe responsive to over 200 mc.
- Integral test speaker.

145K SIG. TRACER KIT $29.95.
WIRED $39.95.

* at less than our cost of handling (see the EICO Guarantee Card enclosed with each Kit and Instrument).

NEW!
SCOPE VOLTAGE CALIBRATOR KIT
495K KIT $12.95. WIRED $17.95.
- Sq. wave output at power-line freq. with full-scale readings of .1, 1, 10 or 100 V. peak-to-peak.
- Accuracy ± 5% of full-scale on each range.

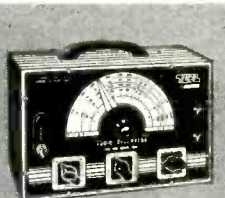
- 1000 Ω/V; 31 ranges
- DC/AC volts: Zero to 1, 5, 10, 50, 100, 500, 5000.
- DC/AC Current: 0-1, 10 ma; 0.1, 1 A.
- Ohms: 0-500, 100 K, 1 meg.

536K MULTIMETER KIT $12.90. WIRED $14.90.
526K MULTIMETER KIT $13.90. WIRED $16.90.

- Fundamentals 150 kc to 34 mc, harmonics to 102 mc.
- 5-step band switching.
- Colpitts audio oscillator generates 400 cps pure sine wave voltage.
- Permits pure RF, modulated RF, or pure AF.

320K SIG. GEN. KIT $19.95. WIRED $29.95.
322K SIG. GEN. KIT $23.95. WIRED $34.95.

NEW!
6V & 12V BATTERY ELIMINATOR KIT
1050K KIT $29.95. WIRED $38.95.
- DC output: 0-8 V or 0-16 V.
- Continuous current rating: 10 A at 6 V, 6 A at 12 V.
- Intermittent current rating: 20 A at 6 V, 12 A at 12 V.
- Separate Voltmeter & Ammeter.



- Complete sine wave coverage, 20-200,000 cps in 4 direct-reading ranges.
- Complete square wave coverage, 60-50,000 cps.
- Cathode follower output circuit.

377K SINE & SQUARE WAVE AUDIO GEN. KIT $31.95. WIRED $49.95.

- Resistance values from 0 to 99,999 ohms with 0.5% precision.
- All resistors have 0.5% accuracy.

1171K RES. DECADE BOX KIT $19.95.
WIRED $24.95.

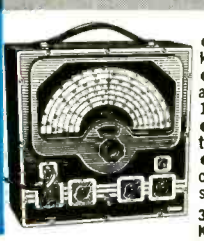
NEW!
DECADE CONDENSER BOX KIT
1160K KIT $14.95. WIRED $19.95.
- All capacitors precision silver mica, accuracy ± 1%.
- Range from 100 mmf — 0.111 mfd in steps of 100 mmf.
- Smooth-action positive detent ceramic switches.

Prices 5% higher on West Coast. Specifications and prices subject to change without notice.

- 20,000 Ω/V; 31 ranges.
- DC/AC/Output volts: 0-2.5, 10, 50, 250, 1000, 5000.
- DC Current: 0-100 ua; 10, 100, 500 ma; 10 A.
- Ohms: 0-2K, 200K, 20 meg.

565K MULTIMETER KIT $24.95
WIRED $29.95

555K MULTIMETER KIT $29.95



- Covers range of 75 kc to 150 mc.
- 7 calibrated scales: accuracy better than 1%.
- Bandspread vernier tuning.
- 4-step RF shielded output multiplier: constant output Z.

315K DELUXE SIG. GEN.
KIT $39.95.
WIRED $59.95.

Write NOW for FREE latest Catalog C-11

EICO®

You build EICO Kits in one evening, but . . . they last a lifetime!
And you SAVE OVER 50%! See the famous EICO line TODAY, in stock at your local jobber.

ELECTRONIC INSTRUMENT CO., Inc., 84 Withers Street, Brooklyn 11, N. Y.

MINIRADIOS

Vast Expansion Due In Small Radio Receivers

By HUGO GERNSBACK

WHEN TELEVISION started its triumphant conquest, the prophets of doom foresaw a quick end for the radio receiver. We thought such reasoning was senseless and said so emphatically on this page at the time. ("Whither Radio?", June 1949 issue.)

In 1949 there were in use in the U.S. 81,000,000 receivers. Now there are over 120 million radios and the end is nowhere in sight. In the first seven months of 1953, we manufactured nearly *eight million* receivers, against *nearly eleven million* radios for the entire twelve months of 1952. We are certain to produce over *fourteen million* receivers during 1953.

Yet this figure is bound to look modest during the years to come. This reasoning is based upon the coming inevitable boom of the *Minireceiver.*

We were probably the first to publicize the idea of the *personalized* receiver in our September 1944 issue, in an editorial entitled "Miniature Receivers." Here are a few excerpts from that article:

. . . These new Pocket Radios will be much smaller than anything that has appeared on the market heretofore. Private constructors have built excellent pocket radios for a number of years—this magazine having described quite an array of them in its pages—but it is one thing for an individual to construct such a set, and quite a different problem to build it commercially by the million.

. . . The pocket and vest pocket type of radios, fill a real demand. Yes, even an acute demand. We predict that before long many millions will be built annually. An entirely new art will be reared upon them. They will be built mostly by female workers who are more nimble in assembling the exceedingly small parts than men. In a way it will bring clock or watchmaking procedure into radio set manufacturing practice.

. . . We will have thin types of radios for breast-pockets, thicker types for side pockets and extra small ones for vest pockets. The latter type—about the size of a cigarette pack—will probably be of the "strictly personal" variety.

What we said then holds true today, only more so, for the following obvious reasons. In 1944 we did not have the transistor, which will soon make the minireceiver not only a practical, but also an economic certainty. During the next few years, the cost of transistors is bound to go far below our present miniature tubes. With the battery drain at an astonishing low, minireceivers can be played daily for many hours, without the annoyance of constant battery replacements. Indeed it appears that the batteries will wear out *not because of current drain,* but by drying out, internal chemical activity, etc.

A number of radio set manufacturers are already deep in the projection stage of minireceivers. It now appears that several such pocket sets will make their appearance in 1954. Recently, the Radio Corporation of America gave several demonstrations of all-transistor miniature receivers with superheterodyne circuits. These extremely well performing sets were free of body capacitance, had internal antennas and played well inside a large steel-construction building. Rather large pocket size, they could have been made to fit into a vestpocket, were it not that the makers desired good quality sound reception. Hence a comparatively bulky loudspeaker was used.

As the art of minireceivers progresses, let no one presume that in the future good audio quality could not be achieved with a loudspeaker with a total diameter less than that of a 25¢ piece.

Once we mass-produce vestpocket minireceivers at a popular price, they will be used chiefly as personalized-portables. Or, to coin a more appropriate term: *Radiowear.* Instant weather reports, news, traffic-road bulletins, etc., are only a few of their uses.

But by far *the most important*—and vital—use will be during the next ten years, probably the most crucial period in our country's history.

The atomic peril has finally caught up with us and—while in our opinion neither the U.S. nor Russia will use atomic mass-destruction bombs—bombing of strategic targets with conventional bombs can no longer be called visionary. We already pointed this out in our March 1948 issue.

Recently our defense department began actual tests over the nation's radio stations with precisely this peril in mind.

Operation *Conelrad* (*Con*trol of *El*ectronic *Rad*iation) will make it impossible for enemy bombers to home on any of our radio broadcast transmitters. When the actual alert comes, all transmitters will operate intermittently—each a few seconds at a time on a nationwide plan. The stations will use only two frequencies: 640 or 1240 kc, to the exclusion of all others. As no station call letters are used, the enemy planes never know to which transmitters they are listening. (RADIO-ELECTRONICS, July 1953, p. 66)

How important personalized receivers will become when the bombs start falling was foreshadowed in our September 1950 issue, under the title of "Emergency Receivers." Here are a few excerpts which we feel are apropos during the present state of a high-tension and jittery world:

. . . In our personal opinion—as stated on this page in our March, 1948, issue—no atom bombs are likely to be used by us or by Russia. Yet we may feel fairly certain that many of our large cities will be bombed by regulation bombs during the next war, if and when it comes. Every military man seems to feel certain that such wholesale bombing will be devastating—certainly much worse than it was in England and Germany during World War II.

It does not take an expert to foresee that, when our metropolises are being bombed, communication is vital. Many radio stations will remain intact and will be able to operate despite all bombings. This was wartime experience in England and Germany. During alert periods and after bombing, radio's importance to morale is incalculable. One thing that a nervous and jittery population demands during such an emergency is quick information. In England and Germany electric lines and electric power plants suffered considerably from heavy raids. Line-operated radio receivers in the affected districts were put out of commission—often for days. Unless the people had battery sets—which in Europe are far more prevalent than in the United States—no radio information could be received.

. . . What is needed even more is an honest-to-goodness pocket-size radio receiver that can be used, not only during emergencies, but in normal times. *In our opinion, any receiver that weighs more than one pound is not a personalized portable.*

In England and Germany there were literally millions of bombed out persons who, unless they found immediate shelter with other families were completely bereft of radio information.

It is important that radio set manufacturers bestir themselves vigorously to perfect a low-priced, battery-powered pocket receiver, that will not bulk too much in a man's pocket and which will also fit into a woman's handbag.

Make no mistake—the miniradio will be the next great developmental phase of radio communications. The world is ready and waiting for *instant,* personalized radio intelligence, wherever humans may find themselves.

COLOR TV—THE NTSC SYSTEM

By MARVIN H. KRONENBERG

DURING the past few years a number of methods of TV color transmission and reception have been developed. One of these, the field-sequential method promoted by the Columbia Broadcasting System, was sufficiently good to win FCC approval. But electronic engineers felt that the final solution to many color TV problems had not been discovered and a group of TV manufacturers formed the *National Television Standards Committee* to pool their ideas and work toward a more advanced system of color TV.

The NTSC system now has the backing of all or probably all the industry and is favorably considered by the FCC. Many of the details of this system are somewhat complicated, but the basic concepts are easy to understand. The NTSC color system is very similar to the "dot-sequential" method developed by RCA some years ago. It is a compatible system (that is, it uses black-and-white scanning standards) and a simultaneous system (as opposed to the obsolete field-sequential system).

To transmit TV in black-and-white the transmitter must be able to send electrical information which is related only to the brightness and detail of the televised scene. The color transmitter must also describe the color components of the picture. To do this within the existing 6-mc channels allocated for TV broadcasting, and without materially degrading the pictures, it is necessary to use either a sequential-type system or a simultaneous system in which a *subcarrier* is used to convey the color information. This latter technique forms the basis of the current NTSC system.

Before discussing the color TV transmitter, let us consider certain fundamentals about color. Three things determine what our eye perceives when it sees a color. They are *hue*, *brightness*, and *saturation*. Hue is the shade by which we identify the color; brightness is the intensity; and saturation is the dilution of the color with white. A pastel or washed-out color is said to be desaturated, and conversely a rich tone is saturated. Another important concept is that what we see as white is really a mixture of colors in just the proper proportions. In order to make white, three primary colors are necessary. Although many combinations of hues may be mixed to make white, it is standard practice in color TV to use red, green, and blue.

The problem of transmitting a color picture is similar to black-and-white TV, except that a "third dimension" must also be included to carry the information which relates only to the color of the object. In the NTSC system, the transmitter sends out the same video signal as in black-and-white TV, plus the color subcarrier. This carrier is located approximately 3.58 mc higher in frequency than the picture carrier, and, unlike the sound carrier (4.5 mc), does not result from a separate transmission but is manufactured in the transmitter video system. This color subcarrier conveys the color information of the televised scene. The color information appears on the color carrier in the form of phase (hue) and amplitude (saturation) modulation. Thus, during color transmission, the video contains in addition to the regular black-and-white signal, a color carrier which is rapidly varying in both phase and amplitude as the various picture elements are scanned by the camera.

To illustrate the way a simultaneous color-video signal is made, a simplified color transmitter is shown in Fig. 1. The color-TV transmitter starts with three cameras instead of the one used in black-and-white TV. Each camera is conventional except for the red, green and blue filters placed in front of the lenses. Due to these filters, the video output of each camera will be a function only of that color component in the scene which can pass through the color filter. The red camera sees only the red parts of the scene, and so on for the green and the blue cameras.

The outputs of the cameras are fed to adder 1 which combines their outputs and supplies the resultant electrical equivalent of white (brightness and fine detail of the scene) to adder 2. The outputs of the cameras are also connected to the transmitter samplers, and at this point the color information is translated onto the color carrier.

The adder which is commonly used in TV transmitter and receiver circuitry does exactly what its name implies. In its simplest form an adder may consist of a dual triode with its plates tied together, and the information to be added is fed separately to each grid.

The color carrier is manufactured in the transmitter sampler. The term *sampler*, as applied to this part of the circuit was undoubtedly coined years ago when the color information was actually selected by an electronic means which was the equivalent of a switch. The commutator of the switch rotated rapidly at a rate which was equal to the color subcarrier frequency and selected or sampled the color information at the output of the color cameras. The NTSC transmitter sampler is somewhat analogous to this basic sampler. However, the action of NTSC sampler on all three color channels is simultaneous rather than sequential.

The transmitter sampler shown in Fig. 2 consists essentially of a local oscillator supplying the color carrier (approximately 3.58 mc), a delay line, and three color modulators which in effect operate as gates for the subcarrier oscillator. The gate is actuated by the video signal. For example, if a pulse of red video, corresponding to a red sector in the televised scene, is applied to the red sampler, a pulse of 3.58 mc will appear in the output of the sampler. The phase of the sampler output will be determined by the delay line which affects the phase of the 3.58 mc input to the sampler.

The output of the transmitter sampler, consists of the color subcarrier modulated both in phase and amplitude. The phase of the color subcarrier is a function of the hue of the scene, and its amplitude (in relation to the white video amplitude) is determined by the degree of color saturation.

The outputs of the transmitter samplers which identify hue and saturation are then connected to adder 2, as is the white video, and are combined to form a simultaneous color TV signal at the output of adder 2.

To visualize the content of the transmitter output, the video-frequency spectrum of such a transmission is shown in Fig. 3. From it we can see that the simultaneous color transmission consists of two basic components in monochrome and color. The monochrome video is equivalent to that in present-day black-and-white broadcasts and results from scanning, brightness, and picture detail information modulated upon the video carrier. The color component consists of a color carrier (approximately 3.58 mc) and sidebands as shown in Fig. 3. These result from phase (hue) and amplitude (saturation) modulation on the color carrier which is determined by the color content of the televised scene.

Over a part of the spectrum, the white video and the color video components appear to interfere. In early systems of this type they actually did interfere, with resultant degrading effects in the received picture. By choosing the color subcarrier frequency in correct relation to the horizontal

scanning frequency—approximately 15,750 cycles—it is possible to cause the color and white sidebands to be interleaved, resulting in a minimum amount of interference. This is known as dot-interlace.

An important feature of the NTSC color system is known as constant-luminance sampling, which results in reduction of the effects of interference to the color subcarrier. This and other features of the system are extremely important in the reception of satisfactory color pictures. However, we are treating only the basic ideas of the system, and a detailed discussion of constant luminance will be left to future articles.

The NTSC color receiver

Up to the point of the video detector, the circuit of the color receiver is very much the same as the present-day black-and-white TV set. Scanning frequencies are approximately 30 frames per second and 525 lines per frame as in existing black-and-white standards.

The signal at the output of the video detector contains the frequency components shown in Fig. 3, that is, the video black-and-white information 0–4 mc and the modulated color subcarrier (3.58 mc and sidebands). The process of using this information to make a color picture which is an accurate reproduction of the televised scene is substantially the inverse of what is done at the transmitter. In a typical NTSC system color receiver (shown in block diagram form in Fig. 4) the second detector video signal is amplified and fed to the kinescope as in the present day black-and-white receiver. This is known as the brightness channel. This portion of the signal contains all the electrical information necessary to describe the brightness or black-and-white components of the picture, including the fine picture detail. In order to extract the color information that is contained in the composite video signal at the video detector, the detector output is also fed through a 2–4 mc band-pass filter to the receiver sampler. At the input of the receiver sampler are frequency components associated with the color subcarrier. Since the phase of the color carrier is determined by the hue of the televised picture, in converting these phase changes back to useful video information the receiver sampler is actually a phase detector. A local oscillator in the receiver which is synchronized to the transmitter is used in conjunction with the receiver sampler to supply the comparison signal for the phase detectors. The delay line shown in Fig. 4 provides phase shifts for the color subcarrier frequency which corresponds to the delay line in the transmitter.

So that the receiver sampler may interpret the phase of the color subcarrier correctly it is necessary that the color subcarrier oscillator in the receiver be precisely in phase with the transmitter. This is done by transmitting a burst at the start of each line-scanning interval. This consists of a sample 3.58-mc color subcarrier generated in the transmitter. A comparison of the standard black-and-white video signal with the NTSC color signal viewed on an oscilloscope at a line-frequency sweep rate is shown in Fig. 5 to illustrate the nature of these color-synchronizing bursts. This burst is in phase (0°) with the transmitter subcarrier oscillator (approximately 3.58 mc), and is separated from the composite video signal in the receiver. The burst, separated from the composite video signal, is used in establishing two continuous wave signals of color subcarrier frequency, having a 90° phase displacement from each other. These two signals are generated by a quartz crystal oscillator whose exact frequency is controlled by a reactance tube. The reactance tube derives its control information from an error signal proportional to the difference in phase between the transmitted burst and the local crystal oscillator output. This latter circuit is a conventional a.f.c. system.

The outputs of the receiver samplers consist of video information which is a function only of the hue and saturation of the televised image. These signals are applied to the tricolor kinescope as shown (Fig. 4), and combined with the black-and-white information to produce a color picture which theoretically contains substantially the quality of detail and tonal gradation of black-and-white TV pictures received on present home receivers, but with the additional color information.

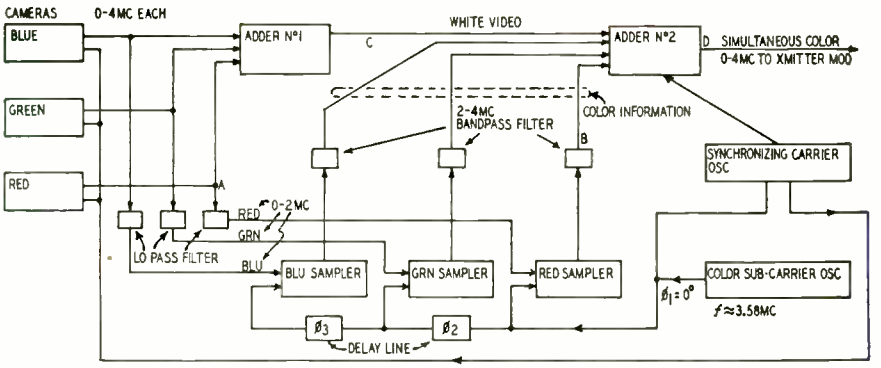


Fig. 1—Basic simultaneous color television transmitter uses three cameras.

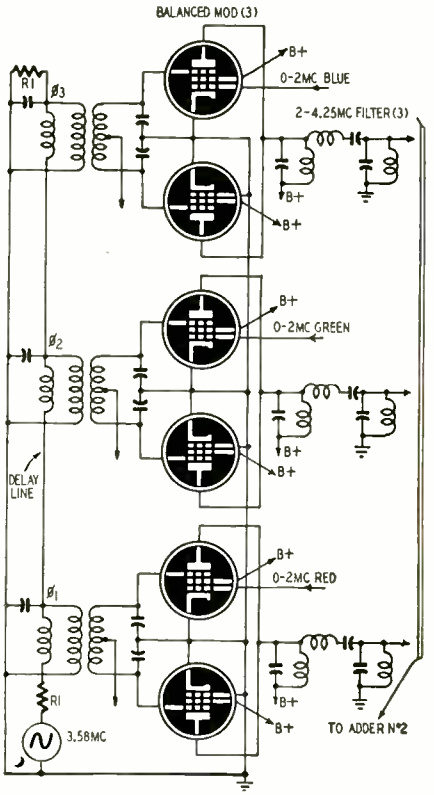


Fig. 2—Sampler contains oscillator, delay line, and 3 color modulators.

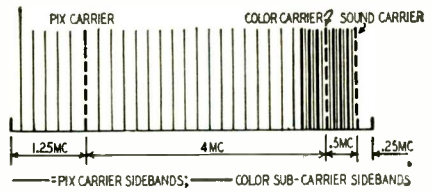


Fig. 3—Color video frequency spectrum.

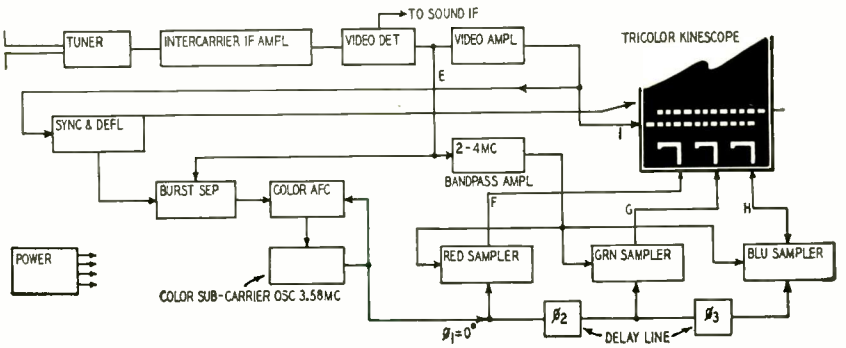


Fig. 4—Block diagram of a typical NTSC system basic color television receiver.

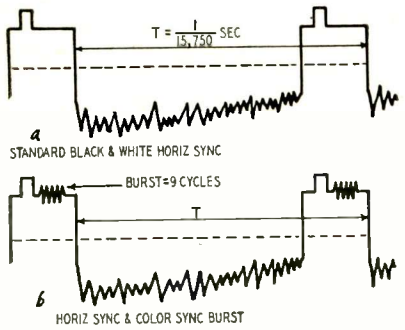


Fig. 5—Comparison of the standard video signal with the NTSC color signal.

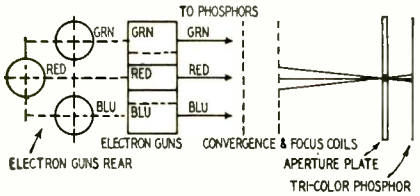


Fig. 6—Tricolor kinescope for NTSC color receivers has three electron guns.

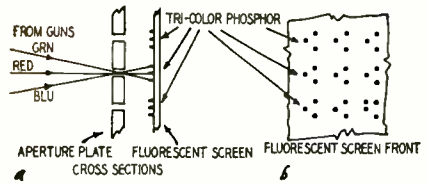


Fig. 7—View of phosphor deposits on fluorescent screen and aperture plate.

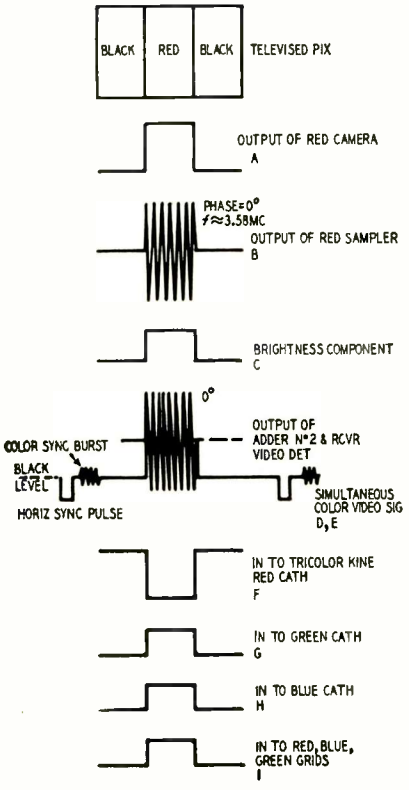


Fig. 8—Typical color video waveforms.

The tricolor kinescope

Up to now many types of tricolor kinescopes have been proposed. There are still many more to come before a practical design is finally completed. One type of the RCA tricolor kinescope, used in conjunction with the development of NTSC type color receivers, contains three separate electron guns (Fig. 6). The individual structure of these electron guns is similar to that in the conventional black-and-white kinescope. The electron beam formed by each gun is focused and caused to converge so that the three beams pass through holes in an aperture plate placed in front of the specially deposited fluorescent screen. Three primary color phosphors are deposited on the screen in the manner shown in Fig. 7. The converging electron beams pass through a hole in the aperture plate and each beam strikes and lights up only one phosphor dot. The holes in the aperture plate correspond to picture elements, and each group of three phosphor dots is arranged so that it is directly in front of a hole in the aperture plate. Thus the three converging electron beams will light up their correct phosphor at any point on the screen. Tricolor tubes currently use aperture plates with approximately 600,000 holes. These microscopic holes are made by a photographic etching process.

The convergent electron beams are deflected in much the same manner as the single beams of a conventional kinescope. Special techniques are required to maintain accurate convergence of the three electron beams (red, green, and blue) at every point on the raster so that the red gun will always light only red phosphor, the green gun the green phosphor, and the blue gun blue. The video signals are applied to the tricolor kinescope in the receiver of Fig. 4, by paralleling the control grids and applying the black-and-white information. The output of the samplers are connected to the appropriate kinescope cathodes so that the output of the red sampler will actuate only the red gun, which in turn lights only the red phosphor, and so on for the other colors.

The complete system

In order to illustrate how color-TV pictures are transmitted and received via the NTSC system, let us trace the path of an elementary color pattern through the transmitter, receiver, and ultimately to its destination, the eye of the observer.

Let us consider what would occur at successive points in the system if a single narrow vertical pure red strip against a black background were presented to the tricolor camera. Fig. 8 shows waveforms that would occur. These are the waveforms that would be seen if an oscilloscope, swept at a horizontal line-frequency rate (15,750 cycles), were connected to those points. In Fig. 8D, the composite signal which appears at the output of adder 2 contains the scanning and color sync information plus the color brightness components. The signal is amplified and fed to the transmitter modulator and then applied to the r.f. carrier for transmission over the air.

In the receiver the second detector signal is similar to the adder 2 output in the transmitter. The brightness and hue information are then separated. The color carrier is fed to the receiver samplers, and the red sampler of the receiver in this case will supply maximum output during the *red color* interval since its phase is 0°. The blue and green samplers give negative outputs during this interval, and thereby cancel the brightness signal at the blue and green grids so that only signals on the red gun grid and cathode add to produce a red bar on the screen. The action of the system for the other primary colors, green and blue, is the same. When a secondary color such as yellow is to be televised then both the red and the green cameras and subsequently the red and the green guns of the tricolor kinescope operate simultaneously. The red and the green phosphors therefore light simultaneously and the eye interprets the color correctly as yellow. When the picture element to be televised is white, the three cameras are picking up the red, the green, and the blue components and the transmitter samplers act to cancel each other out so that only information is left in the brightness channel. In other words, when white is televised the color subcarrier becomes zero. The white video is transmitted to the receiver, and since there is no color signal in the video detector output only the brightness channel of the receiver is active and each gun is lit with equal signals appearing at the control grids. The three phosphors light simultaneously, producing what the eye interprets as a white picture on the screen.

Compatibility

Color-TV transmissions of the type described in this article may be received on a standard black-and-white receiver as a black-and-white picture with excellent detail and monochromatic rendition. Since the scanning frequency standards are the same, no modification of the receiver circuitry is required.

Another feature of compatibility is that considerable attenuation to the color subcarrier frequency exists in most present-day receivers. The pattern that results from the existence of the 3.58-mc color carrier in the video output is usually greatly reduced due to the fact that the over-all bandpass of most current receivers is down considerably at this frequency. The color carrier will hardly be apparent on a standard black-and-white television receiver.

The present system of the National Television System Committee, which has been tentatively approved by the FCC, is currently being field-tested by members of the committee, with a view toward improving this system as the soundest scientific and economic approach to color TV. With the success of the present nation-wide tests, its final approval for national use is virtually a certainty. END

Studio and monitoring room. Station started as a closed-circuit system.

KCJB-TV

Successful North Dakota TV station started as closed-circuit system. Experience gained was invaluable.

By JOHN W. BOLER*

TO learn about television the hard, but least expensive way, we established a closed-circuit TV system in the city of Minot, North Dakota, on July 26, 1952. To the best of our knowledge, the system was original and the first to be established in the United States. The operation differed from the conventional community antenna system in that all programs were originated locally. We are 510 miles from the closest TV stations (Minneapolis-St. Paul).

An average of nine hours per day of program service was offered to subscribers daily except Sunday. It was originally established to supply receiving sets located in stores throughout the business district. Later the system was expanded to the residential area. The area served was limited to the route of the cable extending to the baseball park, college football field, and school and college basketball gymnasiums.

We originally established the closed-circuit system to give our staff experience in local program production. Our staff of engineers and program personnel were totally inexperienced in television, and everyone had to learn from scratch. John Martin, prominent New York TV director-producer was hired, and the first five weeks of operation was under his supervision.

The $12,000 we invested in our closed-circuit operation already has paid dividends. When we went on the air with KCJB-TV April 4, a great number of people told us that our production was excellent. Our technical and program staff operated like veterans. Our transmitter has not been off the air for more than 60 seconds since our initial telecasts. We are doing an unusual amount of local programming for a new station. We are operating 7¼ hours daily, from 3:45 pm until 11:00 pm seven days weekly, and approximately half of this time is filled with local programming and live talent.

We are now using our RG-11/U coaxial cable, from our old community antenna system, in certain areas as a remote broadcast loop. For example, we are televising the local baseball games. Instead of following the usual procedure of microwave operation we hook our camera chain on the end of this line and get excellent quality to the transmitter. We use one camera to cover the baseball games and are doing it successfully. All games are sponsored at double the price of our AM games and the sponsors are very happy.

The only portion of our community antenna system which continues in operation is the portion of the cable used for remote pickups. We no longer charge the original subscribers for the service, since they can get the same broadcasts on the air.

We feel that we will have recovered our entire investment in the closed circuit just from our sports events this year. If we had not had the experience and the facilities installed, we would not have been able to televise the baseball games or basketball games this past spring and summer.

There were numerous program ideas which after having been tested on closed circuit were abandoned because they proved to be impractical either from a standpoint of production cost or lack of interest by advertisers.

We were able to use our closed circuit to interest civic officials and college and high school administrators. As a result, the schools now use five half-hours each week on KCJB-TV and are doing an excellent job of producing programs for themselves.

We are giving consideration to establishing community antenna systems in one or two cities in our fringe area at some later date. Now that we know what and what not to do, we believe that, through the use of closed circuits, we can increase our circulation—which is badly needed in this area due to the sparse population. We are also considering a plan whereby sports events, after this season, may be confined to paying customers on a closed-circuit system. The determining factor will be the attendance figures at baseball games this past summer and basketball games this fall. Schools would be paid on a royalty basis, based on the number of television receivers connected to the system.

Prior to opening KCJB-TV, we had a total staff of nineteen persons operating KCJB Radio. The staff has been increased to the extent of only four persons—three of the four are technicians. A staff of three covers the sports events: one engineer, one cameraman, and one announcer. These games are simulcasts on radio and TV. Commercials are inserted at the studio, using a second camera chain.

We believe that this market will support one television station, but we do not see how a market much smaller than Minot, North Dakota, could support a television station. Minot has two radio stations operating on regional channels and one excellent daily newspaper with a circulation of 24,000, plus a weekly newspaper.

Our TV operating cost will average approximately $10,000 per month. Our total installation costs will be a little less than $200,000. We have erected a 600-foot tower on Signal Hill, approximately 15 miles south of Minot. The point of radiation is approximately 900 feet above average terrain. We have a 5-kw transmitter on channel 13 with an effective radiated power of approximately 28.9 kw. We estimate that there are approximately 15,000 television sets in use at this date. We believe our market potential will be 40,000 sets and this is expected to be accomplished within two years. We have great expectations for our station. Our experience with closed-circuit TV paid dividends.

END

*President, North Dakota Broadcasting Co., Minot, N. D.

TUBE FAILURES in TV RECEIVERS

JOHN B. LEDBETTER*

A LIST of expected tube failures can save time in servicing and reduce inventory requirements. Whether you are an old-timer in television receiver servicing or have just entered the field, you have noticed the tendency of certain types of tubes to become weak or burn out more rapidly than others. Other types may become gassy, leaky, microphonic or intermittently shorted, but seldom burn out. Have you ever thought of the time which could be saved if each tube type could be "catalogued" with its most likely or expected tube failures? If such traits can be considered as average or typical, such a list not only would save servicing time but would be a valuable aid in rearranging or modernizing your tube stock.

The following list of tube failures has been compiled with this thought in mind.

1. Tubes most likely to burn out: The low-voltage rectifiers (5AX4-GT, 5U4-G, 5Y3-GT, 5Z4, and similar types). These tubes supply high current and run very hot. They also may weaken fast, especially when the load current approaches the rectifier's maximum rating. Check for a weak low-voltage rectifier as well as a weak r.f. oscillator if the latter becomes sluggish or drops out of oscillation on the higher channels.

The *horizontal damping* tube (5V4-G, 6AS7, 6BY5-G, 6W4-GT, etc.) also is high on the list. In series-filament receivers, tubes like the 25L6-GT, 35L6-GT, 25Z6-GT, 50B5, and 50L6-GT have a tendency to burn out before other types.

2. Tubes most likely to become weak: Tubes in the sweep circuits (*horizontal oscillator*, *horizontal output*, *vertical oscillator*, and *vertical output*; types 6SN7-GT, 12SN7-GT, 6K6-GT, 6J5, 6BG6-G, 6CD6-G, 6BQ6-GT, etc.). Next in line are the *high-voltage rectifiers* like the 1B3-GT, 1X2-A, and 2X2-A.

3. The most critical tubes: The *r.f. oscillator*. Tubes like the 6J6, 6F8, and 7F8 are notorious for going bad or becoming unstable on the higher channels. Other types to watch are the 6AB4, 6X8, 12AT7, and 12AV7. (The usual result is drifting, or mushy sound, or complete loss of sound on one or more high-frequency channels. The picture may or may not be affected). *Oscillator control* or *automatic-frequency control* tubes (6AL5, 6AC7, 6SH7, etc.) can be very critical (especially the 6AL5). These tubes may check good but still fail to function in the receiver.

4. Tubes most likely to become gassy: The *horizontal output* (6BG6-G, 6CD6, 6BQ6-GT, etc.); the *a.g.c. amplifier* (6AL5, 6AH6, 6AT6); and the *sound discriminator* (6AL5). Replace these for a check even though they test good.

5. Tubes which often short or become leaky: The *video i.f. amplifiers* (6AC7, 6AG5, 6AU6, 6BC5, 6CB6); the *video amplifiers* (6AG7, 6AU6, 6CL6, 6K6-GT, 7C5, 12AU7, 25L6-GT); the *r.f. amplifier* (6AU6, 6AG5, 6AK5, 6AB4, 6BC5, 6BK7, 6BQ7, 6BZ7, 6J6). Test on a good mutual-conductance tester while tapping gently with a pencil eraser or the fingers.

6. Tubes most likely to become microphonic: The *r.f. oscillator* or *video i.f. amplifiers*. The 6J6 is especially critical in this respect. Noise and vibration usually develops an internal mechanical oscillation which results in a high-pitched squeal or sustained howl. The 12AT7 is next in line, with the 6AC7 a close second. (A lead weight on the tube will provide mechanical damping in all but the most serious cases). Occasionally, a microphonic 6AU6, 6AG5, or similar type will show up in the *video i.f.*, *sound i.f.*, or *audio* section.

Other tube failure causes

1. Ceramic capacitors. When a TV set is less than a year old, many of its tube failures can be traced to a defective ceramic-type capacitor. A weak, gassy tube or a burned-out resistor often is the result of a temporary breakdown in one of these capacitors. In many sets, they will become leaky or break down only when the set is on. When it is off, they may pass all tests. A faulty capacitor also may cause intermittent operation of picture or sound, or both.

Suggestions: One method of locating a defective capacitor is to apply heat (i.e., with a floodlamp, sunlamp, etc.) to the suspected unit. Use extreme care and definitely do *not* use this method if any of the leads near the capacitor are made of plastic. Heat will melt or break down the insulation and cause more troubles. Replacing the suspected capacitor is the most logical and time-saving method.

2. Insulation breakdown. Many of the later-model sets use plastic insulation on transformers, wiring, terminal connections, and other parts. Under certain conditions, breakdown or arcing will occur.

3. Terminals. Poorly soldered or badly spaced terminal lugs sometimes short to ground and burn out a resistor, peaking coil, or other component, or weaken it so that later circuit defects will cause a complete breakdown. More often than not, such a condition, even temporary, will cause permanent damage to a tube.

4. Tube sockets. Arcing from tube socket pins to ground (or from pin to pin) is more likely to occur in the *sweep* or *high-voltage* circuits. Replacement with high-quality, low-loss sockets and high-voltage terminal boards will correct this trouble. In every case where arcing or breakdown has occurred in the plate circuit (especially in the sweep tubes), replace the plate-dropping resistor and give the tube a thorough test for intermittent or direct shorts before operating the receiver. An intermittent tube could cause the original trouble to recur.

While the above list represents the most common tube weaknesses, it is only a basic presentation. You can keep it up-to-date by including newer tubes as they appear. (Generally tubes which perform the same circuit functions will be subject to similar weaknesses). As your experience with special circuits widens, you can expand the list to include practically every tube in current use. This list will prove to be a valuable tool. END

Figures 2, 3, and 6 appear through the courtesy of RCA. Figures 1, 4, 5, 7, 8, 9, and 10 first were published in G-E's service publication "Techni-Talk." They appear by courtesy of G-E.

* Engineering Writer, *Convair*. Material in this article abstracted from the author's book, *TV and You*.

TV TROUBLES CAUSED BY DEFECTIVE TUBES.

Fig. 1—Burned out or shorted video i.f.

Fig. 2—Poor interlace; defective sync-amplifier or vertical oscillator tube.

Fig. 3—Burned out or shorted r.f. amplifier.

Fig. 4—Cathode-heater short in video i.f., video detector, or video amplifier tube.

Fig. 5—Defective cathode ray tube.

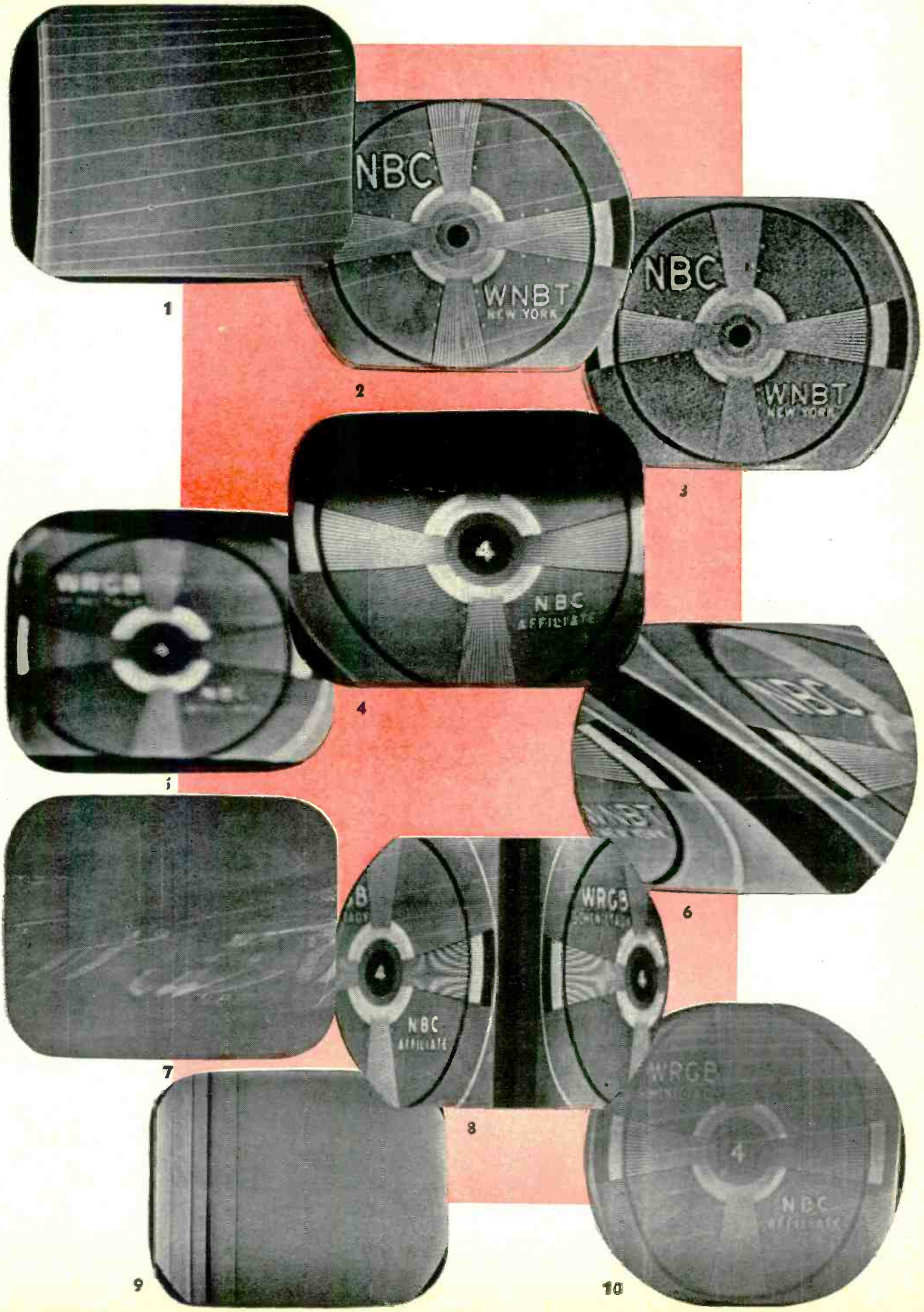
Fig. 6—Gassy or short circuited horizontal automatic frequency control tube.

Fig. 7—Shorted horizontal AFC tube.

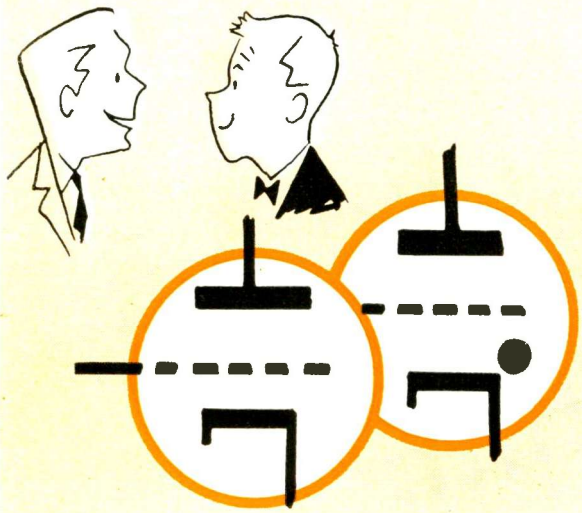
Fig. 8—Defective horizontal AFC tube, or horizontal discriminator transformer.

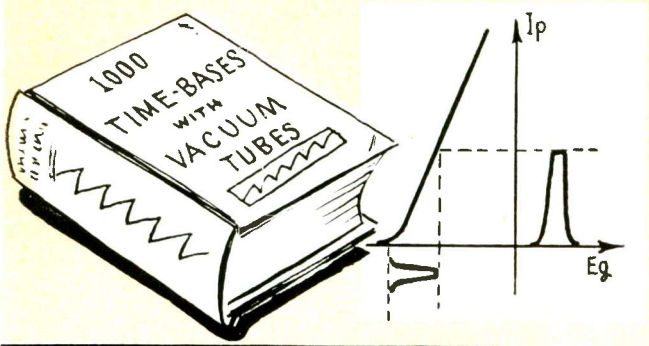
Fig. 9—Barkhausen oscillation, caused by defective horizontal output tube.

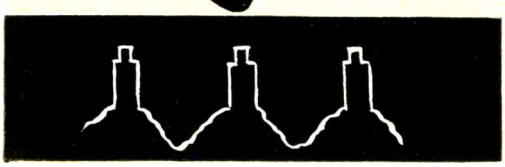
Fig. 10—Short circuit in picture tube.

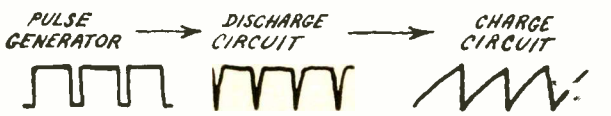

NBC
WNBT
NEW YORK
NBC
WNBT
NEW YORK
4
NBC
AFFILIATE
WRGB
WRGB
4
NBC
AFFILIATE
WRGB
4
NBC
AFFILIATE
1
2
3
4
5
6
7
8
9
10

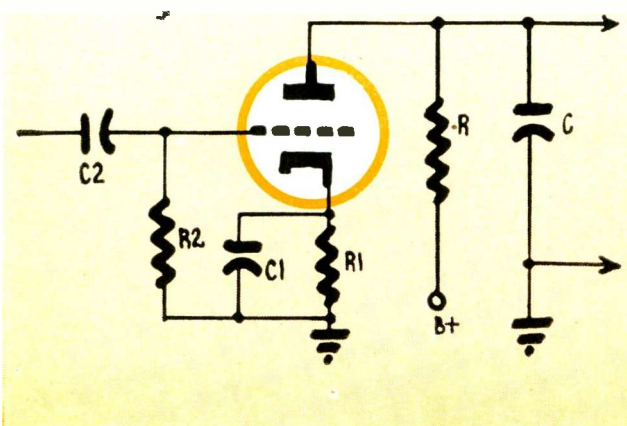
TELEVISION...It's a cinch











By E. AISBERG

Seventh conversation, first half: Time bases with high vacuum tubes.

The "Will" time-base

WILL—You sort of broke a bad habit when you said at the end of our last conversation that thyratron time-bases are really used by modern TV receivers . . .

KEN—Well-l, I may have stretched things a little. They *are* currently used in European television receivers. And they have been used here. But I can't think of a manufacturer using them now. After all, gas tubes have a rather short life . . .

WILL—That's right! I can't see that using thyratrons is a good idea, anyway! Ordinary vacuum tubes would do the job just as well. I've worked out a very simple scheme that will make thyratron time-bases look silly!

KEN—Well, let's hear about it! But I warn you in advance that plenty of inventors have designed time-bases with high-vacuum tubes, long before you!

WILL—As usual! There's never anything left for me to invent. Why wasn't I born 50 years ago? But take a look at this time-base diagram. This is just the "Will" circuit—not the Williamson. It uses one vacuum tube—in this case a triode. It must be one with high mutual conductance and a sharp cutoff. Then we bias it to the point where the current is just cut off, so that a positive voltage pulse on the grid will produce a rather large plate current.

KEN—I can see what you are trying to do.

WILL—It ain't hard. I have a charging circuit made up of resistor R and capacitor C, same as in the thyratron circuit. The cathode-anode space of the tube is the discharge circuit. Normally the cathode resistor R1 (decoupled by C1) biases the tube just about to cutoff. During cutoff time capacitor C becomes charged, at a rate set by resistor R and capacitor C. Then I apply positive synchronizing pulses to the control grid through capacitor C2. As each pulse arrives, plate current is established, permitting capacitor C to discharge itself rapidly through the tube. What do you think of the idea. I'll be surprised if you haven't got at least a few objections!

KEN—No, Will, your lineup will work O.K., *if* the sync pulses arrive at the receiver with roughly constant amplitude. It would work fine with a receiver near a transmitting station. But in a fringe area, the synchronizing signals don't all arrive with the same strength and the discharges would be produced at a variable frequency, which would deform the pictures. Another thing—when your station isn't transmitting, you get no sweep. Then the spot stays in the same place on the screen and destroys the phosphor there.

WILL—If I get you, my idea isn't worth too much?

KEN—No, I think your hookup is good. Only, instead of producing the discharges by applying the pulses direct to the grid, it's better to use locally generated pulses, with their frequency and amplitude both carefully regulated. Then you can control them with the sync pulses, and trigger your discharge tube reliably.

Old idea in a new role

WILL—In other words, you want to introduce scientific organization by separating the functions. The resistance-capacitance charge circuit does its part of the work. The tube acts as the discharge circuit. Some mysterious device puts voltages on the grid to trigger the pulses. And finally, the sync pulses from the transmitter regulate the frequency of the pulses produced by the mysterious device?

KEN—Everything really is just about the way you put it.

And this device (you can call it a "pulse generator") has its own natural frequency, so that even if we lose several sync pulses due to fading, the sweep frequency won't get too far out of the way. And it works whether or not a station is sending sync pulses.

WILL—But how do you make these periodic pulses?

KEN—With the help of a blocking oscillator—or a squegger, as some of our would-be-learned friends would call it. Here's the hookup.

WILL—And *this* is television? Why, Ken, this is one of my oldest friends! I built one of these in the Boy Scouts, when I was learning the code. If it isn't the oldest oscillator in the world, it's not far from it. The grid leak and capacitor are on the wrong side of the grid coil, but that doesn't really change anything. But I do happen to know that this produces sine waves, not the pulses we've been talking about!

KEN—That depends on the circuit constants. To make pulses, capacitor C3 and resistor R3 must have a considerably higher value than for a sine-wave oscillator. And the coupling between the grid and plate coils must be very close.

WILL—I still can't see why—even under those conditions—you get anything but good sine waves. When current starts in the plate circuit, the coupling between L2 and L1 makes the grid more positive. That can't help but still further increase the plate current . . .

KEN—Wait a minute! Stop right there! Your reasoning has been O.K. so far, but it won't be if you go on much longer. Don't forget that the coupling between L1 and L2 is *very tight*. So the grid goes positive very rapidly. Because of that, it begins to attract electrons from the cathode.

WILL—Does it think it's an anode of some kind or another?

KEN—You could look at it that way. In any case, those electrons rush into C3 and charge it.

WILL—Don't they flow rapidly off toward the cathode? Isn't that what "grid current" is?

KEN—They do, but *slowly*, because of the high resistance of R3. So you can see that the grid voltage, after a rapid rise (from *a* to *b* in the curve) not only ceases to be positive, but becomes negative (as at *c*); this *grid-leak-bias* brings the tube down toward the cutoff point and we say the tube is *blocked*. There is no noticeable plate current (or grid current either) for the moment.

WILL—But if there's no grid current, how can we have grid-leak bias?

KEN—Actually, this grid-leak bias comes in two parts. We get it at first because of current flowing from the cathode to the control grid inside the tube. This current flows through the grid-leak resistor, making the grid end more negative than the cathode end.

WILL—That I understand. But when the grid stops attracting electrons from the cathode, and there is no more flow, then where do we get our bias from?

KEN—See that capacitor C3? What is its relationship to R3?

WILL—I don't quite get what you mean?

KEN—Is it in series or parallel with it?

WILL—In parallel, of course, but . . .

KEN—That means, then, that the voltage developed across R3 will also be across C3.

WILL—Check.

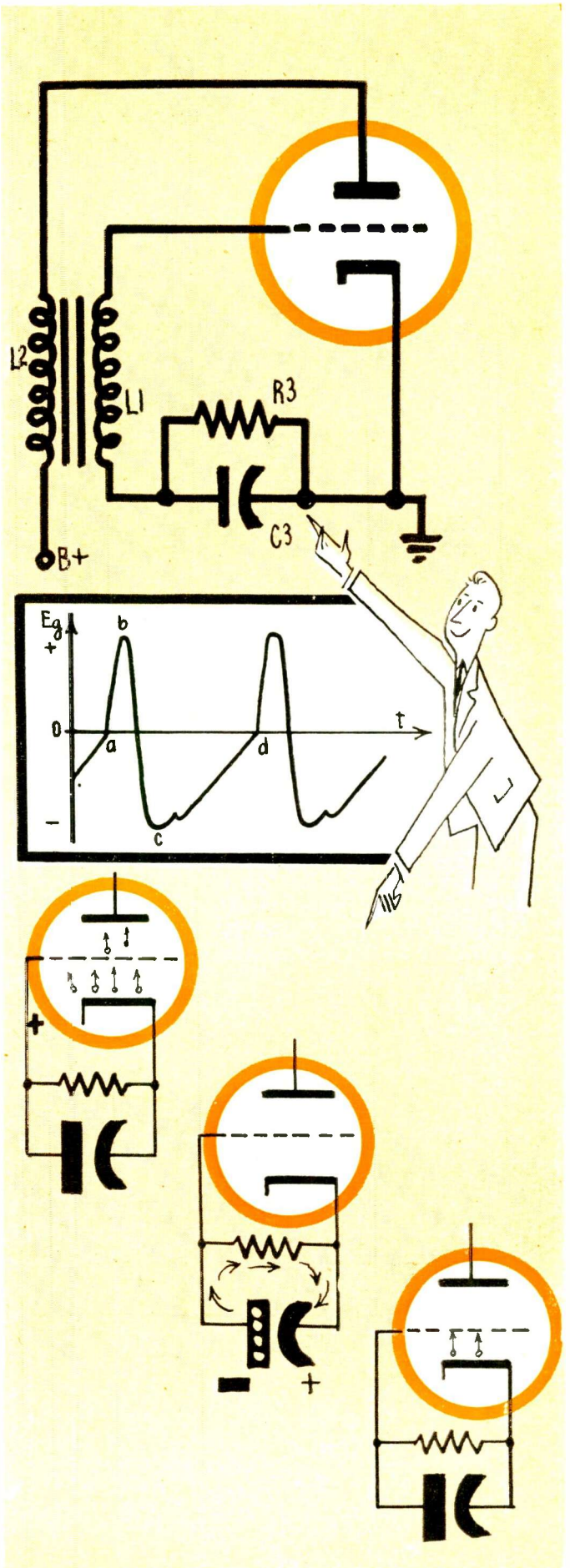
KEN—Then C3 will charge. Now, when will it discharge?

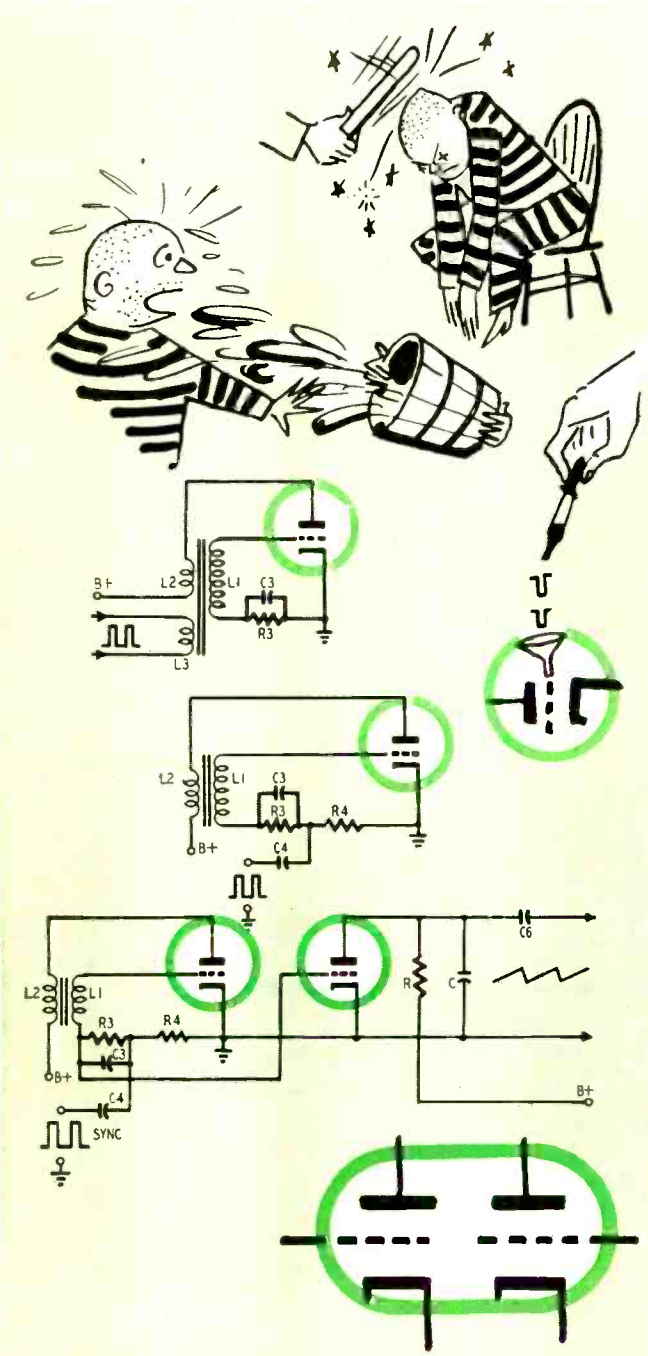
WILL—I understand it now. We get the first part of the bias when the control grid attracts electrons and returns them home through R3. And the second part comes when C3 discharges through R3, which it does just as soon as the voltage across it is *greater* than the voltage across R3. So these two currents, one direct from the grid and the other from electrons stored up in C3, keep the tube cut off till C3 is discharged.

KEN—Correct. And is that all?

WILL—No, that's not all. Everything starts all over again as soon as the grid voltage reaches a point where plate current can flow (*d* on the curve). We have another rapid positive thrust of the grid voltage, which makes another pulse, and a much longer negative period.

KEN—That's just about what I was trying to get across.





WILL—Simple! It's what I'd call a "police interrogation" circuit.

KEN—Do you mean to say you've found something in your favorite *True Detective* stories that you can use in your scientific life?

WILL—It's obvious. Standard third degree! A gangster is being questioned. He gets a heavy rap on the head, passes out; and as soon as he comes to, lets out a yelp. To keep him quiet, they give him another tap on the head. He comes to again, lets out another pulse—I mean another yell—gets another wallop, and so on.

KEN—I only hope, Will, that we will be able to make you as great an authority on television as you seem to think you are on criminology!

Simplifying Simplification

WILL—And how do you synchronize this blocked oscillator?

KEN—Simply by applying positive pulses to the grid, which trigger—at the right instant—the impulses which are being produced in the same direction.

WILL—Third-degree methods again. When the gangster shows signs of coming to, it's correct to pour cold water on his face to speed up his return to consciousness.

KEN—You'll excuse me if I think we can get along without gangster analogies! Now, we can use various methods of applying these synchronizing pulses to the grid of the blocked oscillator. You can use a third winding, L3, on your *blocking transformer* or you can bring them in through a capacitor C4 which is connected at the hot side of a resistor R4 inserted into the grid circuit.

WILL—If we adopt that system, won't the combination of blocking oscillator and discharge tube look very much like the schematic I designed?

KEN—That's right.

WILL—Only, it's no longer very simple.

KEN—That it isn't! In practical circuits, though, you can replace the two tubes with one; or at least use a double triode.

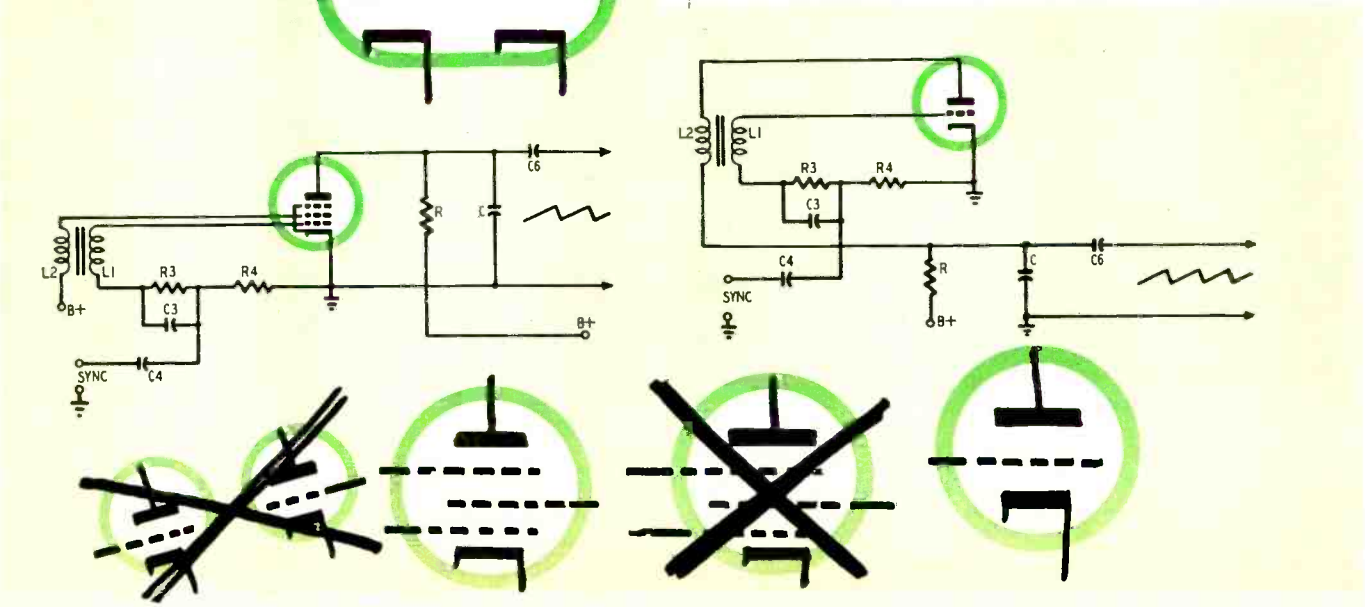
WILL—That doesn't simplify the hookup much.

KEN—Well, let's use a single pentode then. The blocking oscillator uses its screen as an anode. The cathode-anode space still serves as the discharge path for capacitor C. And this discharge is controlled by the rapid positive surges of voltage impressed on the grid at the sweep frequency.

WILL—Couldn't we replace our pentode with an ordinary triode by connecting L2 to the plate and putting the charging circuit in series with it?

KEN—It has been done. But let's stop simplifying—before we wind up with a perfect sawtooth generator made out of a pilot lamp and a flashlight battery!

(TO BE CONTINUED)



MEASURING FIELD-STRENGTH FOR TV

Antenna installation is simplified with TV meter.

By Engineering Staff, Scala Radio Co.

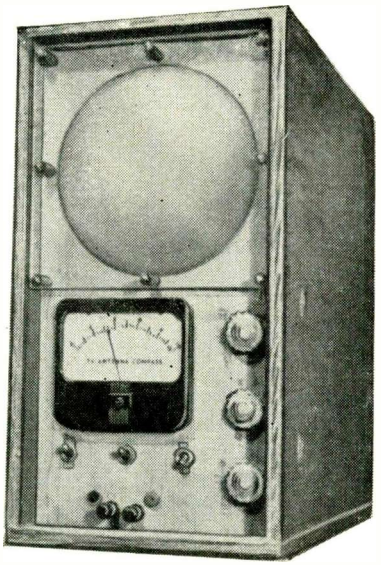


Fig. 1—Complete field-strength meter.

TO get the complete information on field strength needed for fringe-area and master-antenna installations, you need an instrument that displays picture quality and indicates field strength in microvolts. This is because there may be ghosts which can be eliminated by using the right kind of antenna. If the field-strength meter does not show picture quality, two strong ghosts may add in phase or out of phase, causing the field-strength indication to be entirely misleading. With the picture visible, the operator sees what he is measuring, and is not easily misled.

Noise (snow) can also lead to incorrect conclusions, unless the picture quality is determined at the time of the field-strength measurement. Although some noise information can be obtained from headphones energized from a narrow-band circuit, satisfactory data can be obtained only by quantitative measurements in wide-band circuits tuned to the desired channel. The reason for this limitation is that noise is not always uniformly distributed with respect to frequency. In many cases noise which interferes with television reception is resonant at a certain frequency, or over a limited band of frequencies.

An instrument designed to present the required information and to provide operating features for convenient application and accurate indication is illustrated in Fig. 1. Technical details which might be overlooked by the beginner, but which are required to obtain complete information, are developed later in this article.

The field-strength meter is constructed from a small TV chassis and a conventional field-strength meter providing relative field-strength readings. A Simpson TV antenna compass was used in this case. The TV receiver chassis is removed from its cabinet and mounted in a carrying case with a recessed panel, which protects the controls from damage under practical field conditions. For purposes of toughness and utility the carrying case is constructed of plywood.

Quarter-inch transparent plastic sheet is mounted over the face of the 7-inch picture tube, as seen in Fig. 1. This transparent protective sheet is superior to glass for knock-about use in the field. The speaker is mounted on the side of the carrying case and holes are drilled in the side of the case to provide egress for sound, as shown in Fig. 2. The constructor will find it necessary to mount the speaker at a reasonable distance from the picture tube to avoid raster distortion due to the speaker field. It may be necessary to put a ferrous shield over the neck and flare of the tube, as seen in Fig. 3. This shield must be grounded to the chassis, to avoid shock.

Circuit considerations

The front-panel facilities seen in Fig. 1 provide for viewing the quality of the picture, measuring the relative field strength of the video signal, indirect measuring of the absolute field strength, monitoring the audio signal, viewing the waveshape of the video signal with an auxiliary oscilloscope, and for measuring the a.g.c. voltage with an auxiliary v.t.v.m.

The circuit diagram shown in Fig. 4 provides for both 75-ohm unbalanced and 300-ohm balanced input. This feature is very desirable for absolute measurement of field strength, since standard signal generators with calibrated attenuators and an output meter work into 75-ohm unbalanced loads. Although the technician can use a balun between the output of the signal generator and the antenna input terminals of the field-strength meter, it is difficult in practical work to avoid appreciable standing waves in the conversion arrangement. This leads to inaccuracy in the microvolt measurement. When field-strength measurements are read on the meter from a 300-ohm balanced antenna system, and this relative field strength is measured by applying a signal from a standard signal generator, a correction factor must be applied to the calibrated attenuator indication of the generator because of the differing impedances. This correction factor is easily derived, as explained later.

The audio signal must be monitored at the time of the relative field-strength measurement, because—due to changes in propagation, or defects in the distribution system—the video voltage may be much larger than the audio voltage, or vice versa. When such situations are encountered, the technician must take steps to correct the defect, either by relocating the antenna, or by using a more suitable type of antenna (such as one with a narrower lobe), or by correct alignment of tuned circuits which may be discriminating against the sound or picture signal.

It is desirable to be able to view the composite video signal on an auxiliary oscilloscope, because the amplifiers used in distribution systems may be improperly adjusted, with the result that the sync tips are limited or the camera signal is limited, or both. In such case, the technician knows the cause of the trouble and does not waste time looking for trouble in the wrong places. The experienced technician can view the composite video signal on a d.c. scope and tell immediately whether the system amplifiers are performing correctly or not. A pair of binding posts are provided at the bottom of the panel for connection of the oscilloscope.

The technique of checking the video signal for compression or clipping, which leads to sync buzz in the sound,

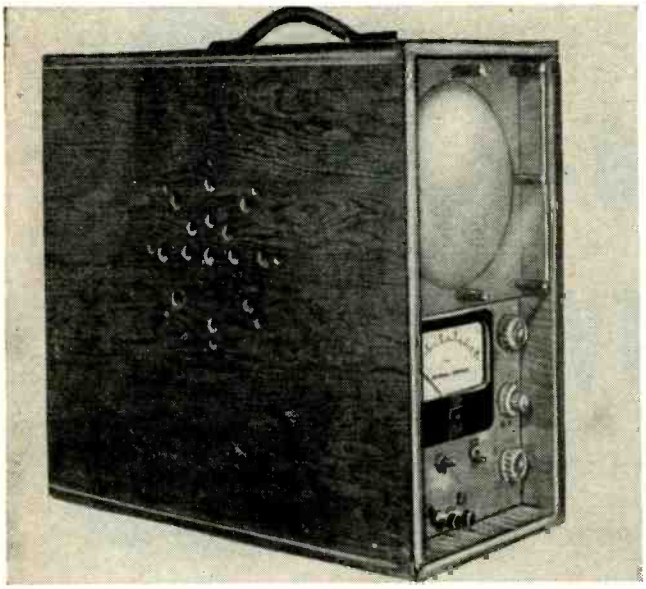


Fig. 2 (Above)—Side view of carrying case.

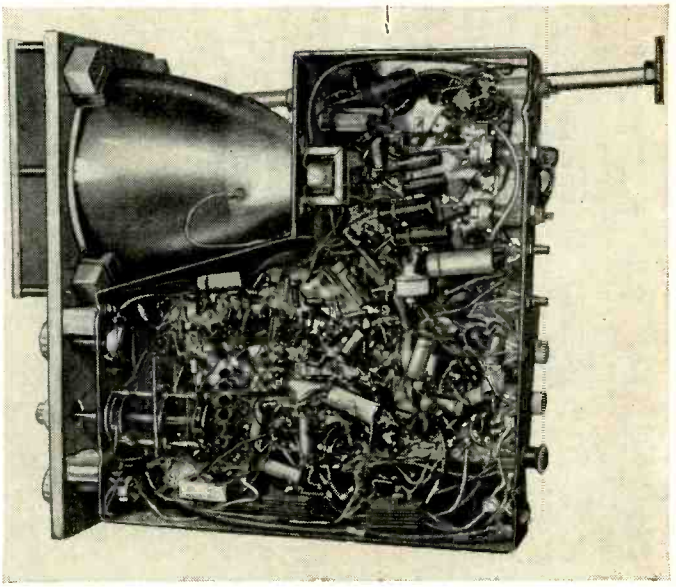


Fig. 3 (Right) Underside view. Shield over neck of C-R tube prevents distortion.

black or white saturation of the picture, and unstable sync action, is illustrated in Fig. 5. As transmitted from the TV station, the picture signal has a maximum modulation of 85%, which leaves 15% of unmodulated carrier at all times for intercarrier heterodyning of the sound signal. If this margin of carrier is reduced by compression of the signal, or if from the same cause the sync tips are limited, cross-modulation of sound and picture occurs in the signal circuits of the receiver. This intensifies the sync-buzz component in the sound signal beyond the ability of the ratio detector to separate the AM disturbance from the FM sound component.

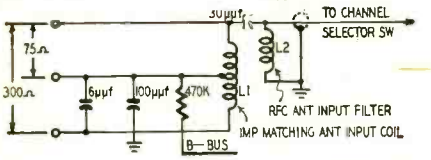


Fig. 4—Antenna input has provision for proper match to 75-ohm unbalanced and 300-ohm balanced line and antenna.

A d.c. scope is required to make a complete check of the signal, because the 15% margin of picture carrier cannot be observed on an a.c. scope, as illustrated in Fig. 5. Although a v.t.v.m. can be used in combination with an a.c. scope to check the percentage of modulation of the signal from the distribution amplifier, the determination can be made more directly and accurately with a d.c. scope which indicates the a.c. and d.c. components of the signal simultaneously.

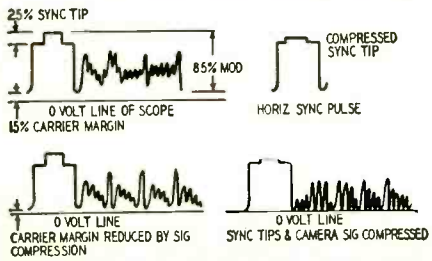


Fig. 5—Characteristics of a video signal, which can be checked with a scope.

As seen from the circuit diagram (Fig. 6). the relative field strength meter is energized from the output of the video amplifier. This field-strength indication will rise or fall somewhat in accordance with line-voltage variations—hence the need for measuring the line-voltage value at the time of the field-strength measurement.

The switches provide front-panel control for disabling the a.g.c. circuit of the receiver, for switching in a meter multiplier to extend the range of the relative field-strength readings, and for removing the meter completely from the video circuit when oscilloscope tests are desired.

The a.g.c. system of the instrument must be disabled during the measurement of field strength, since the meter is energized from the video amplifier, and the normal a.g.c. action of the receiver largely swamps out the meter indication. Accordingly, the switch is thrown to A.G.C. OFF for relative field-strength readings. A meter multiplier (present in the original meter assembly) is used to accommodate wide ranges of field-strength variation. Since the meter loads the video circuit somewhat, it is desirable to be able to switch the meter out of the circuit for inspecting the video-signal waveform with an auxiliary oscilloscope. It is useful to be able to measure the value of the a.g.c. voltage in the receiver with a v.t.v.m., because this reading can be compared with the value developed when the receiver is energized from the distribution system; abnormal operation is sometimes encountered due to the inability of the receiver a.g.c. circuits to accommodate the high signal level from the distribution amplifiers. Receiver readjustment is facilitated by measurement of both video voltage and a.g.c. voltage. Relative field-strength readings can be obtained from the a.g.c. voltage indication.

Signal-to-noise ratio

By detuning the field-strength meter to one side of the picture, the relative field strength of the noise can be measured. With the picture tuned in, the relative field strength of noise plus video signal can be measured. From these two measurements, the signal-to-noise ratio is easily determined. However, the operator must be careful to not be misled by resonant noise. Resonant noise can be detected in most

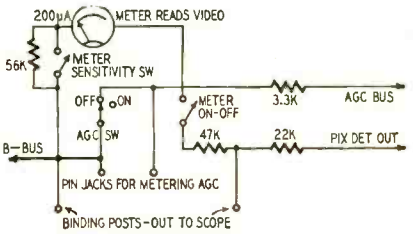


Fig. 6—Diagram of field-strength meter.

cases by watching the screen of the picture tube and listening to the sound as the tuning adjustments are made. A comparative check for resonant noise can also be obtained by making an independent measurement on another channel which develops approximately the same relative field strength of video plus noise voltage. If the technician finds that he is concerned with resonant noise, the determination of signal-to-noise ratio cannot be carried out as described above; instead, a qualitative judgment must be made by merely viewing the picture and listening to the sound.

The operator will often find that maximum signal strength does not always correspond to the best picture, because two in-phase ghosts will develop an abnormally large but unusable video signal. In the same manner, standing waves on the antenna input signal can develop abnormally large video voltages having poor quality. When installing an antenna under dif-

ficult conditions of reception, it is good practice to first try the best possible antenna; then, if the picture quality and field strength are entirely satisfactory, a less expensive and elaborate one can be tried. This procedure is preferred to starting with a poor antenna and working up, as it usually saves time.

The operator should also measure the field strength and view the picture obtained from the lead-in system alone, with the antenna completely disconnected, since line pickup can cause leading ghosts and poor picture quality which may, in error, be blamed upon other parts of the system. By keeping such landmarks clearly in mind, much lost time can be avoided.

Having determined that the lead-in system is operating satisfactorily, the relative field-strength readings of signal and noise combined with observation of picture and sound quality will usually indicate to the experienced technician the approximate type of antenna which will be required for satisfactory reception. Such knowledge is gained from experience, and avoids the necessity for methodically trying out a series of antennas.

Absolute field strength

Measurement of the field strength in microvolts is accomplished (when considered desirable) by energizing the field-strength meter from a standard signal generator having an output meter and a calibrated attenuator. Having made the substitution, the technician adjusts the calibrated output generator until he gets the same peak-to-peak reading at the video detector that he got with the TV transmitter signal. Since the meter provided with the instrument indicates r.m.s., it cannot be used for this purpose. Although the two signals would have the same peak-to-peak value, they would not have the same r.m.s. value. This peak-to-peak voltage can be compared by simply measuring the energy at the terminals provided in the front panel with an oscilloscope or peak-to-peak v.t.v.m.

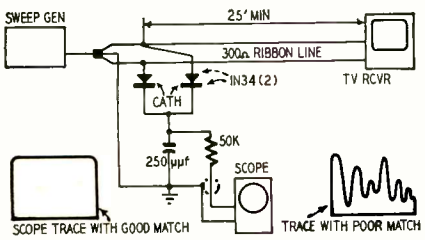


Fig. 7—Determining impedance match of twin lead to receiver with balanced crystal probe, scope, and generator.

The question is frequently asked why this measurement is not made directly on the instrument. The answer is that line-voltage variations in the field will cause inaccuracy in measurement. Furthermore, it is found that because of tube aging in the instrument, a calibration in microvolts is not permanent. For this reason, it is preferred to conduct field tests in terms of relative field strength, and to occasionally convert the relative reading into an absolute measurement in microvolts, if required.

If a receiver having both 75-ohm and 300-ohm input terminals is used in the field-strength meter, the measurement of field strength in microvolts is facilitated, since an impedance-matching device is not required between the output of the signal generator and the input of the field-strength meter. However, there are several pitfalls which may lie in wait for the unwary. For example, it must be remembered that the receiver circuits are voltage-operated, and if the coupling circuits used in the input system of the receiver cause a different voltage to be applied to the grid of the r.f. amplifier tube when the 75-ohm input terminals are used, a suitable correction factor must be applied. For practical work, the service man should accept the advice of the receiver manufacturer in this regard.

The percentage modulation of the signal and recognition of the difference between r.m.s. and peak-to-peak voltages must not be overlooked. The video signal voltage indication on the field-strength meter is necessarily based on the peak-to-peak voltage of the video signal. The output from a standard signal generator, on the other hand, is conventionally rated in r.m.s. voltage. Hence, the r.m.s. voltage output from the generator must be multiplied by 2.83 for proper comparison with the TV signal voltage. The output from the standard signal generator is usually modulated 30%, and it is this modulated component which is measured on the field-strength meter. Since the TV signal is customarily modulated 85% (as on a test-pattern transmission), the differences between these modulation percentages must be taken into account.

The correction factor for 30% modulation is practically unity; that is, the output voltage from the signal generator must be divided 85/30 to correct for the different percentage of modulation, but the output voltage from the signal generator must also be multiplied by 2.83 to correct for r.m.s. vs. peak-to-peak voltages. For other percentages of modulation the correction factor will be some figure other than 1.

Impedance matching

Impedance mismatches are a source of difficulty in several ways. First, the rated input impedance of a receiver is subject to manufacturing tolerances and to disturbance during service procedures. In a long line used in a master distribution system, poor matches lead to poor picture quality because of the time-lag and multiple reflections which may occur. When plugging a line into a field-strength meter, and subsequently into a receiver for tests, the operator should use 300-ohm jacks rather than switches which disturb the line impedance. The jack should be mounted as close to the front end of the receiver as practical, to avoid unequal lengths of line in the tests. These are typical refinements in technique, some of which are more important than others, but all of which will be taken into account by the professional service technician. Of the various mismatch considerations, line mismatch in the master distribution system is usually most serious.

Impedance checking is a complete subject in itself, and cannot be covered in this article. However, the reader may be interested in referring to Fig. 7, which shows how a sweep-frequency generator can be used with a scope and balanced crystal probe to check for an impedance match of a line to a load, such as a length of twin lead connected to the front end of a TV receiver. The chief consideration is for the service technician to recognize the basic factors which are at work. He can then devise his own testing procedures to meet the requirements of individual jobs.

Some sweep generators provide a zero-volt reference-line function, as indicated in the sketches of traces shown in Fig. 6. The zero-volt reference-line function is quite useful in checking impedance matches, because this zero-volt line makes it possible to determine the ratio of maximum to minimum; otherwise, the technician may be in considerable doubt concerning whether the mismatch is large or small.

The reader should carefully note that a generator without a zero-volt reference-line function can be used as well, provided an extra test is made. This test consists of shorting the load end of the line which causes an extreme standing-wave pattern. The peaks and valleys of this extreme pattern exhibit the worst possible situation of mismatch; the technician can draw a pair of horizontal lines on the scope screen with a grease pencil to indicate the maximum pattern excursion for complete mismatch, which automatically locates the zero-volt reference line. Lesser degrees of mismatch are then easily sized up by the operator.

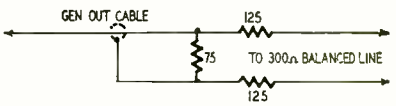


Fig. 8—Balun for impedance matching.

To acquaint himself with the various degrees of mismatch and the patterns which correspond to them, the technician will find it very instructive to terminate the line with various values of resistors, such as 10, 100, 300, 500, and 1,000 ohms. By noting the various scope patterns which result from the use of these load values, the technician will get the feel of the job, and will be able to conduct the tests with confidence.

Some sweep generators have a 300-ohm balanced output, while others have a 75-ohm unbalanced output. Since conventional twin lead has a 300-ohm balanced impedance, the operator must use a balun to drive a twin lead from a 75-ohm unbalanced generator. A suitable balun for this purpose is shown in Fig. 8. The principle of the balun is to provide a resistive pad which has approximately 75 ohms impedance looking into the pad from the generator end, and approximately 300 ohms impedance looking into the pad from the line end. END

TV SERVICE CLINIC

Conducted by
MATTHEW MANDL*

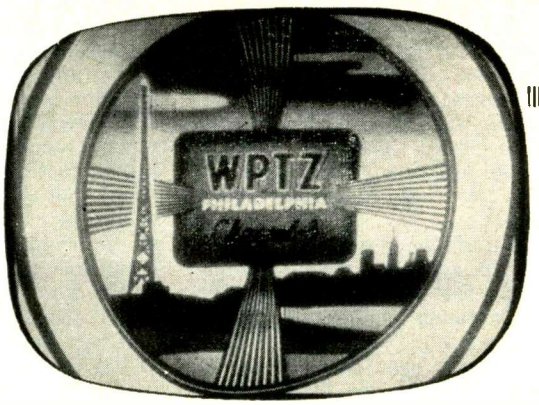


Fig. 1—Antenna is misoriented by 90°.

A NUMBER of localities are serviced by only one or two v.h.f. stations. In fringe areas, narrow-band Yagi antennas are often used. During the current reallocation plan of FCC, many such stations are assigned new channels. When the station frequency is changed, the narrow-band Yagi antennas give inferior results and often produce a blurred picture. Several readers have complained of reception which resembles ghosts, and have asked for dimensions so that they can modify the Yagi antennas to restore good reception. Other readers have asked for data on designing Yagis for fringe-area installation, or to replace other types of antennas.

The spacing between the elements is not as critical as the element lengths in Yagi antennas. Thus, complete redesign is not necessary when the new frequency is only one or two channels removed from the old. A change of element lengths will usually restore the antenna to receive clear pictures with almost the same gain as before. Table 1 gives the lengths of the antenna, reflector, and director for the v.h.f. spectrum. A table covering the u.h.f. band may be published in a later issue. Where a station has been changed to a higher channel it simply means cutting the antenna elements down to the dimensions given in table I. If the allocation has been to a lower channel, new rods will have to be installed.

*Author: Mandl's Television Servicing

Channel Number	Over-all antenna length (in inches) (Corrected for end effect)	Reflector (inches)	Director (inches)
2	97.2	102	93.3
3	88	92.3	84.4
4	80	84.3	77
5	70	73.6	67.3
6	65.2	68.2	62.5
7	3 .2	32.8	30
8	30.2	31.8	29.0
9	29.2	30.8	28.1
10	28.4	29.8	27.2
11	27.6	29	26.4
12	26.8	28.2	25.7
13	26	27.3	24.9

Table I—Antenna, reflector, and director lengths for channels 2 to 13.

Often the antenna and reflector elements can be used for the directors, thus reducing the number of new rods which must be purchased. For the busy technician, the quickest solution is the installation of a new antenna for the reallocated station.

Another factor which can affect picture quality is orientation. When Yagi antennas are used for either v.h.f. or u.h.f., the antenna should be oriented carefully for maximum signal strength. Not only will picture quality be impaired when the antenna is not oriented correctly, but also sync stability may be affected. In some instances the effect on sync may be noticeable before picture quality suffers greatly. Fig. 1 shows reception of a strong signal with the antenna misoriented by approximately 90°. Note the beginning of picture pull as evidenced by the bending of the vertical wedges. This is the forerunner of severe horizontal instability and vertical roll.

Even with the broad-pattern characteristics of the biconicals, misorientation is a frequent cause of poor picture quality and poor synchronization. This is usually the case when the antenna is to receive three stations from one general direction. When the signals arrive over an angle of approximately 60° to 90° the antenna will be misoriented for one and perhaps two stations, with resulting pulling, weaving, and poor picture quality. A good clue is sync instability or the tendency toward pulling and weaving by one of several stations which can be received. Orienting the antenna to favor the weaker station usually solves the problem. If the trouble is present for all stations, the receiver itself will have to be checked.

Vertical linearity

In an Admiral 20T1 receiver there is very poor vertical linearity. I have tried adjustments with the controls and also replaced the vertical output tube but this did not help. Brilliancy is adequate and horizontal width is all right. I checked all the parts associated with the vertical linearity control but nothing seemed wrong. I used my scope on the grid of the 6S4 tube and the waveshape seemed good. I tried the scope across the vertical deflection coils but got a waveshape which looked like the letter S in reverse. Some vertical ringing seems to indicate that the resistors across the deflection coils are missing. Is my diagnosis correct, or what is the trouble? V. Z., Haddon Heights, N. J.

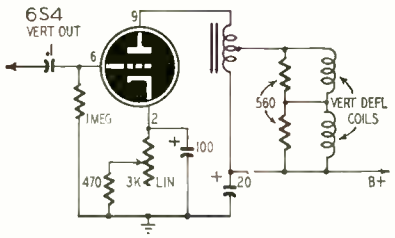
You mentioned trying a new vertical output tube, but often this trouble can be caused by the vertical oscillator tube, so you should try this tube also before making other checks. If the damping resistors across the vertical coils are open or are missing, they should be installed as shown in Fig. 2.

For proper observation of the waveshape in the vertical deflection coils, a 10-ohm resistor should be placed in series with the coils and a scope reading taken across it. Magnetic deflection is created by a linear current rise, and to produce this, a modified sawtooth voltage is used. The current flow through the 10-ohm resistor will establish the proper waveshape for viewing purposes.

Power line arcing

In our locality, channels 2, 4, and 5 are persistently interfered with by what I suspect is a corona discharge from a main power transmission line. This runs cross-country, north and south, and is located about two miles west of the receiver. From the size of the insulators, the transmission voltage is certainly in excess of 100 kilovolts. The interference is similar to auto-ignition interference but is grouped into two well-defined bands, separated by approximately one-half the picture height. These bands drift slowly up or down, and, since the stations are all in Los Angeles, it indicates that the interference is related to the local power system which is not interconnected with the Los Angeles system. I surmise that corona discharge takes place on the positive and negative swings of the 60-cycle power frequency, or 120 times a second, resulting in two bands on the raster.

If my diagnosis is correct, I would appreciate your comments regarding what can be done about the interference. There is the possibility that the antenna is coupled to the source of interference by the secondary power distribution



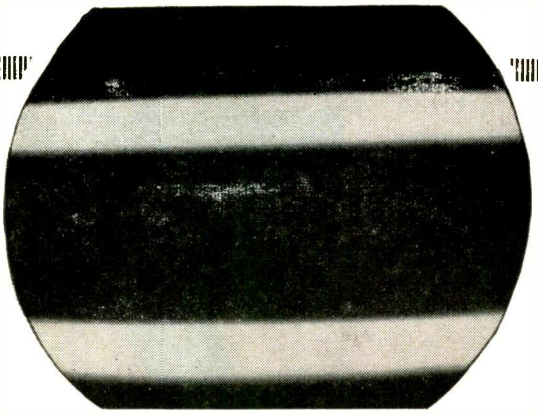


Fig. 2 (above)—Location of damping resistors across vertical deflection coils.
Fig. 3 (right)—120 cycle modulation.

line which is seldom more than 100 or 200 feet away from the antennas in this area. J. M., San Diego, Calif.

Your diagnosis of the source of interference is correct, for corona discharge at both peaks of an a.c. wave will introduce the two-bar impulse type of noise on the screen. In some investigations into double-bar interference in television receivers I ran across a complaint where two black bars appeared on the screen (Fig. 3). This was later traced to an amateur station where the filter capacitors of a full-wave supply had opened, causing heavy 120-cycle modulation of the carrier (and harmonics). Another instance was a double-bar pattern with ignition type of streaks, similar to what you described. This was traced to a local home where an ultraviolet-ray machine was in use periodically for therapeutic purposes. In one locality (embracing several blocks) the double-bar interference was present most of the time, again of the ignition type. The condition was worse during rain, which led us to suspect corona and arcing in a distribution line carrying several kilovolts. A portable battery-type radio finally seemed to indicate a transformer, because the noise became a roar in the radio near the pole on which the transformer was mounted. The matter was reported to the power company and the condition was corrected by them.

There is little you can do except report the matter to the power company. Line filters may help a little, as would a higher and more powerful antenna. The latter would increase the signal-to-noise ratio for the lower channels—where most impulse-type noise becomes noticeable in TV.

U.h.f. bowtie

Please advise me regarding dimensions of a bowtie u.h.f. antenna suitable to receive channels 51 to 67. What are the stacking dimensions for a pair of these? R. W., Easton, Pa.

The bowtie antenna is a broad-band type and if designed for the lowest channel to be received, will work for the higher channels. (This is not the case with narrow-band Yagi antennas.)

You could make the length of the bowtie 12 inches, which would cover channels 14 to 83. If you want it designed for channels 51 to 82, an 8-inch over-all length would be suitable.

The bowtie has low gain as compared with the Yagi types. A screen reflector placed about 6 inches behind the bowtie would increase gain and improve the front-to-back ratio.

For stacking, use the same distances mentioned above for the antenna lengths. Thus, a 12-inch spacing will be approximately one-half wavelength for channel 14 and will favor the lower channels. To favor higher channels, space the stacked antennas one-quarter wavelength (one-half the dimensions given for the over-all antenna length).

Transient trap

In an Admiral 221K46 receiver I am getting vertical white bar interference. I have replaced the horizontal output tube, the damper, and also the high-voltage rectifier. I have checked the capacitors in the damper circuit with no results. I have also replaced leaky capacitors in the horizontal output circuit and still get the vertical bar interference. What could cause this? W. H., Dayton, Ohio

First, adjust the drive control below the point where left-hand stretch or center compression occurs. If the white lines still remain, obtain the following parts:

Width coil, part No. 94A4.
Capacitor, .01-μf, 600 volts.
Resistor, 470 ohms, 1 watt.

Connect these units in parallel and insert this filter in series with the lead from terminal 4 of the horizontal output transformer to the plate of the damper-tube, pin 5, 6W4-GT. Adjust the slug of the coil until the vertical bar interference is reduced to a minimum. In some instances an omission of the 470-ohm resistor may help reduce the bar interference.

Hv arcing

Recently I cleaned the high-voltage compartment of an RCA 9PC41 projection receiver using air pressure. Since then a crackling sound comes from the high-voltage unit for about two minutes after the receiver is turned on. After warmup, an intermittent loud crack occurs, putting a flash across the screen. What is the best method for eliminating this arcing? J. O., Newark, N. J.

The fact that the crackling sound stops after the set warms up indicates that during load the peak voltages have decreased to where no arcing or corona occurs. Evidently when you cleaned the unit under air pressure some of the wiring may have been disturbed. You should check the unit by watching the high-voltage compartment in a darkened room to see where the arcing occurs. Space the wires apart from each other and from the chassis, and avoid sharp bends. You also could use a plastic spray or anticorona dope to insulate the sections where arcing occurs.

Poor signal

I have installed a rotator on the antenna for a Philco model 90 receiver. I also had to splice a 5-foot section of twin-lead to the original lead-in. Since then reception has been poor and the picture contains considerable snow. What is the likely cause? J. O., Portland, Ore.

An open circuit probably exists in the newly installed system. It is also possible that the 5-foot section which was added to the existing lead-in may not be making a good connection. A soldered joint should be made where the two wires connect, to insure good contact.

Also make sure the antenna lead-in is not taped to the mast. Standoff insulators should be used and the lead-in spaced off from tin roofs, rain gutters, and other metal objects.

17BP4 to 17HP4

A Mattison Silver Rocket model 630-6AB receiver uses a 17BP4A tube. I would like to use a 17HP4 electrostatic focus. What changes are necessary? B. S., Ontario, Canada

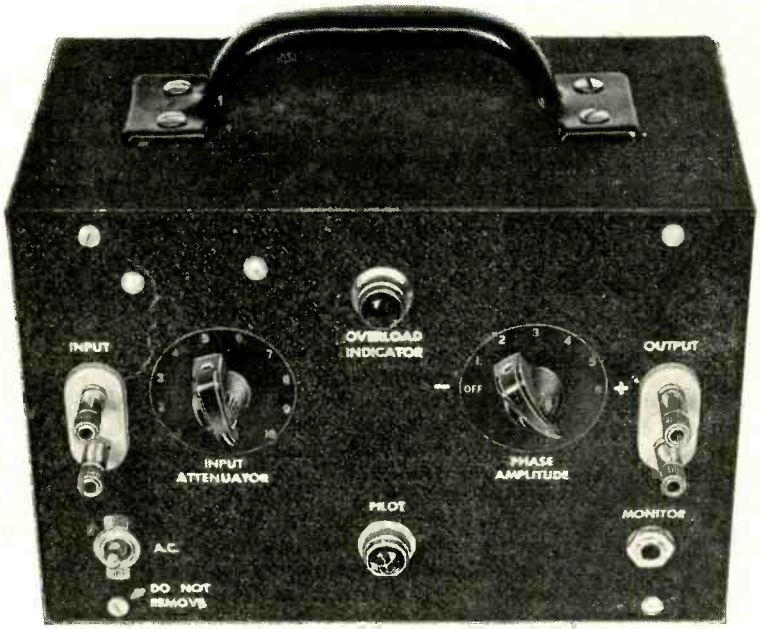
If the 17BP4A is to be replaced with a 17HP4, the focus unit must be removed from the neck of the tube and a variable resistor installed in the low-voltage power supply which will permit a voltage change from about minus 50 to plus 270 volts. This becomes the focus control.

A much better plan is to use a self-focus tube such as the 17KP4 or the 17SP4. These do not need a variable-focus potentiometer. The focus unit is removed from the neck of the tube, and when the ion trap is adjusted for maximum brilliancy, the focus will be properly set. END

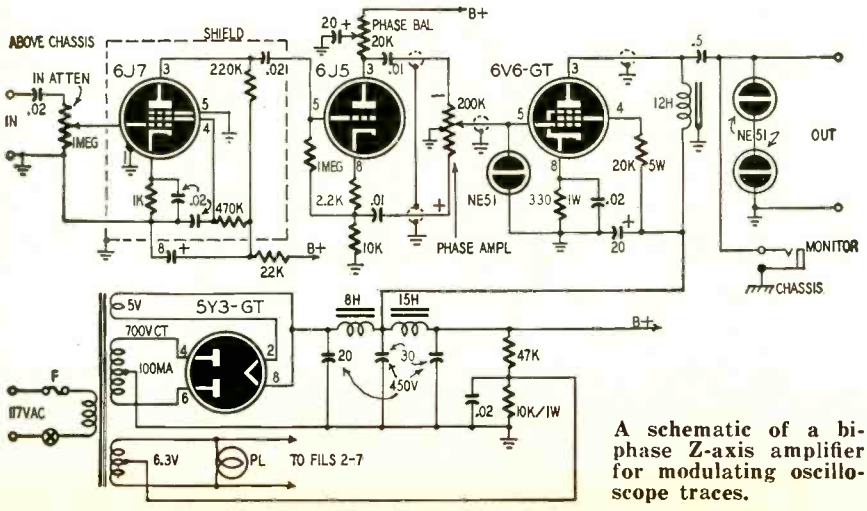
Z-AXIS for your SCOPE

Put your oscilloscope to work. Z-axis amplifier gives it new life and versatility.

By RONALD L. IVES



Front-view photo of the Z-axis amplifier.



A schematic of a bi-phase Z-axis amplifier for modulating oscilloscope traces.

WHENEVER serious experimental work is undertaken, the need for one or more additional amplifiers becomes apparent. This need becomes particularly acute if the oscilloscope is not equipped with a Z-axis amplifier, and a timing circuit is desired. The amplifier to be described is designed to insert timing "pips" or "breaks", via the Z-axis, into an oscilloscope display.

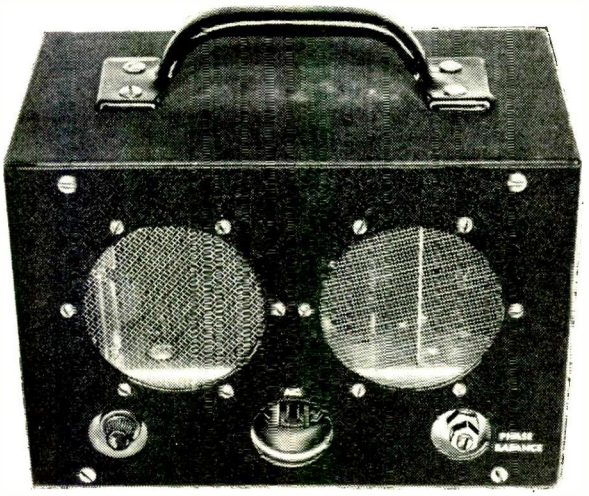
Fundamental requirements

For most types of experimental work, a Z-axis amplifier needs a voltage gain of little more than 1,000; an output power of more than 100 milliwatts; a very low hum level; and great electrical stability. For convenience, it should be self-contained and compact. To keep first cost and maintenance at a minimum, components should be standard wherever possible. Some means of reversing the phase of the output is highly desirable; and all exposed components should be "dead" with respect to power supply voltages (both a.c. and d.c.).

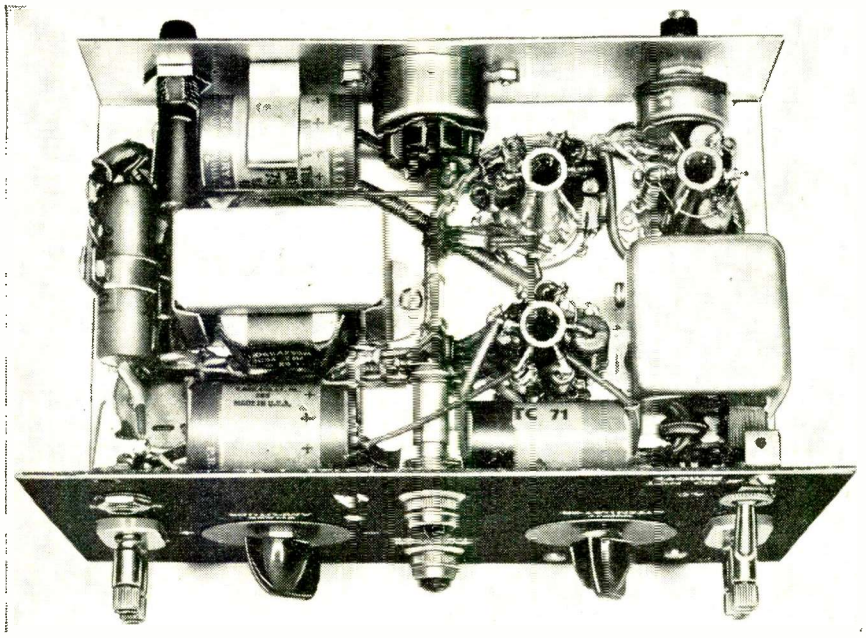
The circuit

After considerable experimenting with several types of amplifiers, the circuit in the schematic was arrived at as being the best compromise between technical perfection and operating convenience. It consists of a pentode first stage with high impedance input, a triode phase inverter (phase inversion optional); and a pentode power output. (All operated from a power supply with adequate filtering.)

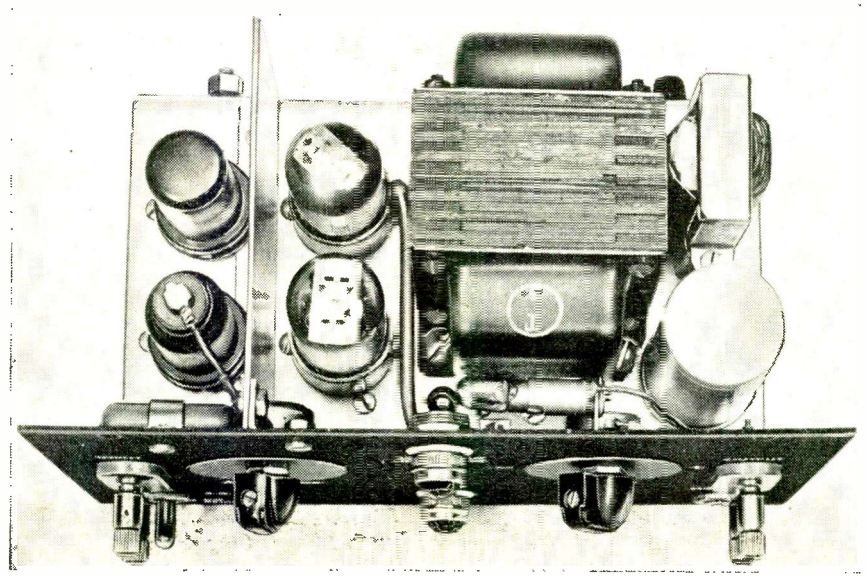
The input stage is conventional, and uses a 6J7 because of the ease of circuit isolation. This stage has a theoretical voltage gain of almost 200—and an attainable voltage gain of about 150—from 25 cycles to 50,000 cycles. Gain falls off rapidly from 50,000 to 100,000 cycles and becomes erratic at higher frequencies, though some amplification is still noticeable at 1 mc.



Rear-view photo of the amplifier showing ventilating grilles and phase balance.



Bottom-view photo of Z-axis amplifier showing turret sockets and shielding.



Top view of the amplifier. The dark line to left of power transformer is copper tube shielding the 6V6 grid input lead.

The triode phase inverter, a 6J5, is connected in a somewhat modified "hot cathode" circuit, with "bootstrap" bias. The output capacitors, instead of being connected to the grids of a pair of push-pull output tubes, are connected to a center-tapped potentiometer, permitting the choice of either phase in any desired amplitude. The arm of this phase amplitude control is connected to the final tube input.

The output tube is a 6V6-GT, pentode-connected, with a choke output. The NE-51's in the grid and plate circuits of this tube are used as "de-peakers," and are highly desirable to prevent spark-overs when the input amplitude is too high. Because this amplifier is designed to handle pulses as well as sine waves, some sort of spark-over protection is essential.

The power supply is a fairly conventional full-wave arrangement, with a two-section L-C π-type filter. Filter capacitors are considerably larger than optimum, to compensate for gradual loss of capacitance with age. To reduce hum, particularly that due to diode action from cathode to filament of the tubes, the filament center-tap is biased about 45 volts positive with respect to ground.

Construction

As originally breadboarded, and minus the circuit-isolating resistors and capacitors, this amplifier, loosely arranged on an 11 x 17 x 3-inch chassis, performed beautifully, and was very stable. Because bench space is somewhat limited, and all instruments used in a given test should be within reach from one position, some reduction in size was found desirable.

The component parts totaled slightly more than 140 cubic inches. Making due allowance for shape factors, cooling space, and necessary supports, it appeared that this amplifier, with its power supply, could be built in a standard 5 x 6 x 9-inch utility box, using standard parts throughout.

This concentration of parts proved highly unstable on the first attempt. The amplifier functioned as a very powerful a.f. oscillator. After considerable experimenting, during which the shielding and circuit isolations necessary for stable operation were determined, the final model shown in the photographs was designed and constructed. Internal arrangements of components and shields required some careful planning to avoid packing-factor troubles. Use of a mild-steel chassis (not aluminum) was found essential, and the above-chassis shield partition also was made of mild steel, cadium plated to prevent rusting. The placement of parts is shown in the interior above-chassis view of the amplifier. The filter capacitor, a triple unit (Mallory FP 396), is mounted to the right of the power transformer to isolate it from tube heat. Directly behind it, the second filter choke and the output choke are mounted "piggy-back," to conserve space.

To provide convenient mountings for the smaller components, Vector turret sockets were used throughout, as is apparent in the under-chassis view. Extensive shielding of signal leads was found essential; and the entire first stage subchassis assembly was shielded with an aluminum can. Braided tinned copper shielded tubing was adequate for the low-power leads, but short sections of spring curtain rod (iron) were found better for higher-power leads. To prevent damage from vibration, all capacitors are mounted either on turrets, on brackets, or on clips, and all supply leads are cabled. The ends of the lacing cord are made safe with cellulose cement (red nail polish works well).

Wiring is fairly straightforward, and only two sets of connections need polarization. The phase attenuator should be so connected that the input and output signals are in phase when the knob is turned to + position (extreme clockwise rotation of the control marked PHASE AMPLITUDE in the photo); and the output choke should be polarized for minimum hum.

Panel terminals (National R-39) were chosen for compatibility with terminals and connectors already in use on other equipment. To eliminate recurrent difficulties with dangling cords, which usually get stepped on at inopportune moments, a male a.c. connector, in a sunk mount (Amphenol 61-M10), was installed at center rear of chassis. A standard fuse mount was included in the supply circuit.

All front panel controls, terminals, and indicators are labeled with commercial decals (Tekni-cals), as are rear connector and control (see photographs). Strong rubber feet are bolted to the bottom of the case, to eliminate scuffing and skidding; and a strong handle (Stanley No. 3 door pull) was bolted to the top of the case. As the amplifier weighs 13 pounds 2 ounces, it could cause considerable damage if dropped cornerwise onto someone's foot!

Ventilation was provided through two-inch holes in the back of the case. These were covered with wire screen grilles. The grilles consist of rings of soft iron, 3¾-inch o.d. and 3-inch i.d., to which the wire screen is soldered, and are held in place by six 6-32 machine screws spaced 60°. For ease of servicing, the front lip of the case was cut away at the lower left, to clear the first stage shield can, and the screw normally in that position was replaced by an angle-bracket, so that the holding screw goes through the bottom of the case (DO NOT REMOVE in the photograph). All sheet-metal screws, supplied with the case, were replaced with 6-32 binding-head screws, tapped into the case, to eliminate future stripping trouble.

Adjustment

After assembly is completed, and the amplifier has been checked for operation, the two phases should be adjusted for balance. This is done quite simply. Connect a signal generator across the input of the amplifier, setting the frequency at about 400 cycles per second. Connect a vacuum-tube voltmeter across the output terminals, and load the output with a shunt resistor of about 10,000 ohms. Neither the input frequency nor the output load are at all critical.

Adjust the input attenuator to any convenient setting below the overload point (overload indicator not flashing). Set the PHASE AMPLITUDE control at the extreme clockwise position (+), and record the voltage indicated by the v.t.v.m. Set the phase attenuator at extreme counterclockwise position (−), and adjust the PHASE BALANCE potentiometer (on rear of chassis) until output is the same at maximum positive and maximum negative settings of the phase attenuator. After careful checking, tighten the shaft lock of the balancing potentiometer. Ordinarily, it will need no further adjustment until the 6J5 needs replacing.

Since many oscilloscopes do not provide a Z-axis input, it may be necessary to construct one. The most direct method is to feed the output of the Z-axis amplifier to the control grid of the oscilloscope through a .05-μf capacitor, with a 1-megohm resistor from the hot input terminal to scope ground. The capacitor should have at least a 2.2 kv rating.

Performance

Rather careful checking of the performance of this amplifier indicates that it is somewhat better than is needed for a Z-axis input amplifier.

With a 0.1-volt (r.m.s.) input, available output exceeds 150 volts from 45 cycles to slightly over 15,000 cycles. From 15,000 cycles to about 60,000 cycles, the available output falls off rather uniformly, reaching 35 volts at about 60 kc. From this point up, amplification is somewhat erratic, and waveforms are visibly distorted, although a signal of sorts is put out at all frequencies up to about 1.2 mc. These tests were made with a sinusoidal input and a 10,000-ohm output load.

Tests with pulse input show that clean pulse output is obtained with pulses up to 3.5 microseconds long, at repetition frequencies up to 100,000 cycles per second. With longer pulses, a damper diode is needed across the output to eliminate flybacks; and with higher repetition frequencies, pulse stretching causes pileups.

Power output is approximately 2.25 watts without visible distortion, at frequencies from 45 to 15,000 cycles. If the neon overload lamp is removed, an output (badly distorted) of up to 6.5 watts is obtainable at voice frequencies.

Materials for Z-axis amplifier

Resistors: 1—1,000, 1—2,200, 1—10,000, 1—22,000, 1—220,000, 1—470,000 ohms, 1—1 megohm, ½ watt; 1—30, 1—10,000, 1—47,000 ohms, 1 watt; 1—20,000 ohms, 5 watts, 1—20,000-ohm, 1—200,000-ohm, 1—1-megohm potentiometer.

Capacitors: (Paper) 2—.01, 6—.02, 1—0.5 μf, 600 volts. (Electrolytic) 1—8, 2—20, 1—20-30-30 μf 450 volts.

Chokes and transformers: 1—8-henry, 80 ma; 1—12-henry, 80 ma; 1—15-henry, 60 ma; 1—power transformer, 700 volts c.t., 100 ma; 5 volts, 2 amp; 6.3 volts, 3 amp.

Tubes: 1—6J7, 1—6J5, 1—6V6-GT, 1-5Y3-GT; 3—NE-51 neon tubes.

Miscellaneous: Pilot light and socket, 2-amp fuse and holder, sockets, chassis, shield partition, off-on switch, hardware, wiring, etc.

Conclusion

After approximately six months use in varied experimental and test work, it appears that this amplifier not only meets the need for which it was originally designed—Z-axis input—but is also a very satisfactory general-purpose test amplifier. In addition to its primary function, this amplifier has performed well as a speech amplifier, as a trigger amplifier in stroboscopic work, and as a component in an electrical stethoscope.

Total cost of this amplifier, at 1952 net prices, was just under $30, with top-quality parts used throughout, and ample margins of safety being allowed. Costs might be approximately halved by use of off-brand and surplus parts, although such might reduce the dependability of the instrument.

Construction time of this model was about 20 hours, and down-time for repairs, during six months, was zero. As nearly as can be determined from experience with this amplifier, and with similarly constructed equipment, the only maintenance work likely is replacement of the pilot lamp after 750 hours, replacement of tubes after 2,500 hours, and replacement of electrolytic capacitors after two years (whether the equipment is used or not). END

UNUSUAL INTERMITTENT PICTURE

The "intermittent" in this instance was in a G-E model 830 and the symptoms were baffling. Customer complaint was that the picture would suddenly grow dim and sometimes disappear completely. The sound was unaffected. When I switched the set on I found the picture brilliantly clear. This happened several times, and once, just as I was leaving the shop to have another look at it, I received a cancellation. The lady said the picture had returned all by itself when she left the set on for a while.

By this time it became evident that a poor connection, a cold-soldered or corroded joint, or an intermittent component was responsible, but there were hundreds of spots where the trouble might lie. Luckily, I remembered that somewhere, sometime, I had found a loose wire in a tube-base pin which had caused plenty of trouble although the spot of solder at the end of the pin made detection difficult. The wire from one of the tube-filament leads was just resting against the spot of solder at the end of the hollow base pin.

Well, a hot iron and a bit of rosin-core solder was the answer here, too. Believe me, I never saw this trick in any TV handbook. —*Albert White*

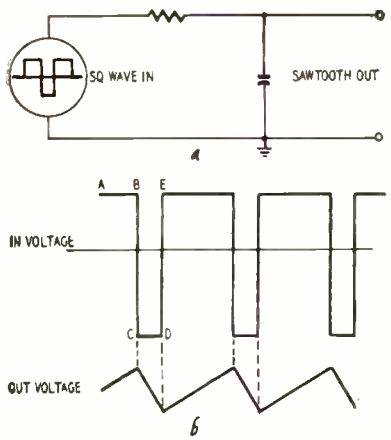


Fig. 1—Generation of a sawtooth wave.

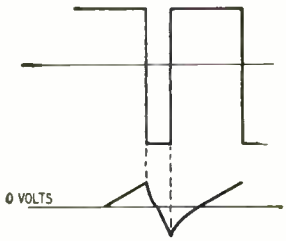


Fig. 2—This kind of thing doesn't happen!

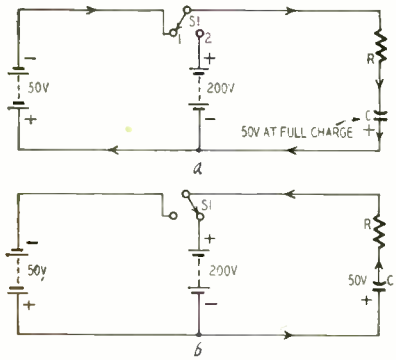


Fig. 3—The capacitor is first charged to 50 volts, then is discharged in series with a 200-volt battery, as shown.

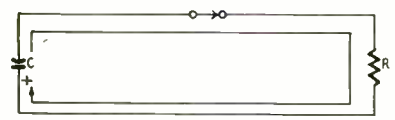


Fig. 4—Simple R-C discharge circuit.

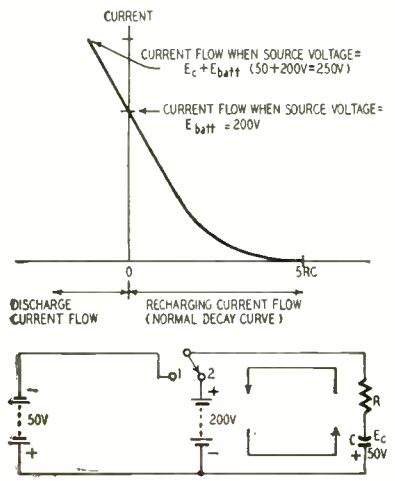


Fig. 5—Current flow as capacitor discharges to 0, then recharges to 200 volts.

Analyzing the R-C CIRCUIT

R-C theory frequently reveals the basic characteristics of a circuit's operation, greatly facilitating its design and repair

By CYRUS GLICKSTEIN

THE key to a circuit problem is often tied to one small point that just doesn't fit into place. After the "minor" point is broken down, there is a completely new picture of circuit operation. A simple illustration of this situation is shown in the circuit of Fig. 1, where a sawtooth wave is projected from a square wave.

TV technicians are familiar with the fact that a square wave applied across an R-C circuit as in Fig. 1-a, produces a sawtooth wave (Fig. 1-b) provided the R-C circuit has a long time-constant and the output is taken off the capacitor (integrated).

It seems reasonable that the capacitor charges linearly when the square wave is first applied, giving a rising sawtooth voltage in the first quarter-cycle. But in the next quarter-cycle, when the square wave voltage reverses, why doesn't the capacitor voltage discharge exponentially to zero (as shown in Fig. 2) before the capacitor charges up in the reverse direction? From ordinary R-C circuit theory it seems a capacitor should do just that. Yet from experience (oscilloscope examination, etc.) we know that a linear sawtooth is obtained.

This action is based on an interesting point about capacitor action not found in most reference texts. The basic action can be illustrated in the circuit shown in Fig. 3. The capacitor C has been charged to 50 volts on the No. 1 position of the switch, Fig. 3-a. When the switch is placed in the No. 2 position (Fig. 3-b), there is a 200-volt battery in series with the charged capacitor. In this switch position, the capacitor first discharges to zero and then recharges in the opposite direction to 200 volts. Current in the circuit then stops. How long does it take the capacitor to discharge down to zero, before it starts charging in the reverse direction? In a simple discharge circuit, Fig. 4, it takes a charged capacitor 5RC to discharge to (approximately) zero. But the answer is definitely not 5RC in the circuit of Fig. 3-b because this is not a simple discharge circuit. It is a modified discharge circuit until the capacitor discharges to 0 volts. Then, the circuit acts exactly like any normal charge circuit while the capacitor recharges in the opposite direction to the battery voltage of 200.

To explain the discharge action, it must be remembered that in any R-C circuit, whether charge or discharge, the current at the instant the switch is closed is determined by the potentials in the circuit. These voltages may be in the battery or across the charged capacitor or *both*, if the capacitor already has a charge across it. In this case, at the instant the switch is thrown to the No. 2 position, the initial current depends on both the battery voltage (200) and the voltage across the capacitor (50). The two voltages are in series and can be considered one voltage in analyzing the action. An initial current flows which is based on the sum of the two voltages. The discharge circuit therefore acts *exactly the same as if the capacitor were charged up to 250 volts*, with no battery in the circuit. Current keeps decreasing as the capacitor discharges to zero. At the instant the capacitor voltage is zero, only the battery voltage of 200 is in circuit. The capacitor then charges in the reverse direction. Current continues in the same direction and continues

to decrease, in typical charge circuit action. When the capacitor is fully charged to the battery voltage, no current flows.

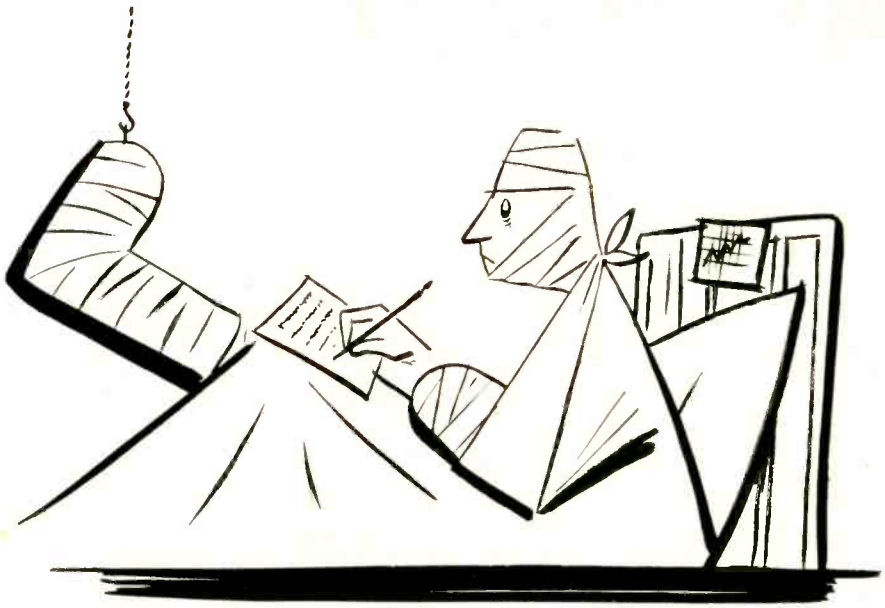
It does not take long for the capacitor to discharge to zero, compared to the time needed for recharging. At the instant the switch is thrown to position 2, the current is maximum. There is a voltage drop of 250 across R. When the capacitor voltage is zero, there is a voltage of 200 (battery voltage) across R. Current therefore must drop 20% or ⅕ to cause the voltage across R to go from 250 to 200 volts. According to R-C series circuit theory, a 20% drop in current (or in voltage across R or C) takes place in a time of 0.2 RC. More important, the first 20% of charge or discharge in an R-C circuit is *linear*. To state this fact somewhat differently: as long as the capacitor voltage is small (⅕ or less compared to the battery voltage) when the switch is thrown to position 2, the discharge of the capacitor will be linear. After the discharge to zero, the recharge in the opposite direction will also be linear, provided the capacitor is not allowed to charge up to more than 20% of the source voltage.

Actually the initial discharge in such circuits can be considered a linear extension of the standard charge curve for current (Fig. 5).

This principle explains the production of a sawtooth voltage across a capacitor when a square wave is applied to an R-C circuit as shown in Fig. 1-a. Assume the square wave (Fig. 1-b) is positive at A, when the switch is turned on. The capacitor starts to charge. When the square wave goes sharply negative (B–C) there is no exponential decay of voltage to zero before the capacitor recharges. Instead, the negative source (square wave) voltage is in series with the voltage in the capacitor. It discharges *linearly* to zero on the basis of the total voltage in the circuit. At the instant the capacitor voltage reaches zero, it then starts to recharge in the opposite direction, based only on the source voltage. The recharge is linear also, when the capacitor does not have time enough to charge up to a substantial percentage of the applied voltage. When the source voltage reverses polarity again, the capacitor voltage again is in series with the applied voltage, and the discharge current is based on the combined voltages. There is a linear discharge until the capacitor voltage reaches zero, then it recharges, and so on.

A linear sawtooth is produced when the time-constant of the charging circuit is large compared to the time of the applied voltage. The capacitor then charges to only a small part of the applied voltage. This means it charges only on the initial portion of the charging curve where the voltage rise is linear.

The principles of capacitor action discussed in this article can be applied to clarify the operation, design, and repair of many different kinds of circuits. END



RADIO DIAL MECHANISM

National Service Manager
Superoptic Radio and TV Corp.
Ninety Six, S. C.

Dear Sirs:

Thank you very kindly for the instruction sheet which you enclosed with the new dial cord and pointer kit for replacement in your model T-175. There is some question, however, as to the completeness of the installation procedure as outlined on the sheet. The following are a few points that might be added:

First, as the cord is grasped firmly in the left hand and the dial spring is held in the right hand (as shown in the instructions), I found no trouble in threading the cord around drum A, through eyelet 3A and under slider X. However, I think it should be noted that in order to cut the cord at W while spring R-1 is stretched to 1.1 inches and the dial pointer is located at 720, it is necessary to transfer the cord (W-1) so that it is held between the teeth, so the left hand is free to cut the cord at H.

Also, since the dial drum tends to move while stretching spring R-1, it is necessary to remove one shoe (preferably the right) and place the big toe through cutout S-1, under plate 7 of variable capacitor C17A, being careful not to bend the plates with the toenail. A note of caution is also necessary in the instructions for stretching tension spring B-7 to point A; since in case the spring is pulled beyond point A, serious injury may result to the right elbow (required to hold drum C from falling off shaft T while set-screw S-19 is loose). In addition it should be advised that a first-aid kit be kept handy while looping cord 2 through hole F and around drum G. It seems that this procedure often causes heavy pressure on springs L-1 through L-7, resulting in their flying in all directions around the room.

My second suggestion is to provide a procedure for setting the dial pointer P1 to indicate 720 on the dial. Since it is required to set the pointer before cutting the dial cord, and since the cord cannot be cut until spring R-1 is stretched to exactly 1.1 inches, some difficulty may be encountered. Remember that the left hand is holding cutting pliers; the right hand is stretching spring R-1; the teeth are holding cord Y; the left knee is preventing the chassis from falling off the table; the right elbow is holding drum C on shift T; and the right toe is inserted in cutout S-1 under plate 7 of variable capacitor C17A. It is therefore necessary that a board (not supplied with kit) be propped up behind the dial plate between J and D to apply pressure to the slider at Z. This will hold the dial pointer exactly at 720. Extreme care must be taken in placing the board on the slider since the board will tear the speaker cone completely off the speaker frame if it slips.

After cutting the dial cord (at point W as shown on the instructions) it was found that a note of final warning should be included on the instruction sheet. The heavy tension caused by spring R-1, when stretched to 1.1 inches, results in the sudden revolving of dial drum C (despite the pressure of the elbow against it). Dial drum C will then spin off of shaft T and spin across the front of the chassis, breaking tubes V1, V2, and V3, unless these have been removed.

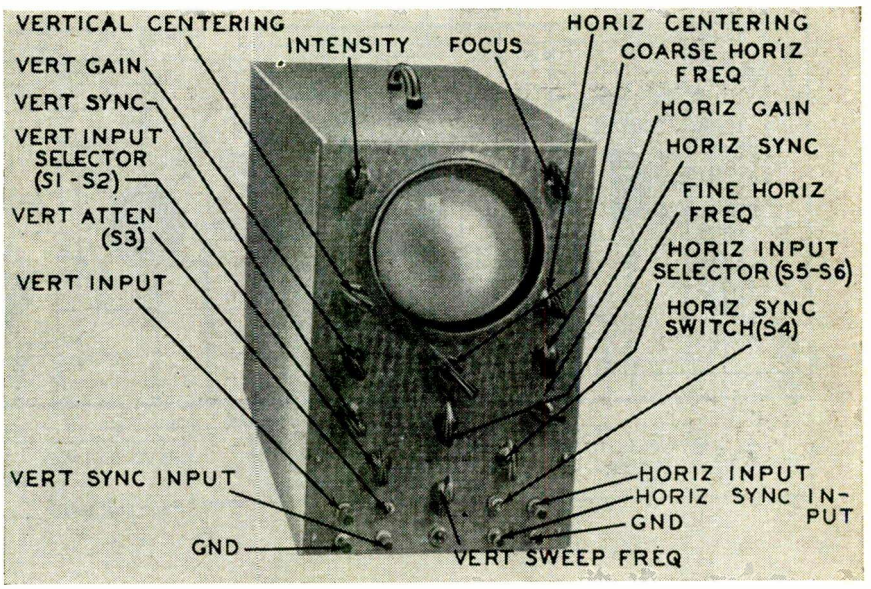
Also, please note my order for another installation kit of the same type —the original was ruined when the cutter slipped. Please send the kit as soon as possible, since my physician advises me that I will be on my feet again in a few weeks.

Very truly yours,
Herbert Michels

Versatile Scope you can build

Vertical and horizontal sweep circuits make it useful for television work.

By LLOYD B. HUST



Front view of oscilloscope. Controls are neatly arranged.

THE oscilloscope is a versatile instrument. It is useful in measuring voltages, indicating phase differences, indicating modulation percentages, etc. When sweep circuits and amplifiers are added to it, its versatility is increased many times. Its voltage range can be extended, and it becomes very useful for indicating frequency and waveform.

The oscilloscope described here is more versatile than most models now on the market. Its horizontal sweep frequency extends to 100 kc, which is double or triple that of most oscilloscopes. Its sensitivity is better than that of many others, and it incorporates a vertical sweep circuit, which increases its usefulness in television work. Sixty-cycle a.c. can be switched into either the horizontal or the vertical inputs, and provision has been made to have the 60-cycle input to the horizontal circuit 180° out of phase with that supplied to the vertical, which makes for interesting phase comparisons.

The frequency response of the instrument is relatively flat to 2 mc, somewhat lower than the video amplifier of a good television set, but adequate for most oscilloscope purposes, including television servicing. This response could be made to approach that of a good TV set if video peaking coils were used in the plate circuits of the amplifier stages. Such extended response is seldom necessary in any case. The frequency response permits viewing a fair television picture on the cathode-ray tube of the oscilloscope.

The circuit (Fig. 1) consists of amplifiers for both vertical and horizontal circuits, sweep oscillators for both circuits, internal or external synchronization for the horizontal sweep circuit, and external synchronization for the vertical sweep circuit.

The vertical amplifier consists of a 6J5 cathode follower which feeds a 12AT7. Both sections are connected in cascade. The 12AT7 feeds a 6C4 which is used as a phase inverter to supply the signal to the vertical output tube, a 12AT7. This push-pull output tube feeds the vertical plates of the cathode-ray tube, which can be a 5BP1 or 5BP4. The input of the first stage contains a step-attenuating circuit controlled by S3, which allows signals of either high or low intensity to be fed into the vertical amplifier. The switch S1 switches the input of the first stage to the output of the vertical sweep oscillator, or directly to the oscilloscope input terminal, or to a 60-cycle test voltage. S2 (ganged to S1) removes the plate voltage to the vertical oscillator for all positions of S1 except position 1. Thus, the oscillator is disabled when not switched to the input of the amplifier.

The cathode follower input stage allows good high-frequency response because the necessity of the volume control being in the grid circuit of this tube is eliminated, thereby eliminating high-frequency attenuation caused by grid resistance variation. This type of input stage makes it possible to mount the first tube near the front panel, and the following tubes near the base of the C-R tube, the long leads introducing little loss as they would in other types of circuits. Large capacitors and direct coupling from the 12AT7 to the 6C4 insure good low-frequency response.

The horizontal amplifier consists of a 6J5 which acts as a phase inverter feeding a 12AT7 which supplies the signal to the horizontal plates of the C-R tube. The spot is positioned by the potentiometers across the plate load resistors of the output stages. The horizontal amplifier is connected to either the output of the horizontal sawtooth oscillator, the horizontal input binding post, or a 60-cycle test voltage by switch S5. S6 cuts off the plate voltage to the oscillator when S5 is in positions 2 or 3, but connects it when S5 is in position 1, the position in which the output of the sweep oscillator is fed to the input of the amplifier. The 60-cycle test voltages supplied to the vertical and horizontal amplifiers are 180° out of phase as each is taken from an opposite side of the filament supply, the center of which is grounded. Although this gives only 3.15 volts for the a.c. test, it is adequate to give a trace close to 2 inches long on the C-R tube.

Low values of plate resistance are used in both amplifiers, and all cathodes are unbypassed. These two factors limit the gain of the amplifiers, but this

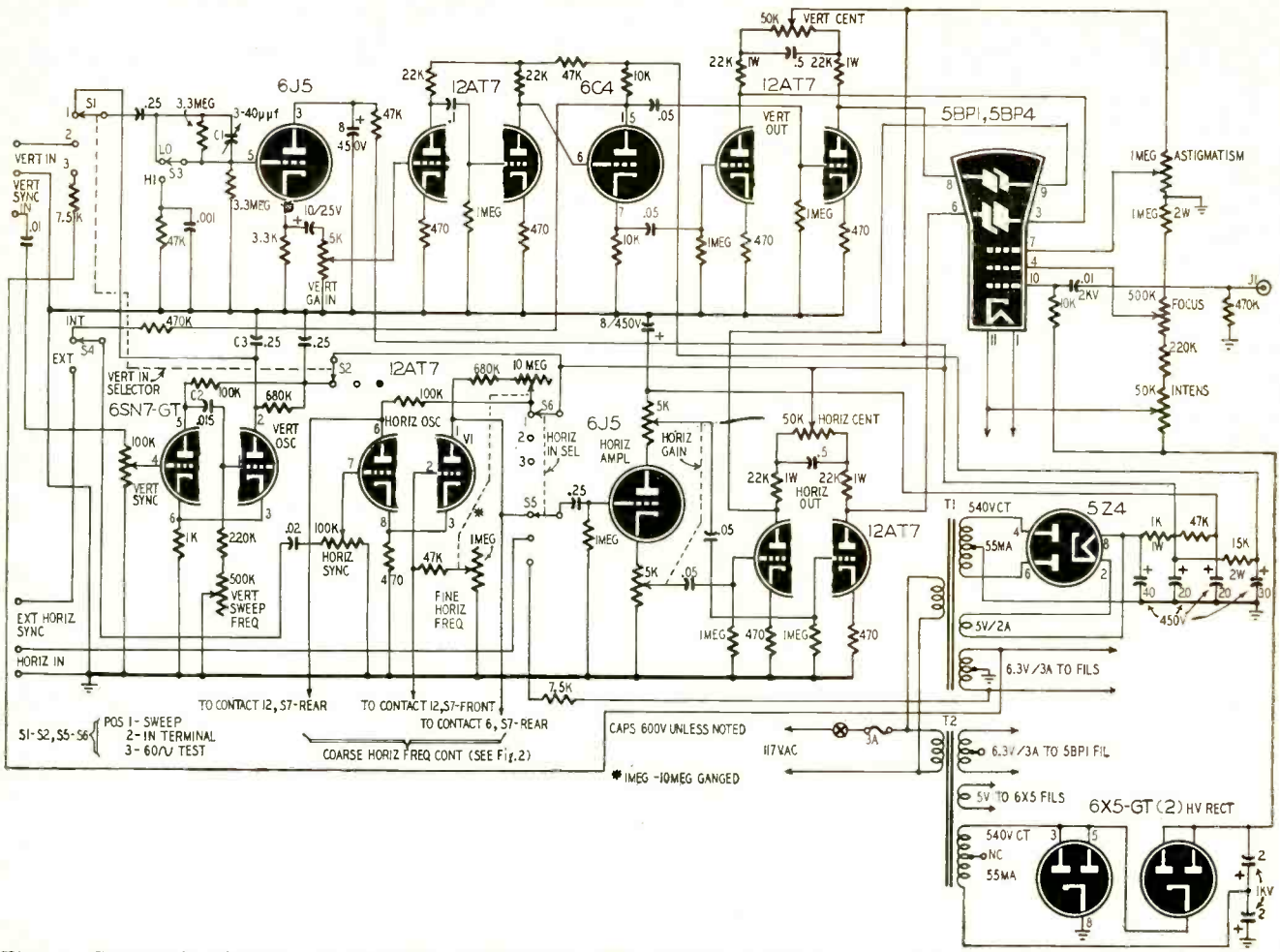
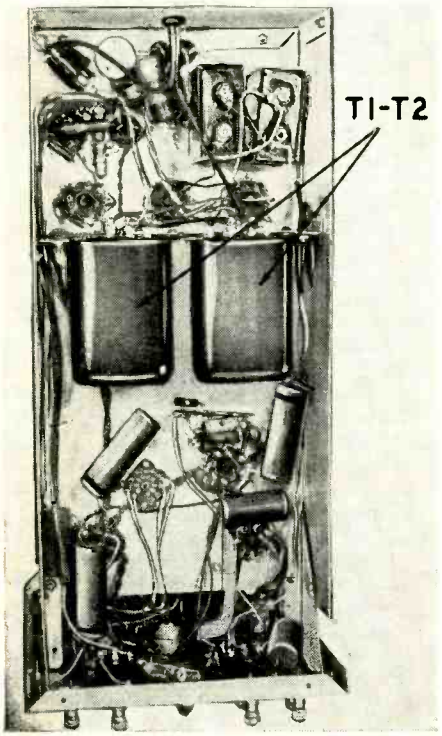
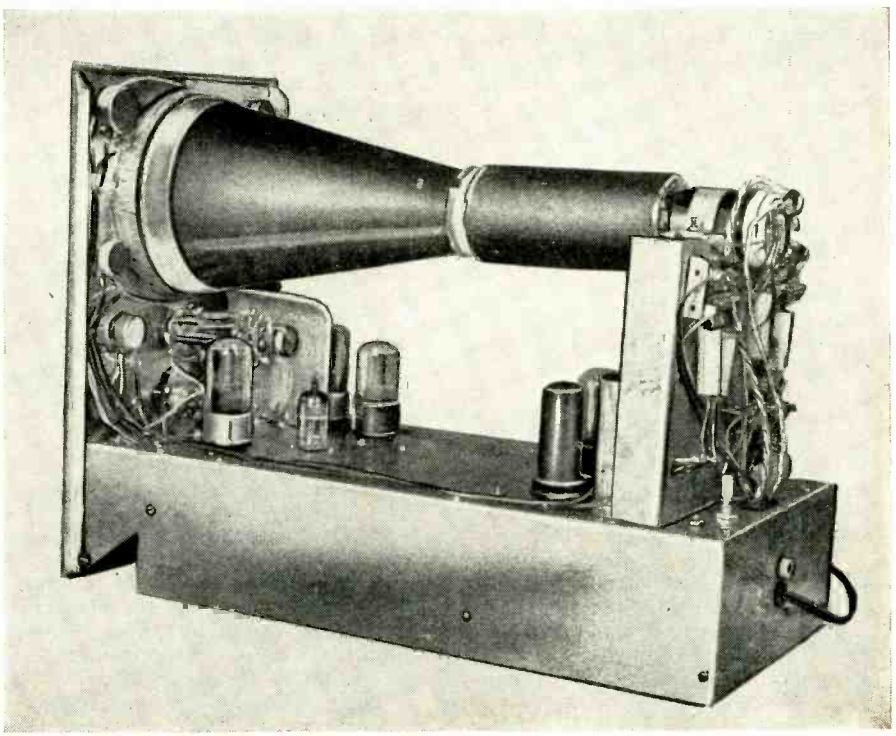


Fig. 1—Schematic diagram of versatile oscilloscope. All cathode resistors are un-bypassed to reduce distortion.



Underchassis view of oscilloscope. Angle brackets are mounted on the corner of each transformer, and to the side of the chassis. Primary terminals are up.



Side view. To eliminate stray fields, length of iron pipe is placed over neck of tube. Vertical chassis with components mounted is seen at right.

disadvantage is offset by the higher quality of the amplified signal. The reason for this is that the degeneration introduced in each stage by the lack of bypassing reduces distortion, and the low-value plate load resistors aid in maintaining good high-frequency response. The amplifiers have enough gain for the purposes of the instrument.

The horizontal sweep circuit is composed of a multivibrator built around a 12AT7 tube. This tube produces a sawtooth voltage. Its frequency depends upon the values of the capacitors switched into the circuit by S7 (Fig. 2), and by the values of resistance introduced into the circuit by the sections of the FINE HORIZ. FREQ. control. Output of the sweep generator varies from a minimum of about 12 cycles per second to slightly over 100 kc, giving a very useful range. The frequencies of this circuit for the different positions of the COARSE HORIZ. FREQ. control are as follows: position 1, 12 to 120 cycles; position 2, 120 to 1,200; position 3, 1,200 to 12,000; and position 4, 12,000 to over 100,000. The setting of the horizontal sync control will vary these values somewhat.

The switch S7 which is used as the coarse frequency control, is listed in the parts list as Mallory 1325-L. This is a 2-gang, 2-circuit-per gang, 5-position switch. It has an adjustable stop which should be set so that only the first four positions are used. The switch should be wired as shown in (Fig. 2). Capacitors C4, C5, C6, C7 and C8 should be mounted between the terminals of the front and rear sections of the switch. This facilitates mounting and makes it possible to isolate these circuits from others by shielding.

The vertical sweep circuit is somewhat similar to the horizontal, except that it uses a 6SN7-GT tube and covers a frequency of about 15 to 90 cycles. It was incorporated into the instrument to make it possible to view a television picture directly on the oscilloscope. This circuit is very similar to the vertical sweep circuits used in electrostatic deflection TV sets. Since commercial tolerances on resistors—and particularly on capacitors—vary, it may be necessary to experiment with the value of C3. Check this capacitor if the vertical sweep fails to supply a 60-cycle sawtooth wave at about the mid-setting of the vertical sweep control, which corresponds to the vertical hold control on a TV set.

The power supply is somewhat different from that of most other oscilloscopes. I wanted to use good-quality shielded transformers, but did not want to have to purchase specially designed units. The Chicago PSC-55 power transformers were found to be ideally suited for this application. One of these is used in a conventional full-wave power supply, with a 5Z4 tube as rectifier. This supply furnishes the voltages to the various amplifier and oscillator tubes. The other transformer is used in a voltage-doubling circuit with two 6X5 tubes to supply the high voltage to the C-R tube. Filament power for the 6X5's and for the C-R tube is furnished by this transformer. The 5-volt filament winding is connected to the 6X5's, and although the ratings of these tubes indicate 6.3 volts for filaments, the 5 volts supplied by this transformer does the job in fine style. The center-tap of the high-voltage winding is left floating and the entire high-voltage winding supplies the voltage to the doubler circuit. This type of high-voltage supply has several advantages; a standard radio power transformer can be used; the voltage rating of the h.v. capacitors can be just half that required by conventional half-wave power supplies; and special high-voltage rectifier tubes are not necessary.

The voltage delivered by this doubler circuit is practically double that of the *peak* rating of the high-voltage winding of the power transformer. Measurement with a v.t.v.m. showed the voltage across each of the voltage-doubling capacitors to be from 850 to 900, giving a total of 1,700 to 1,800 volts for use by the C-R tube. Since the current drain is small, there is practically no voltage drop, and this voltage gives excellent brilliance on the cathode-ray tube, even when its face is covered with a television raster.

It is very important that shielded transformers be used for both power supplies, as the strong magnetic field which surrounds unshielded transformers will deflect the electron beam in the cathode-ray tube. It is also important that the power transformers be mounted *underneath* the chassis and well toward the rear. The photograph of the under side of the chassis will serve as a guide in the mounting of these units.

Construction

Although exact chassis layout can vary, the photographs show the general construction and can serve as a guide to the builder. I followed the practice of some commercial oscilloscope builders in mounting the input tubes and power supply on the main chassis, and the other tubes on a small vertical chassis at the back. The small vertical chassis also holds the cathode-ray tube. The builder can depart from this layout, but he should keep in mind that the input and oscillator tubes should be mounted near the front panel. The horizontal oscillator tube and associated components should be separated by a shield from the other tubes and components. The power supply should be on the main chassis, and the power transformers underneath the chassis and toward the rear of the unit.

The tubes feeding the cathode-ray tube should be mounted near its base. The cathode-ray tube mounting should clamp the metal part of the tube base solidly, but should not put any strain on the neck of the tube. If the front of the tube is mounted as shown in the photos, with a felt lining protecting it, and the base is clamped firmly, no additional support will be needed.

The panel is drilled for the various controls and switches, etc., as shown in the front-view photo. The opening for the C-R tube is 5½ inches in diameter and can be cut with a circle cutter in a drill press. A slow speed is necessary for cutting a hole of this size. A strip of sheet metal about 2 inches wide is bent into a circle and is inserted in this hole as shown in the photographs. It is soldered to the back of the panel, and it should project about an inch to the front and rear of the panel. It is lined with a piece of soft felt or velvet of such thickness that the end of the C-R tube will make a snug fit. Panel and chassis sizes can vary to suit builder.

A few precautions should be taken. First, because many of the leads carry high voltage, the hookup wire should be well insulated. See that no high-voltage terminals are bent close to the chassis, or that other bare wires run near them. A few terminal strips conveniently placed will facilitate wiring. Since the vertical amplifier is essentially a high-gain unit, take great care to prevent hum. All ground connections should be made carefully. Although it is not necessary to have a ground bus, it is wise to make the grounds in connection with each tube at the same place. Most sockets are provided with grounding lugs for this purpose.

The power transformers are mounted on an angle-iron bolted underneath the chassis. In addition, a small angle bracket is fastened to a mounting hole on the corner of each transformer and to the side of the chassis as seen in the photograph. The transformers were mounted with the primary terminals up (when the chassis is upside down for wiring). The power supply should be wired first, and the voltages should then be tested. It will be noted that the *positive* side of the C-R tube high-voltage supply is grounded, while the *negative* side of the amplifier plate supply is grounded in the conventional manner.

The builder must realize that the chassis is "hot" with respect to the negative side of the C-R tube supply as well as to the positive side of the amplifier supply.

Testing

When the power supplies have been wired and tested, the C-R tube and its controls—intensity, focus, centering, etc.—can be wired in, and proper operation of that circuit can be tested by seeing if a spot will appear and can be centered on the screen of the tube. Make this test as soon as possible so that any "bugs" can be removed before continuing with the wiring of the amplifiers and oscillators. A small round spot which can be focused and moved from side to side and up or down, insures that the C-R circuit is correct.

If it is impossible to secure a small round spot after adjusting the INTENSITY and FOCUS controls as well as the ASTIGMATISM control, which has some effect on the shape of the spot, make any changes necessary to achieve this

end. The usual reason for producing an elongated spot, or in some cases a small round circle, is electromagnetic interference. This is usually caused by the magnetic fields surrounding the power transformers. Even shielded units will have some magnetic field about them.

In my first attempt, the spot was elongated, and I found that by changing one of the primary leads on the power transformers, the two transformers worked in a hum-bucking arrangement, and the trouble was eliminated. The connections to the primaries of the transformers were made in this way: One power line lead went to pin 1 on T1, the other power line lead going to pin 2. Then pin 1 on T1 was connected to pin 2 on T2, and pin 2 on T1 was connected to pin 1 on T2. This may not work in every case, but in this instance it cleared up the trouble.

Shielding the C-R tube will also help, and although a good spot was obtained on the model shown without shielding, I decided to do this shielding for good measure. A piece of 2-inch iron pipe was cut the length of the narrow neck of the C-R tube, and the neck of the tube was wrapped with sponge rubber held in place by Scotch tape. The iron pipe was then slipped in place. If these measures do not eliminate all trouble from stray fields, the transformers may have to be rotated slightly to remove or cancel out their fields.

As soon as a small round spot can be obtained on the scope, the other parts may be wired. The C-R tube should be removed while this is being done. When wiring is completed, the final tests can be made. Remember that a bright stationary spot can burn the fluorescent material on the face of the tube, so keep the spot as faint as possible or keep it moving.

If all wiring is correct, the following results should be obtained: With S3 in low position (high input signal needed), and S1 and S5 in position 2, with all gain controls off, a stationary spot should appear on the screen. This spot should be capable of being centered by the two centering controls. Then with S2 in position 3, and the vertical gain control turned up, the spot should become a vertical line. With S1 back in position 2, and S5 in position 3, a similar line in a horizontal directon should result as the horizontal gain control is advanced. With S1 and S5 in position 3, a diagonal line should result if both horizontal and vertical gain controls are advanced. If these results are obtained, the action of the sweep generators can be tested.

S1 should be in position 3, and S5 should be in position 1. This will place a 60-cycle test voltage in the vertical circuit and a sawtooth sweep voltage in the horizontal circuit. The coarse horizontal sweep control should be in position 1, that is, in the counterclockwise position, and the sweep vernier control can be adjusted from minimum to maximum position. The minimum position would show about 5 cycles of sine waveform as the vertical gain control is advanced. Increasing the rotation of the sweep vernier should make it possible to get 4, then 3, then 2, and then 1 cycle on the screen. Advancing this control still further should produce a half cycle, which will be represented by something like the letter "X." These traces can be made to stand still by rotating the horizontal sync control if the sync switch is in the internal position. Only as much sync as is necessary to make the trace stand still should be used, otherwise the wave may be distorted.

The vertical sweep circuit can now be tested. S1 is set to position 1, and S5 is set to position 3. This will place a 60-cycle voltage in the horizontal circuit and vertical sawtooth voltage in the vertical circuit. With these settings, and with both horizontal and vertical

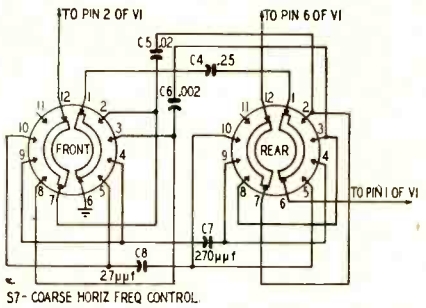


Fig. 2—Switch shown in position 1, looking from the front or knob end, in extreme counterclockwise position.

gain controls advanced, it should be possible to get one cycle to appear on the screen. This will occur in a vertical position and will look something like the letter "S." If this occurs with the vertical frequency control at or near mid-position, all is well with the vertical sweep circuit. If it is impossible to get one cycle in this position, it may be necessary to change the value of C2. This can range from about .01 to .02μf. On the scope shown here, the value of .015μf worked out just right. If one cycle can be obtained by this method, then it is suggested that both S1 and S5 be turned to position 1, and a sawtooth voltage will be observed. Then by rotating the horizontal frequency control switch to the fourth position, and advancing the fine frequency control slightly, a raster similar to that on a television screen will appear. It will be necessary to increase the intensity control and to readjust the focus control to obtain sufficient brilliance, since this raster will form a rectangle filling the screen of the C-R tube.

When these tests have all been made, the instrument is ready for final adjustment. This consists of adjusting the trimmer C1. A square-wave generator is necessary for this. A square wave of about 10 kc is connected to the vertical input binding posts. The attenuator switch S3 should be set to *low* position, that is, the position in which the gain of the amplifier is lowest. C1 should then be adjusted for the flattest top of the square wave. The frequency of the generator can now be set at 1,000 cycles and the trimmer readjusted for a flat-topped wave. This makes the frequency response of the amplifier in the *low* position the same as in the *high* one. If a square-wave generator is not available, this adjustment can be postponed until one can be borrowed, as the oscilloscope will give good results even without this adjustment being made.

This instrument has one use not commonly found in oscilloscopes: you can observe a television signal with it. To observe such a signal, the grid of the TV picture tube is connected by a short length of wire to the jack J1, which is known as the intensity modulation jack, and is located at the back of the scope. The horizontal sync pulse is applied at the horizontal sync binding post, the sync selector switch being set for external sync. The vertical sync pulse is taken from the TV set *after* it has passed through the integrating circuit in the TV set. This pulse is applied to the vertical sync binding post. The vertical sync control is advanced, and the vertical frequency control is adjusted for a frequency slightly less than 60 cycles. The horizontal frequency control switch is placed in position 4 and the fine frequency control is rotated slowly, along with the sync control, until the picture locks into place. To lock the signal in, it is necessary that the sync pulses have negative polarity. No attempt has been made to supply d.c. reinsertion to the scope C-R tube grid, so the TV signal background lighting may not be accurate. In spite of this, all the normal contrasts of the TV picture will be present.

Oscilloscope parts list.

Resistors: 7—470, 1—1,000, 1—3,300, 2—8,200, 3—10,000, 2—22,000, 5—47,000, 2—100,000, 2—220,000, 2—470,000, 2—680,000 ohms, 6—1 megohm, 1—3.3 megohms, ½ watt; 1—1,000, 4—22,000 ohms, 1 watt; 1—15,000 ohms 1—1 megohm, 2 watts.

Potentiometers: 1—5,000, 3—50,000 (linear), 2—100,000, 2—500,000 ohms, 1—1 megohm; 1—1 megohm—10 megohms, ganged; 1—5,000—5,000 ohms, ganged.

Capacitors: (Paper) 1—.01 μf, 1—.015 μf, 2—.02 μf, 4—.05 μf, 1—.01 μf, 5—.025 μf, 2—.05 μf, 600 volts; 2—2 μf, 1,000 volts; 1—.01 μf, 2,000 volts. (Ceramic) 1—3-40 μμf, trimmer; 1—27 μμf; 1—270 μμf; 1—1,000 μμf; 1—2,000 μμf. (Electrolytic) 2—8 μf, 1—30 μf, 1—20—20—40 μf, 450 volts; 1—10 μf, 25 volts.

Tubes: 2—6J5; 4—12AT7; 1—6C4; 1—6SN7; 1—5Z4; 2—6X5; 1—5BP1 or 5BP4 C-R tube.

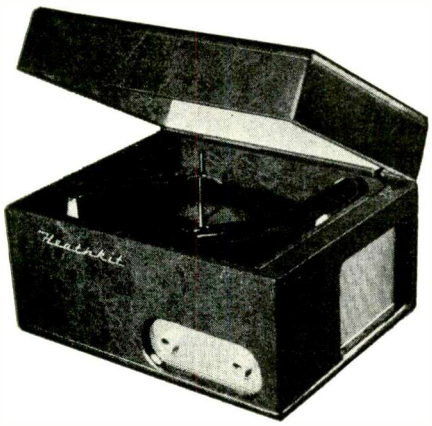
Miscellaneous: 2-power transformers, 540 volts, c.t., at 55 ma, 6.3 volt at 3 amp., 5 volt at 2 amp. (Chicago PSC 55); 2—2-pole 3-position switch, (Mallory 322-3J); 2—s.p.d.t. toggle switch; 1—2-gang, 2 circuits per gang, 5-position switch (Mallory 1325 L); 1—s.p.s.t. switch; 1—6.3-volt pilot light; 1—insulated phone tip jack; 1—3-amp fuse.

It was not intended that this scope be used as a TV slave unit, but a sufficiently accurate picture can be obtained to aid in the servicing of a TV set, particularly when there is some question as to the condition of the TV picture tube.

The case for the instrument was made from 24-gauge galvanized sheet steel. The local tinner was co-operative in allowing his equipment to be used for the building of both case and chassis. If the builder does not have the tools for building such a case, he can have it built at almost any tin shop. The case measures 8½ x 17¼ x 13 inches. It has a 2-inch hole in the rear to accommodate the power cord and the intensity modulation jack. END

COVER FEATURE

HIGH-QUALITY RECORD PLAYER IN KIT FORM

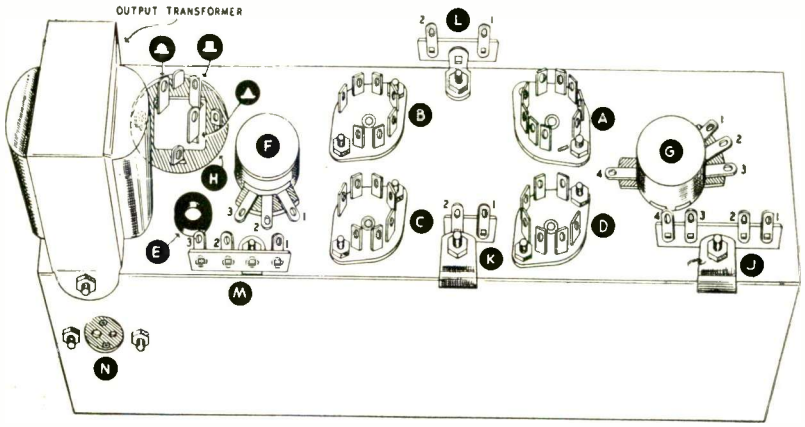


By JEROME KASS

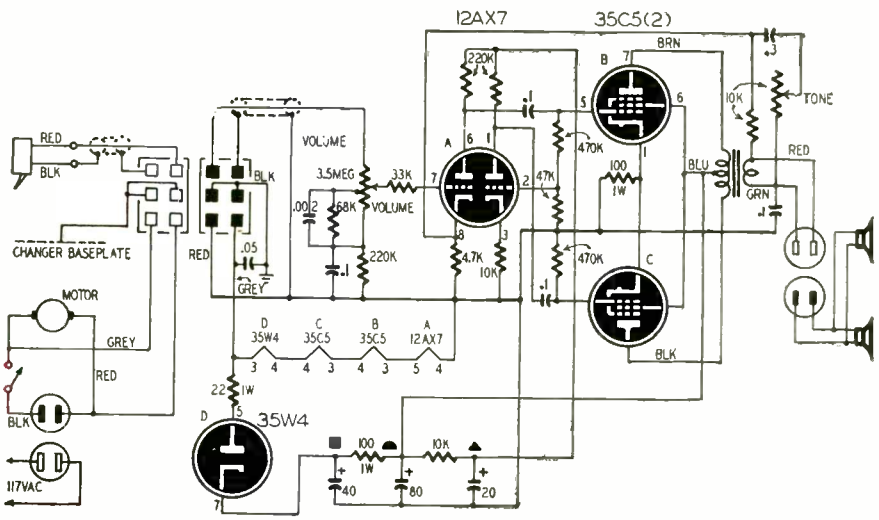
ASSOCIATE EDITOR

AFTER MANY years in the complex field of electronics, I have become very suspicious of any attempts to oversimplify, whether in equipment or literature. Experience has shown that the fabulous one-tube this or that, usually falls far short of expectations, and the handy-dandy fix-it-yourself booklet has left many a TV owner bloody and bowed.

I have watched the growth of the various kit companies with a wary eye. From the very simplest devices, kit manufacturers have expanded their lines to include equipment to outfit the home, workshop, and laboratory. I have seen many assembled kits in action, in homes and in factories, and have been impressed with their performance. However, I took exception to the manufacturers' claims of the ease with which they can be assembled. I could understand a skilled technician undertaking the task, but when the manufacturer claimed that a complete novice could do an artistic job, I had my doubts. As the years went by, and the kit manufacturers expanded and diversified their lines, my curiosity became overwhelming; I had to see for myself. Having a pretty complete line of test instruments, I decided upon the Heathkit record player. It would satisfy my curiosity and at the same time possibly provide entertainment for all the family.



Chassis before wiring. Letters and numbers minimize possibility of errors.



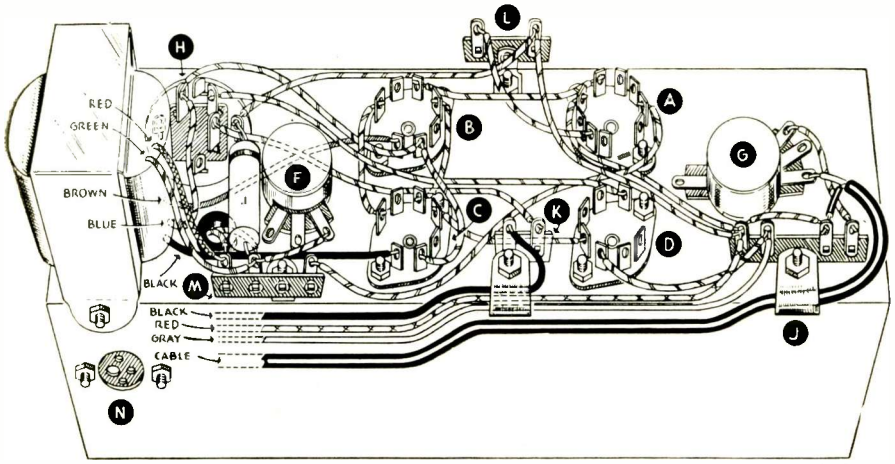
Schematic diagram of the Heathkit record player. Letters indicate code to text.

The package arrived. With tongue slightly in cheek, I examined the contents. There was a 3-speed record changer, two 6-inch speakers, a cabinet, and several bags filled with parts for the assembling of the amplifier. This can be done by a novice? Ridiculous!

I noticed some papers in the box, and I assumed them to be the schematic and parts list. To my amazement, they turned out to be 22 pages of instructions and 4 huge pictorial diagrams. This seemed unbelievable. I've seen broadcast transmitters assembled on less instructions. Well, I thought, I'll have none of it. I spread out the various parts, took the chassis in hand, studied the schematic briefly, and began to mount tube sockets. Since each socket has two positions, 180° displaced, I studied the pin connections to find the most convenient position. After a few minutes of study, I decided, well, it wouldn't hurt to take a little peek at the pictorial layout. After taking a peek, then followed by a long perusal, a thought began to dawn upon me.

Perhaps there was rhyme and reason to these papers. Perhaps they could be the result of careful and scientific research in the layout of this record player. And perhaps what I was starting out to do had been done many times by the manufacturer and these papers might represent the most efficient and simplest method of assembly. But why so many pages for a record player? I turned to the first page and read.

The schematic diagram was drawn in conventional style. It showed the cartridge working into a high-impedance input. The volume control fed a 12AX7 voltage amplifier-phase inverter, which in turn drove 2-35C5's in push-pull. B plus was supplied by a 35W4 half-wave rectifier working with a double-pi R-C filter. The speakers were in parallel, and



Pictorial shows amplifier wiring. Cable and transformer are color coded.

the tone control was part of a feedback network from the output transformer secondary to the cathode of the input triode. The sequence of filament wiring with respect to ground also was shown. All this would be quite clear to a technician, but probably hopelessly complicated for a beginner. I scanned the next page on soldering and wiring. Pretty good, I thought. This would be clear even to my wife.

I was now up to the mechanical assembly. A glance at the pictorial layout on this page instantly revealed the method to all this madness. The entire layout of parts was resolved into an elementary system of letters and numbers. The four tube sockets would hereafter be known as A, B, C, and D. Every part was identified by a letter, and if that part had more than one possible connection, such as in tube sockets and terminal strips, each connection was numbered. Here indeed was the master plan. Any child who could read and had some manual dexterity could assemble this amplifier.

The next few pages contained deliberate step-by-step instructions for mounting. I followed along, checking off each step, in the space provided, as I went. I saw that by this checking, and watching the pictorial diagram, a mistake was virtually impossible. I ran into a minor difficulty when my capacitor-mounting wafer did not fit the prepared position. With a small reamer and rat-tail file this obstacle was overcome.

With everything mounted, I was now up to page 7, the start of amplifier wiring. Here again, I was immediately confronted with a pictorial diagram showing the exact positioning of every wire in the amplifier. Since the only hookup wire supplied was black, I reached into my private stock and allowed myself the luxury of various colored wire to color-code the amplifier circuits. The wiring ran smoothly with one serious exception. The output transformer was color-coded differently from the instruction sheet. If I had connected color for color, the loudspeakers might have been ruined. This was the only occurrence where complete ignorance of electronics might have resulted in damage to the record player. I paused at this point to consider the human equation. Here was a tragedy of oversimplification. A slight error by the manufacturer could cost the uninformed builder time and expense. (I wrote to the manufacturer, and was informed that this situation has since been corrected.)

The wiring followed a very logical pattern. Out of curiosity, I followed the step-by-step instructions on the diagram. First the filaments were wired, then the power supply, and so on. The wiring on the pictorial was so clearly illustrated that the exact placement and even the curvature of wiring could be easily duplicated. On page 10 a special cable was assembled. Whenever detailed work of this sort appeared it was accompanied by copious illustrations. Page 12 completed the amplifier assembly with the mounting of the capacitors and resistors. Once again a pictorial diagram facilitated the assembly. A few of the pictorials were actually larger than lifesize.

With the completion of the amplifier, the final assembly began. The two speakers and the amplifier were mounted in the cabinet. This required some fine carpentry. The instructions were clear, but the fittings were close. Breaking through the proxylin covering of the cabinet required utmost care. Finally, after a mild application of blood, sweat, and tears, everything was properly mounted. In the course of final assembly, I ran out of some hardware, and had an excess of others. This I suppose is inevitable. The hardware, being standard (6/32-screws), was easily located. Wiring of the speaker plug required some patience. As many radio technicians have learned, soldering phone tips can be tedious.

The preliminary testing began on page 16. The instructing sheet called for a visual inspection followed by a test run. At this point I became unnerved. I had learned from many sad experiences the danger of plugging in an electronic device without any preliminary resistance measurements. Yet, I had followed instructions to the letter up to now; I had been impressed with them, and I resolved to continue to the bitter end. With a stiff upper lip, eyes closed, and fingers crossed, I plugged in the record player. Displaying incredible nerve, I placed one of my wife's favorite records on the changer.

When the tone arm made contact with the record, the room was filled with the most beautiful music this side of Benton Harbor. I used a symphonic recording to obtain bass of reasonable duration. I then reversed the speaker leads several times while listening carefully to the music. I retained the position which gave me the more predominant bass response. The tone arm required no adjustment, as the sapphire stylus made a perfect one-point landing. The tone and volume control seemed to have effective range, and with these controls turned up and no signal input, only a slight low-pitched hum was audible.

Flushed with success, I decided to measure the playback response of the amplifier. I had listened to several recordings with such pleasure that I was anxious to know just what the frequency capabilities of this amplifier were. Fortunately, I was able to avail myself of a test record specifically designed for this purpose. I used a v.t.v.m. to avoid any loading effect on the amplifier, connecting it across the secondary of the output transformer. Making allowance for the test record's (a Cook 10LP) response curve, I measured the output from 30 to 20,000 cycles.

From approximately 100 to 20,000 cycles, the output remained within 1 db of the AES playback curve. Below 100 cycles I had a bass boost of a few db. Since I had the volume turned down low, this boost was probably due to the volume control which is compensated for the Fletcher-Munson effect at low levels. This response confirmed my initial opinion: in its price range this was an excellent player.

What intrigued me most was that this was all done without any necessity for the schematic. Anyone who could read and handle a soldering iron could have built this record player. Looking back, the step-by-step organization was something to truly marvel at. As far as my particular record player was concerned, it was completed. It wasn't unique in design, being similar to the Columbia 360 and possibly others, but it was a kit and I had assembled it.

What if something had gone wrong? What if I had obtained smoke instead of music? I read on. In the center of page 18 was a paragraph headed, "In case of difficulty." Here in very calm, cool, and collected language was trouble-shooting procedure. Hints on checking wiring, a voltage chart listing the potential on every pin of every socket, and control settings for obtaining various effects were clearly listed. The trouble-shooting section ends with a brief discussion on common errors and circuit checking.

And so, 6 hours after I began, the 22 pages came to an end. Only then was I able to fully appreciate what had been accomplished. My cynicism toward the kit manufacturer has been replaced with a healthy respect. END

JUNIOR GOLDEN EAR AMPLIFIER

By JOSEPH MARSHALL

Here is what we've all been waiting for. A truly inexpensive high-fidelity amplifier. The frequency range is stretched, while the dollar is squeezed. Circuit is not critical.

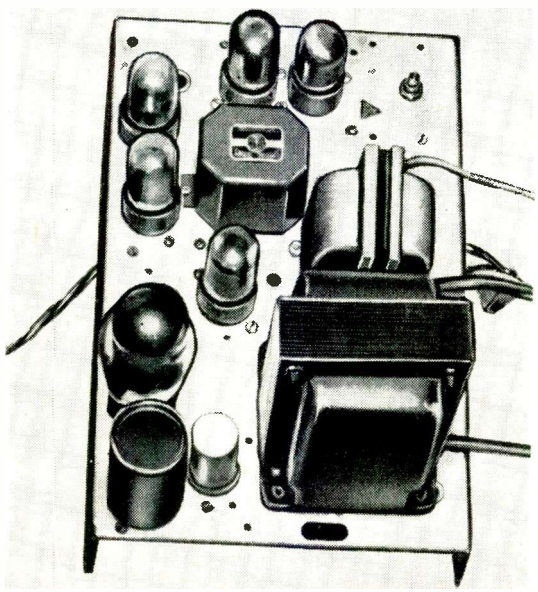
HIGH fidelity today is expensive. Good commercial amplifiers start at around $100 and run to $300. Even the cheapest Williamson kit leaves no change out of a $50 bill, which is still likely to strain the average music lover's pocket book and family relationships. In short, what this country needs is a good $25 high-quality amplifier.

In my last article "Extending Amplifier Bandwidth" (in the September, 1953, issue) I indicated that it is possible to design an inexpensive amplifier with whose performance only the most critical "golden ear" could quibble. This article presents the Junior Golden Ear amplifier which can be reproduced at a total parts cost of around $25, and yet will take very little if any backtalk from $100 amplifiers. The circuit is not critical and is easily constructed by anybody with any construction experience.

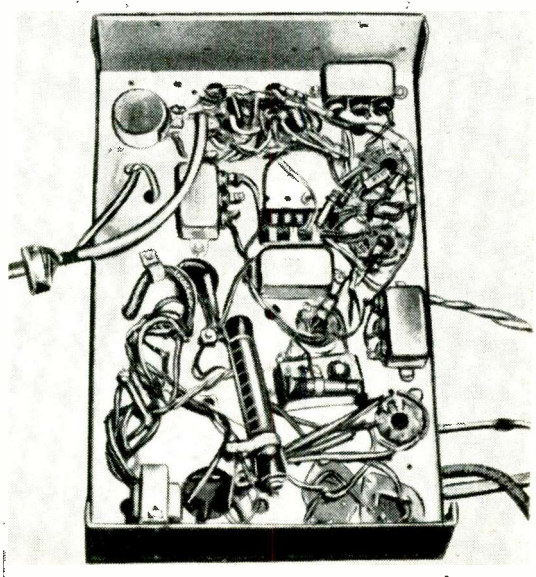
The circuit

Those who have read the article mentioned above will recognize the circuit as that of a direct-coupled inverter and voltage driver, capacitance-coupled to a pair of self-bias output tubes, with two feedback loops. The first 12AU7 and the 12AX7 comprise a cross-coupled phase inverter which is direct-coupled to a neutralized 12AU7 driver stage. Presuming that the output capacitor on the tuner or preamp is .05-μf or larger, response of the inverter and driver, without feedback, will be approximately 2 to approximately 50,000 cycles. The input tube is a cathode follower and its input resistance is therefore several times the value of the grid resistor. So, any capacitor of .05-μf or larger will have a time-constant long enough to pass signals below 10 cycles. Since the 12AX7 is driven by the very low impedance of the cathode follower it is not affected by the Miller effect below 100 kc. The neutralization of the 12AU7 driver minimizes the operation of the Miller effect in that stage, and the direct coupling produces no phase shift at any frequency below 50 kc.

The 0.5-μf capacitors which couple this section to the output tubes are the only source of internal phase shift in the amplifier, but much if not all of this phase shift is neutralized by the inner feedback loop from the plates of the output tubes to the cathodes of the driver stage. The 6V6 output tubes are operated in a modified form of the Ultra-Linear circuit by connecting the screens to the 4,000-ohm taps of the UTC S-15 output transformer. This method of operation is intermediate between triode and tetrode and has several virtues. First, it improves the high-frequency response because this connection in effect neutralizes the plate-grid capacitance of the output tubes,



Left—Top view of Junior Golden Ear Amplifier. Note position of transformers. They are placed at right angles to prevent undesirable coupling.



Right—Underchassis view of amplifier. Note the use of bathtub capacitors. These high-quality capacitors assure excellent low-frequency response.

which in triode operation would result in very serious attenuation above 10,000 cycles. Second, it more than doubles the 4 watts output which 6V6's deliver as triodes. The optimum screen load for true Ultra-Linear operation is 18.5% of the plate load. Special (and expensive) transformers are manufactured for this style of operation. However, a ratio of 40%, as in this case, results in excellent performance and permits a standard medium quality output transformer to be used. The maximum output of the amplifier is more than 8 watts.

Two feedback loops are employed. The inner loop, from plates of 6V6's to cathodes of the drivers, provides a feedback factor of 14 db. The time-constant of the feedback network is the same as the time-constant of the coupling network from drivers to output tubes, but the phase shift in the feedback loop is exactly opposite to that in the coupling. So this feedback loop in effect neutralizes the low-frequency phase shift of the capacitor coupling, and the amplifier—though not entirely direct-coupled—is, for audio purposes, just about as responsive at low frequencies as a direct-coupled amplifier. The inner feedback loop, being balanced, also helps maintain the excellent static balance of the amplifier over the full dynamic range. Since it also includes the two stages responsible for most of the distortion, the output tubes and drivers, it produces about a 5–1 reduction in distortion. The over-all feedback loop runs from the output transformer secondary to the cathode of one of the input tubes. The feedback factor in this loop is more than 20 db. This not only further reduces the distortion but it is enough to flatten the response of the output transformer to a level acceptable for high fidelity.

The response of the amplifier from input to output transformer is virtually flat from 2 or 3 to over 100,000 cycles. The response of the output transformer is flat only from 50 to 10,000 cycles. However, the extreme bandwidth of the amplifier itself, plus the more than 20 db of over-all feedback, extend the response on both sides of the slopes of the output transformer, producing an output curve which is essentially flat at levels of 2 watts or less, from 10 to some 60,000 to 70,000 cycles. This is as good or better than that of most Williamson-type amplifiers using much better output transformers, but possessing a very much narrower internal bandwidth because of Miller effect and uncorrected low-frequency phase shift.

Because the distortion-producing stages are subjected to a feedback factor of 30 or more, the output distortion is extremely low. At levels below 2 watts, which represent the average power peak in home listening, the distortion is measurable only on laboratory equipment. At maximum output the harmonic distortion is under 1% while the intermodulation is about 1%. This is so slight as to be of no practical consequence, since an output level of 2 watts, given a reasonably efficient speaker system, will not often be exceeded in small home or apartment listening.

Although the photographs of the experimental model show bantam-type tubes, it is better to use the miniature tubes specified in the wiring diagram. If you already have two 6SN7-GT's and a 6SL7-GT and want to use them, there will be only a slight difference in high-frequency response, and that will probably be noticeable only by measurement and not by ear.

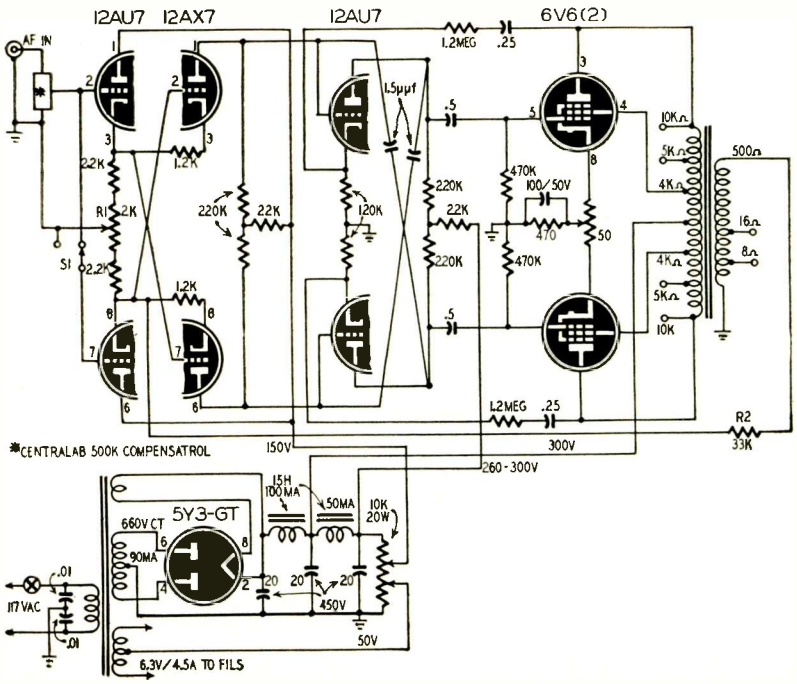
The amplifier is push-pull from beginning to end and can be balanced both statically and dynamically. Thus maximum use is made of the distortion-canceling properties of push-pull amplifiers. The series resistors, common to both sides of the plate loads of the voltage-amplifier section, are balancing resistors and should not be left out. The 2,000-ohm balancing control in the cathode circuit of the input stage and the single-pole, double-throw switch provide a means for over-all dynamic balancing. They should preferably be mounted on the rear or top of the chassis where they will not be disturbed accidentally.

There is nothing at all critical about the layout, and no special wiring measures have to be taken. If your chassis is already punched, arrange the tubes as conveniently as possible. Vector turret sockets could be used if the most compact amplifier is desired. A common ground wire should be run from the ground point of the input jack around the chassis and all ground leads should be soldered to it. The filament wires should be twisted together and the two sides of the filament loop kept about the same length. The center-tap of the filament transformer is returned to the voltage divider at a point between 40 and 50 volts positive. By this means, as well as the two feedback loops, the hum level is kept extremely low. In fact, it should be completely inaudible, with your ear at the speaker, unless a Klipsch-type horn is used, in which case you may be able to hear some hum with your ear right at the output of the horn.

The neutralizing capacitors in the 12AU7 driver are 1.5-μμf molded gimmicks of the type used for oscillator injection in superheterodynes. They are available from most parts distributors. The NPO series of ceramic capacitors can also be used. In an emergency the capacitors can be improvised by twisting together two 2-inch lengths of hook-up wire. Be sure to connect the end of one wire to the plate and the end of the *other* wire to the grid. The two open ends should be lightly taped to prevent any possible accidental shorts to chassis.

The 0.5-μf coupling capacitors to the 6V6 grids must be of good quality with low leakage. Bathtub types are recommended. Do not substitute lower values or the low frequency response will suffer. The 0.25-μf capacitors in the feedback loop should also be of equally good quality.

The plate, grid and cathode resistors in the opposite sides of the push-pull stages should be matched. This can be done effectively enough on an ohmmeter. Ordinary carbon resistors will do. Of any five of a given value, two can usually be found which match to 1 or 2%. The exact value is not important, as long as they match. Thus the 220,000-ohm plate loads can be 200,000 or 240,000 ohms, so long as both are as nearly identical as possible. Be careful not to overheat the resistors when soldering them in place, for it might change their value. If you hold the wire leads in a pair of large pliers between the soldering point and the body of the resistor,



Schematic diagram of amplifier S1 enables overall dynamic balancing.

most of the heat will be dissipated in the pliers before reaching the resistor. If you have a Wheatstone bridge, it would be an excellent idea also to match the coupling and feedback capacitors, to preserve the best possible frequency balance.

The output tubes are balanced through the 50-ohm potentiometer which is adjusted for equal plate currents, or for zero voltage difference as indicated on a high-resistance voltmeter connected from plate to plate. The bias voltage should be about 20 with a plate voltage of around 300.

The cathodes of the 12AU7 driver should be about 10 volts more positive than the grids. This will be achieved with approximately a 2–1 ratio of plate load to cathode resistance. The direct-coupled front section is balanced, as indicated later, at d.c. by the balancing potentiometer in the input tube circuit. The switch is a great convenience in obtaining over-all balance, permitting easy rebalancing from time to time to compensate for tube aging or when changing tubes. It is not essential to the operation of the amplifier.

When connecting the inner feedback loop, be sure that you do not cross it by connecting it to the opposite side instead of the same side. Proper connection is evidenced by reduced output. The diagram shows the over-all feedback loop going to the lower side of the amplifier, but it should be applied to whichever side produces negative instead of positive feedback. Touching the end of the loop to each of both grids, in turn, of the 12AX7 will determine the proper one. With the transformer specified, the feedback loop should result in stable operation. If another transformer is substituted, or if feedback results in oscillation, the feedback resistor R2 should be increased in value until oscillation cannot be sustained.

The power supply is conventional except for the connection of the filament center-tap to a positive point on the voltage divider. If your power transformer does not provide a center-tapped filament winding, insert a potentiometer of 50 to 100 ohms across the winding, connect the slider to the positive voltage point, and adjust the potentiometer for minimum hum. A 90-ma power transformer will more than suffice. Ultra-Linear operation does not produce as great current swings as does triode operation. The plate current remains quite constant over almost the total dynamic range. The low current requirement of this amplifier makes practical the use of a larger transformer to supply both the amplifier and associated tuner.

I believe that in the large majority of cases tone-control circuits are neither necessary nor desirable. Therefore, a Centralab Compentrol in the amplifier input is specified. This gives boosts at both low and high frequencies at low volume levels and is very satisfying, except perhaps in rooms whose acoustics at low frequencies produce too boomy a sound. The amplifier does not include a phono preamp. Any of the standard circuits can be added, or a G-E preamp can be mounted on the chassis and connected to the same power supply. In that case, it would be well to add another switch at the input to permit switching in the different input sources —FM tuner, AM tuner, phono, etc.

This amplifier apparently can be built without regard to wire lengths, parts layout, and so forth. Several versions of the amplifier have been put together quickly on breadboards, old chassis, etc., with no resulting trouble. If you are relatively new at constructing amplifiers, keep this in mind: Double-check each connection before you make it, and several times after it is made, to see that it is correct. Before inserting tubes and turning on power, make resistance measurements at the socket terminals with an ohmmeter to be sure that you have no shorts or opens. Make the connections firm, and solder carefully so that you do not have noise-producing joints. When you are sure the hookup is correct, make the following adjustments, in the order given:

1. Insert the output tubes and adjust the cathode control so both tubes draw equal current, or so a high-resistance voltmeter connected from plate to plate indicates zero voltage.

2. Insert the other tubes. Connect the voltmeter from plate to plate of the 12AU7 driver stage, and adjust R1 for zero voltage.

3. Turn switch S1 so that the two grids of the first 12AU7 are tied together; feed any signal into the input and now adjust R1 again for a null in the output from the amplifier. Because of feed-through via the over-all feedback loop, a true null may not be obtainable; in that case, adjust the minimum output, using an a.c. meter if possible.

This procedure will balance the entire amplifier from beginning to end. Periodically, the balance can be checked and retrimmed as in step 3. It should also be done any time one or more of the tubes are changed.

The Junior Golden Ear amplifier is capable of very high quality reproduction, and merits the use of the best speaker you can afford. Fortunately, several good combinations of speaker and baffle are today available from $30 to $50. One of these amplifiers and the Baruch-Lang speaker system provides a very compact portable system with astonishing reproduction. With good speakers, tuners and magnetic phonograph pick-ups, the Junior Golden Ear will yield results which belie the low cost, and are very likely to shock owners of Williamson and commercial amplifiers costing many times more. Do not let the small output transformer mislead you. After all it is not the transformer curve which counts, but the overall response curve.

While the output transformer in the Junior Golden Ear is much poorer than that of Williamson amplifiers, the rest of the amplifier is excellent in flatness of bandwidth and freedom from phase shift, with the result that the over-all performance is just about as good.

Modifications

The only thing which stands between the Junior Golden Ear and a place in the ranks of the really great audio amplifiers is the output transformer. If you have an additional $15 to spare, you can remove this imperfection by adding an Acro-Sound T-310 output transformer. This will give you true Ultra-Linear performance with an output in excess of 10 watts and an over-all bandwidth of 2 or 3 to nearly 200,000 cycles. The distortion characteristics should be superior to those of any other amplifier in its class. For a still more de luxe model, with higher output and, I believe, the finest performance the art permits, you are referred to the New Golden Ear amplifier, senior version, as described in my articles in recent issues of *Audio Engineering*. The senior version uses the same input section but fixed bias output tubes with higher power output and still wider bandwidth and lower distortion.

It may be that you have an amplifier with a fairly good—or even extra good —output transformer, and would like to improve it. The addition of the direct-coupled front section and the inner feedback loop will improve any amplifier, including higher priced commercial ones. If your present output transformer does not provide intermediate primary taps, you can use tetrodes as triodes, but adding neutralization to eliminate the Miller effect. The simplest way to achieve neutralization is to add a pair of 4–30-μμf ceramic trimmers in the standard cross-neutralizing style. Before connecting the feedback loops, remove the filament voltage from the output tubes, feed a signal into the amplifier, and adjust the trimmers for a null in the output.

Materials for Golden Ear Amplifier

Resistors: 1—470, 2—1,200, 2—2,200, 2—22,000, 1—33,000, 2—120,000, 4—220,000, 2—470,000, 2—1.2 megohms, ½ watt; 1—10,000 ohms, 20 watts, 2 adjustable taps; 1—50 ohms, 1—2,000 ohms, potentiometers; 1—Centralab Compentrol.

Capacitors: (Ceramic) 2—1.5 μμf. (Paper or bathtub) 2—.01, 2—25, 2—5 μf, 600 volts. (Electrolytic) 1—20-20-20 μf, 450 volts.

Tubes: 2-12AU7, 1—12AX7, 2—6V6, 1—5Y3-GT.

Miscellaneous: 1—Output transformer, type UTC-S-15; 1—Power transformer, 660 volts c.t. at 90 ma., 6.3 volt at 4.5 amp.; 1—Filter choke, 15 h at 50 ma.; 1—filter choke, 15 h at 100 ma.; 1-s.p.d.t. switch; wire, tube sockets, chassis, and hardware.

The modification will extend the bandwidth of any amplifier, no matter how good or expensive it is, and because the two loops provide more feedback, will also reduce distortion. Finally, because of the wide bandwidth, the low phase shift, and the neutralization of positive feedback loops due to grid-plate capacitance, the circuit will also improve the transient response, despite the added feedback. I have found this circuit highly suitable for 6L6's, 1614's, 5881's, KT66's, 807's, etc. The operating voltages would have to be adjusted to conform with the tubes operating conditions. END

The solution is to separate the back and the front of the cone so that the air movements they create can no longer reach the air together and cancel. One way to do this is to mount the speaker in a hole in a large, flat board, so placed that the front of the board faces the listener. Now before reaching the ear the air movements from the back of the cone must take time to go around the edges of the board, while those from the cone front reach the ear directly. The board is known as a *baffle*. If the baffle is large enough, it will permit excellent bass response.

The baffle is not the perfect answer, though it is often used in installations where intelligibility counts more than high sound quality—as in paging and in some public address systems. The sound from the rear still can reach the listener's ear, even though it may not come soon enough to exactly cancel that from the front. At certain frequencies a rarefaction from the rear may reach the ear together with a compression from the front. Even though they may be several cycles apart, they tend to cancel and at that frequency there will be a definite dip or valley in the response curve. At other frequencies, rarefactions from the front may be concurrent with rarefactions from the rear, and at those frequencies there will be definite peaks. These effects depend on the distance between the speaker location and the edges of the baffle in terms of wavelengths of sound in air. Since the number of wavelengths at any such particular distance depends on the frequency, it is impossible to find any combination of dimensions which will make the distance equal to exactly the right number of half-wavelengths to prevent these bad effects at some frequencies. Of course, if the baffle is very large indeed—20 to 30 feet in each dimension—the sound from the back may be sufficiently attenuated by the time it reaches the front to interfere less seriously.

The reader should note that the usual commercial radio-phono combination cabinet acts as a baffle—not as an enclosure for the speaker—since the back is usually open. Its only effect toward good bass is to provide some delay before the sound from the back of the speaker cone reaches the front, and not much delay at that. This is the reason why, despite the occasional use of comparatively large speakers—12-inch sometimes—bass is rarely satisfactory on a combination. Some models have labyrinths or other acoustical provisions, and they perform better. But at best the speaker cannot perform at its highest efficiency in the same cabinet with the rest of the components.

The "infinite" baffle

After the simple baffle, the next step in improving bass is merely an extension of the baffle toward infinite dimensions. That is, theoretically the board would be of infinite size and the time required for the rear sound to reach the front, infinitely long. This would give optimum sound, but unfortunately infinity cannot be reached. Therefore we stay on the level of practicality and build a box.

The box can be a very simple one of any shape, such as a rectangle or triangle. It should have only one opening for each speaker, a round hole against which the speaker is mounted (inside the box). If the box material is very solid and if there are no stray openings of appreciable size, the rarefactions and compressions of air caused by the back of the speaker cone cannot reach the outside air at all, and we have, in effect, an infinite baffle.

Such a speaker enclosure is a very good one and is often used in the best-sounding systems. It is the best type for constructors to build because it is not critical as to design and is easily made. Only the front of the speaker cone can affect air that reaches the listener's ear, and the speakers will reproduce the lowest tones of which it is mechanically and electrically capable.

A few musts have to be observed. The wood must be very solid so that it does not vibrate appreciably. Nothing lighter than ¾-inch plywood should be used, and even that should be braced internally. The inside volume of the box must be large enough so that when the speaker cone moves inward it does not compress very much of the air in the box and encounter more resistance than it does from the outer air in moving outward. This calls for a volume of at least 8 cubic feet, and 10 is a more comfortable margin. At least one of every two parallel walls within the box must be covered with very soft material such as thick cotton batting or Ozite, the material that goes under rugs. This prevents sound from bouncing from wall to wall and creating interfering modes that reflect back to the speaker cone. The front can be covered with loose-woven speaker cloth. Fig. 8 shows a Cabinet enclosure of this type with 8 cubic feet content.

Bass-reflex

The bass-reflex enclosure is a variation of the infinite baffle. It, too, is a box, but it contains a rectangular slot cut in the front wall below the speaker opening. The function of the slot is to deliberately allow certain of the back-waves to come through to the front. Its size and that of the box proper is so designed that the back-wave coming through the slot is in phase with the front-wave and reinforces it at a frequency slightly below the mechanical resonance frequency of the speaker.

The bass-reflex enclosure is an attempt to extend the bass range of a speaker without making the enclosure as large as infinite baffling would require. For best effect it is designed for a particular speaker, and even then it is doubtful that really high-quality results are possible, for there are interfering effects at other frequencies. If space for the enclosure is limited, bass-reflex may be beneficial. An article on page 84 of the March, 1949, issue of RADIO-ELECTRONICS gives dimensions for enclosures of various sizes. The right-hand cabinet in Fig. 9 is a typical bass-reflex unit.

The horn

Once we have managed to separate the front and back waves so that the speaker pushes some air at all its operating frequencies, we have another problem. While a good speaker in an infinite baffle has excellent frequency response, it lacks real efficiency at the lowest frequencies because its cone area is limited and it cannot push *enough* air when it is moving slowly. The reason is that there is poor mechanical coupling between the small speaker cone and the large volume of air in the room.

The solution to this problem, which is actually an acoustic impedance mismatch, is to make the transition be tween the speaker cone area and the air with an exponential horn—one whose diameter increases as the exponent of the increase in distance from the small end. (If the exponent is 2, for example, the diameter increases in proportion to the square of the distance; if it is 3, the increase is proportional to the cube.)

Fig. 10 shows a roughly exponential horn used for public-address work. Note that the sides of the horn curve into a flare, rather than being straight as in a megaphone, showing that it is more exponential than linear. This kind of horn is the ideal projector of all frequencies down to a limit set by the diameter of the mouth (large end) in relation to the cutoff frequency. The horn of Fig. 10 is not useful below about 200 cycles.

To reach the low frequencies required for high-quality audio, the horn would have to be so gigantic that no normal house could hold it. Indeed, there are one or two examples of enthusiasts who have built houses around horns, with part of the horn housed in a separate building. The modern home solution is a folded horn, a passageway for the sound which starts with the small cross-sectional area of the speaker and takes the sound through a gradually increasing-area path to the outer air; the passageway is not straightforward but is folded within an enclosure of practical size.

One of the earliest and still finest enclosures of the folded-horn type was designed by Paul W. Klipsch. It and similar types are sold today by the designer and other firms. The Klipsch enclosure, pictured in Fig. 11, is placed in a corner of the room and uses the walls, floor, and ceiling as the walls of the final section of the folded horn. Sound emerges through the sides of the enclosure rather than the front, which is solid, after passing through passageways built into the inside. The corner location benefits the treble frequencies which tend to be confined to a limited angle around the speaker axis.

The choice of a speaker system is difficult for the average music enthusiast to make. In the final analysis, the only way to make a really intelligent choice is to listen. (TO BE CONTINUED)

TRAIN *FASTER*—TRAIN *BETTER*—TRAIN *EASIER*

IN 10 MONTHS—OR LESS—FOR

RADIO-TELEVISION

Our 21st Year Training Men for Greater Incomes and Security in Radio-Television

I SEND YOU 18 BIG KITS

of Radio Television parts and equipment. Much of your training will be actual construction and experimentation . . . the kind of truly PRACTICAL instruction that prepares you for your Radio-Television career.

Frank L. Sprayberry
President
Sprayberry Academy of Radio

NEW! NO OBLIGATION PLAN

You Have No Monthly Payment Contract to Sign
Pay For Your Training as You Earn and Learn

You can get into Radio-Television, today's fastest growing big money opportunity field, in *months* instead of years! My completely new "package unit" training plan prepares you in as little as 10 months or even less! *No monthly payment contract to sign—thus NO RISK to you!* This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. Start your own profitable Radio-Television shop . . . or accept a good paying job. I have trained hundreds of successful Radio-Television technicians during the past 21 years—and stand ready to train you, even if you have no previous experience! Mail coupon and get all the facts—FREE!

Valuable Equipment Included With Training

The new Sprayberry "package" plan includes many big kits of genuine, professional Radio-Television equipment. You perform over 300 demonstrations, experiments and construction projects. You build a powerful 6-tube 2-band radio set, multi-range test meter, signal generator, signal tracer, many other projects. All equipment and lessons are *yours to keep* . . . you have practically everything you need to set up your own profitable Radio-Television service shop.

Earn Extra Money While You Learn!

All your 10 months of training is IN YOUR HOME in spare hours. Keep on with your present job and income while learning. With each training "package" unit, you receive extra plans and "Business Builder" ideas for spare time Radio-Television jobs. New television stations everywhere, open vast new opportunities for trained Radio-Television Technicians—and those in training. If you expect to be in the armed forces later, there is no better preparation than practical Sprayberry Radio-Television training.

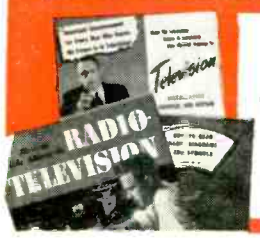
YOU BUILD the Television set and the powerful superhet radio receiver shown above. IN ADDITION to the other test units shown here (many are not shown because of lack of space). All equipment I send you is YOURS TO KEEP.

Approved for Veterans under the G. I. Bill

SPRAYBERRY ACADEMY OF RADIO

111 NORTH CANAL ST.
Dept. 20-C, Chicago 6, Ill.

MAIL COUPON TODAY! NO OBLIGATION



I invite you to get all the facts—

FREE TO YOU 3 BIG RADIO-TELEVISION BOOKS

I want you to have ALL the facts about my new 10-MONTH Radio-Television Training—without cost! Rush coupon for my three big Radio-Television books: "How to Make Money in Radio-Television." PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—ALL FREE. No obligation and no salesman will call. Mail coupon NOW!

SPRAYBERRY ACADEMY OF RADIO, Dept. 20-C
111 North Canal St., Chicago 6, Ill.

Please rush to me all information on your 10-MONTH Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Be sure to include 3 books FREE.

Name..... Age.....

Address.....

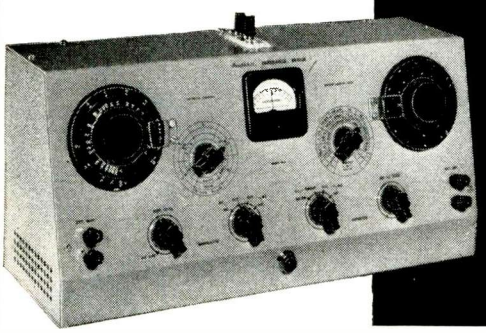
City..... Zone..... State.....

Heathkit IMPEDANCE BRIDGE KIT

MODEL IB-2

$59.50

SHIPPING WT. 15 LBS.



Features

- Simpson 100-0-100 microampere meter.
- Completely AC operated.
- Built-in phase shift generator and amplifier.
- Battery type tubes, no warm-up required.
- Newly designed two section CRL dial.
- Single knob D, Q, and DQ functions.
- Special impedance matching transformer.
- New modern cabinet styling.
- ½% precision resistors and silver mica condensers.

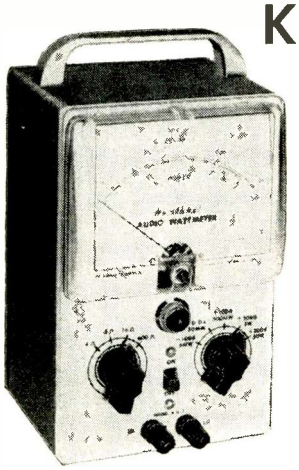
Another new, outstanding instrument design so typically characteristic of Heathkit operation in producing high quality instrument kits at the lowest possible price. A new, improved model Impedance Bridge kit featuring modern cabinet styling, with slanted panel for convenience of operation and interpretation of scales at a $10.00 price reduction over the preceding model. Built-in adjustable phase shift oscillator and amplifier with all tubes of the battery operated type completely eliminates warm-up time. The instrument is entirely AC line operated. No bothersome battery replacements.

The Heathkit IB-2 Impedance Bridge Kit actually represents four instruments in one compact unit. The Wheatstone Bridge for resistance measurements, the Capacity Comparison Bridge for capacity measurements, Maxwell Bridge for low Q, and Hay Bridge for high Q inductance measurements. Read Q, D, DQ all on one dial thereby eliminating possible confusion due to the incorrect dial reference or adjustment. Only one set of instrument terminals necessary for any measurement function. Panel provisions provided for external generator use.

A newly designed two section CRL dial provides ten separate "units" switch settings with an accuracy of .5%. Fractions of units are read on a continuously variable calibrated wire-wound control. A special minimum capacity, shielded, balanced impedance matching transformer between the generator and the bridge. The correct impedance match is automatically switch selected to provide constant load operation of the generator circuit. The instrument uses ½% precision resistors and condensers in all measurement circuits.

The new Heathkit IB-2 provides ourstanding design features not found in any other kit instrument. The single low price includes the power supply, generator, and amplifier stages. No need to purchase separate instrument accessories in order to obtain the type of operation desired.

Heathkit AUDIO WATTMETER KIT



MODEL AW-1

$29.50

SHIPPING WT. 6 LBS.

A new Heathkit design for the audio engineer, serious hi fi enthusiast, recording studio, or broadcast station; the Heathkit Audio Wattmeter Kit. This specialized instrument instantly indicates the output level of the equipment under test without requiring the use of external load resistors. All readings are taken directly from the calibrated scales of a 4½" 200 microampere Simpson meter.

The Heathkit Audio Wattmeter features five full scale power measurement ranges from 5 milliwatts up to 50 watts with db ranges of −15 db to +48 db. The instrument has a power measurement rating of 25 watts continuous and 50 watts maximum for intermittent operation. Non-inductive resistance load impedances of 4, 8, 16, and 600 ohms are provided through a panel impedance selector switch. Frequency effect is negligible from 10 cycles to 250 kc. A conventional VTVM circuit utilizes a 12AU7 twin triode tube. The meter bridge circuit uses four germanium diodes for good linearity.

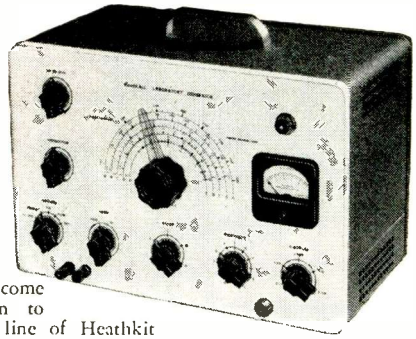
With the Heathkit AW-1 desired information can be obtained instantly and conveniently without bothering with the irksome setups and calculations usually required. Useful for power curve measurements, frequency response checks, monitoring indicator, etc. Convenient calibration directly from 110 volt AC line source. This new instrument will help to supply the answers to your audio operating or power output problems.

Heathkit LABORATORY GENERATOR KIT

MODEL LG-1

$39.50

SHIP. WT. 16 LBS.



Another welcome new addition to the popular line of Heathkit instruments, the Heathkit Laboratory Generator. Specifically designed for flexibility of operation, accuracy and versatility beyond the performance level provided by the conventional service type generator. Frequency coverage of the Colpitts oscillator is 150kc to 30mc in five convenient ranges with provisions for internal or external modulation up to 50%, and .1 volt RF output throughout the frequency range. Panel mounted 200 microampere Simpson meter for RF "set reference level" to provide relative indication of RF output. Individually shielded oscillator and shielded variable and step attenuator provide flexible control of RF output.

The circuit features a 6AF4 high frequency oscillator, a 6AV5 amplifier with grid modulation, 12AU7 400 cycle oscillator and modulator, OB2 voltage regulator tube, and a selenium rectifier for the transformer operated power supply. The smart professional instrument appearance and over-all flexibility of operation will prove a decided asset to any industrial or educational laboratory. The Heathkit Laboratory Generator sets a new level of operation, far superior to any instrument in this price classification.

HEATH COMPANY • Benton Harbor 20, Mich.

CHECK THESE *Features*

- New 5UP1 CR tube
- Re-trace blanking
- Voltage regulation
- Extended band width
- Peak-to-peak calibrating provisions
- Good square wave response
- Astigmatism control
- New heavy duty shielded power transformer

NEW 5" *Heathkit*

OSCILLOSCOPE KIT

MODEL O-9

$59.50

SHIPPING WT. 28 LBS.

Announcing the latest addition to a brilliant series of Heathkit Oscilloscopes, the new Model O-9. This outstanding instrument incorporates all of the features developed and proven in the production of well over 50,000 kits, in addition to a host of many new design features for truly outstanding performance. This new scope features a brand new (no surplus) commercially available 5UP1 cathode ray tube for fine focusing, high intensity, and freedom from halation. The 5" CR tube is the standard size for design and industrial laboratories, development engineers, and service men. The only size CR tube offering a wide range of types, colors, phosphors, and persistence. The answer to good oscilloscope performance lies in improved basic design and operating characteristics, and not in the use of larger CR tubes.

VERTICAL AMPLIFIER — New extended band width vertical amplifier with sensitivity of .025 volts per inch, down 3 db at 2 mc, down only 5½ db at 3 mc. Three step vertical input attenuator, quality ceramic variable capacitors for proper input compensation, provisions for calibrated 1 volt peak-to-peak reference, with calibrated screen for direct reading of TV pulses.

HORIZONTAL AMPLIFIER — New input selector switch provides choice of horizontal input, 60 cycle sweep input, line sync, internal sync, and external sync. Expanded horizontal sweep produces sweep width several times the cathode ray tube diameter. New blanking amplifier for complete retrace blanking and new phasing control.

POWER SUPPLY — New high voltage power supply and filtering circuit for really fine hairline focusing. New heavy duty power transformer with adequate operating reserve. Voltage regulated supply for both vertical and horizontal amplifiers for absolutely rock steady traces and complete freedom from bounce and jitter due to line variations.

The acid test of any oscilloscope operation is the ability to reproduce high frequency square waves and the new Heathkit O-9 will faithfully reproduce square waves up to 500 kc. This is the ideal all around, general purpose oscilloscope for educational and industrial use, radio and TV servicing, and any other type of work requiring the instantaneous reproduction and observation of actual wave forms and other electrical phenomena.

NO. 342

$3.50 SHIP. WT. 1 LB.

Heathkit LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television work requires the use of a low capacity probe to prevent loss of gain, distortion, or false service information. The Heathkit Low Capacity Probe features a variable capacitor to provide the necessary degree of instrument impedance matching. New probe styling with bright polished aluminum housing and polystyrene probe ends.

NO. 337-B

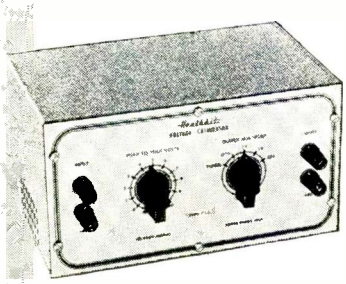
$3.50

SHIP. WT. 1 LB.

Heathkit SCOPE DEMODULATOR PROBE KIT

In applications such as trouble shooting or aligning TV, RF, IF, and video stages, the frequency ranges encountered require demodulation of signals before oscilloscope presentation. The newly-styled Heathkit Demodulator Probe in polished aluminum housing will fulfill this function and readily prove its value as an oscilloscope service accessory. Detailed assembly sheet provided, including instructions for probe operation.

Heathkit VOLTAGE CALIBRATOR KIT



MODEL VC-2

$11.50

SHIPPING WT. 4 LBS.

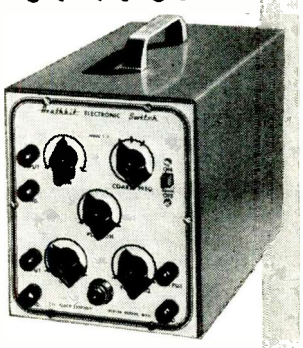
The Heathkit Voltage Calibrator provides a convenient method of making peak-to-peak voltage measurements with an oscilloscope by establishing a relationship on a comparison basis between the amplitude of an unknown wave shape and the known output of the voltage calibrator. Peak-to-peak voltage values are read directly on the calibrated panel scales. To offset line voltage supply irregularities, the instrument features a voltage regulator tube.

With the Heathkit Voltage Calibrator, it is possible to measure all types of complex wave forms within a voltage range of .01 to 100 volts peak-to-peak. A convenient "signal" position on the panel switch by-passes the calibrator completely and the signal is applied to the oscilloscope input thereby eliminating the necessity for transferring test leads.

Heathkit ELECTRONIC SWITCH KIT

The basic function of the Heathkit S-2 Electronic Switch Kit is to permit simultaneous oscilloscope observation of two separate traces which can be either separated or superimposed for individual study. A typical example would be observation of a signal as it appears at both the input and output stages of an amplifier. It will also serve as a square wave generator over the range of switching frequencies, often providing the necessary wave form response information without incurring the expense of an additional instrument.

Continuously variable switching rates in three ranges from less than 10 cps to over 2,000 cps. Individual controls for each input channel and a positioning control. The five tube transformer operated circuit utilizes two 6SJ7, two 6SN7, and one 6X5 tubes. Buy this kit and enjoy increased versatility of operation from your oscilloscope.

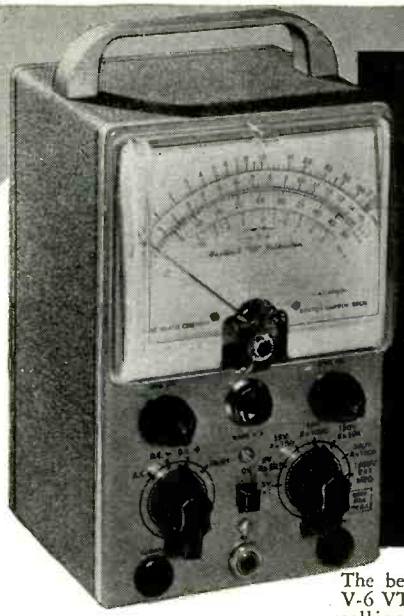


MODEL S-2

$23.50

SHIP. WT. 11 LBS.

HEATH COMPANY • Benton Harbor 20, Mich.



Heathkit VACUUM TUBE VOLTMETER KIT

MODEL V-6

$24.50

SHIPPING WT. 6 LBS.

Features

- New 1½ volt full scale low range
- 1,500 volt upper limit DC range
- Increased accuracy through 50% greater scale coverage
- High impedance 11 megohm input
- Center scale zero adjust
- Polarity reversal switch
- 1% precision resistors
- Clearly marked db scales

The beautiful Heathkit Model V-6 VTVM, the world's largest selling kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven in the production of over 100,000 VTVM's. This is the basic measuring instrument for every branch of electronics. Easily meets all requirements for accuracy, stability, sensitivity, convenience of ranges, meter readability, and modern styling. It will accurately measure DC voltages, AC voltages, offers tremendous ohmmeter range coverage, and a complete db scale for a total of 35 meter ranges.

New 1½ volt full scale low range provides well over 2¼" of scale length per volt. Upper DC scale limit 1,500 volts. DC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 volts full scale. AC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 (1,000 volts maximum). Seven ohmmeter ranges from .1 ohm to 1,000 megohms. For added convenience a DC polarity reversing switch and a center scale zero adjustment for FM alignment.

The smartly styled, compact, sturdy, formed aluminum cabinet is finished in an attractive gray crackle exterior. The beautiful two-color, durable, infra-red, baked enamel panel further adds to the over-all professional appearance.

Top quality components used throughout. 1% precision resistors — silver contact range and selector switches — selenium rectifier — transformer operated power supply. Individual calibration on both AC and DC for maximum accuracy. DB scale printed in red for easy identification, all other scales a sharp, crisp black for easy reading. A variety of accessory probes shown on this page still add further to over-all instrument usefulness.

Heathkit 30,000 VOLT DC PROBE KIT

For TV service work or any similar application where the measurement of high DC voltage is required, the Heathkit Model 336 High Voltage Probe Kit will prove invaluable. A precision multiplier resistor mounted inside the two-color, sleek, plastic probe body provides a multiplication factor of 100 on the DC ranges of the Heathkit 11 megohm VTVM. The entire kit includes precision resistor, two-color plastic probe, tip connector spring, test lead, phone plug panel connector, and complete assembly instructions.

No. 336

$4.50

SHIP. WT. 2 LBS.

No. 338-B

$5.50

SHIP. WT. 2 LBS.

Heathkit PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scales of the Heathkit 11 megohm VTVM. Readings can be directly made from the VTVM scale without involved calculations. Measurements over the frequency range of 5 kc to 5 mc. Use this probe to extend the usefulness of your VTVM in radio and TV service work. The Peak-to-Peak Probe Kit features the new polished aluminum housing with two-color polystyrene probe ends. Detailed assembly sheet including instructions for probe operation.

Heathkit RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 mc, ± 10%. A useful, convenient accessory for those occasions when RF measurements are desired. The RF probe body is housed in the new, smartly-styled polished aluminum probe body featuring two-color polystyrene probe ends and a low capacity flexible shielded test lead. The kit is complete with all necessary material and a detailed assembly sheet as well as instructions for probe operation.

No. 309-B

$3.50

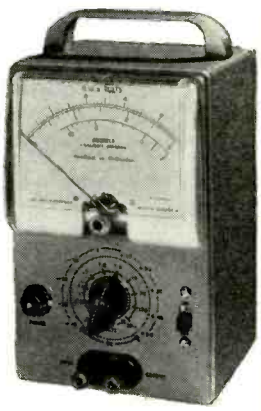
SHIP. WT. 2 LBS.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50

SHIPPING WT. 5 LBS.



The new Heathkit AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts, and experimenters. Especially useful for hum investigation, sensitive null detection, phono pick-up output measurements, making frequency response runs, gain measurements, ripple voltage checks, etc. Low level measurements are easy to make because of the complete voltage coverage of the instrument and the one knob operation.

The large 200 microampere Simpson meter has clearly marked and easy to read meter scales. Ten voltage ranges covering from .01 rms full scale to 300 volts rms full scale, with frequency response ± 1 db from 20 cycles to 50,000 cycles. Instrument input impedance 1 megohm, ten db ranges from −52 db to +52 db. For stability and good linearity characteristics the meter bridge circuit features 4 germanium diodes. Attractive instrument styling, a companion piece for the popular Heathkit VTVM and the new AW-1 Audio Wattmeter.

HEATH COMPANY • Benton Harbor 20, Mich.

CHECK THESE *Features*

- 20,000 ohms per volt DC sensitivity, 5,000 ohms per volt on AC
- Polarity reversal switch
- 1% precision multiplier resistors
- 50 microampere 4½" Simpson meter
- Meter ranges for service convenience
- New resistor ring-switch assembly
- Total of 35 meter ranges
- New Modern cabinet styling

NEW *Heathkit*

MULTIMETER KIT

MODEL MM-1

$26.50

SHIPPING WT. 6 LBS.

The most important Heathkit announcement of the year, the new 20,000 ohms per volt Heathkit Multimeter, Model MM-1. The universal service measuring instrument, accurate, sensitive, portable, and completely independent of AC line supply. Particularly designed for service use incorporating many desirable features for the convenience of the service man. Full 20,000 ohms per volt sensitivity on DC ranges — 5,000 ohms per volt sensitivity on AC —polarity reversal switch, no bothersome transferring of test leads — 1% precision multiplier resistors — large 4½" recessed non-glare 50 microampre Simpson meter — conveniently slanted control panel — recessed safety type banana jacks — standard universally available batteries — rugged practical sized cabinet with plastic carrying handle, and a total of 35 calibrated meter ranges.

RANGES

Voltage ranges selected entirely for service convenience. For example 1½ volt full scale low range for measuring portable radio filament voltages, bias voltages, etc., 150 volt full scale range for AC-DC service work, 500 volt full scale range for conventional transformer operated power supply systems. Complete voltage ranges AC and DC, 0-1.5—5—50—150—500—1,500—5,000 volts. DC current ranges, 0-150 microamperes—15 milliamperes—150 milliamperes—500 milliamperes—15 amperes. Resistance measurements from .2 ohms to 20 megohms x 1 x 1,000 x 10,000. DB coverage from —10 db to +65 db.

CONSTRUCTION

Entirely new design permits assembly, mounting and wiring of precision resistors on a ring-switch assembly unit. The major portion of instrument wiring is completed before mounting the ring-switch assembly to the panel. No calibration procedure is required, all precision resistors readily accessible in event of replacement.

CABINET

Strikingly modern cabinet styling featuring two piece construction, durable black Bakelite cabinet, with easy to read panel designations. Cabinet size 5½" wide x 4" deep x 7½" high. Good cabinet physical stability when operated in vertical position.

The Heathkit MM-1 represents a terrific instrument value for a high quality 20,000 ohms per volt unit using all 1% deposited carbon type precision resistors. Here is quality, performance, functional design, and attractive appearance, all combined in one low priced package.

Heathkit

BATTERY TESTER KIT

MODEL BT-1

$8.50

SHIP. WT. 2 LBS.

The Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three color Good-Weak-Replace scale. Operation is extremely simple and merely requires that the test leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for "A" or "B" battery types. The Heathkit Battery Tester features compact assembly, accurate meter movement, and a three deck wire-wound control, all mounted in a portable rugged plastic cabinet. Checks portable radio batteries, hearing aid batteries, lantern batteries, etc.

Heathkit

HANDITESTER KIT

MODEL M-1

$14.50

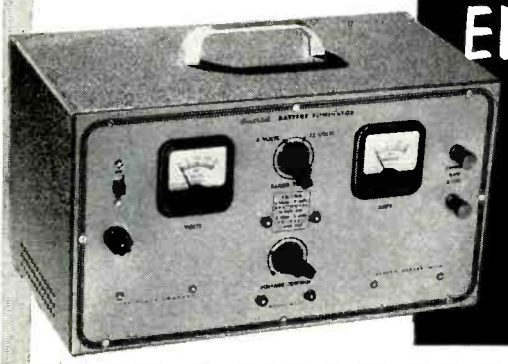
SHIPPING WT. 3 LBS.

The Heathkit Model M-1 Handitester readily fulfills major requirements for a compact, portable volt ohm milliammeter. Despite its compact size, the Handitester is packed with every desirable feature recuired in an instrument of this type. AC or DC voltage ranges full scale, 0-10—30—300—1,000—5,000 volts. Two ohmmeter ranges, 0-3,000 and 0-300,000. Two DC current measurement ranges, 0-10 milliamperes and 0-100 milliamperes. The instrument uses a Simpson 400 microampere meter movement, which is shunted with resistors to provide a uniform 1 milliampere load on both AC and DC ranges. Special type, easily accessible, battery mounting bracket — 1% deposited carbon type precision resistors — hearing aid type ohms adjust control. The Handitester is easily assembled from complete instructions and pictorial diagrams. Necessary test leads are included in the price of this popular kit.

HEATH COMPANY • Benton Harbor 20, Mich.

New *Heathkit* 12 Volt

BATTERY ELIMINATOR KIT



MODEL BE-4

$31.50

SHIPPING WT. 18 LBS.

CHECK THESE *Features*

- Either 6 or 12 volt operation
- Continuously variable voltage output
- Constant ammeter and voltmeter monitoring
- Automatic overload relay — self-resetting
- Two 10,000 mf condensers
- New 18 disc split type heavy duty rectifier unit
- Fuse protection

Here is the new Heathkit Battery Eliminator necessary for modern, up-to-date operation of your service shop. The Heathkit Model BE-4 furnishes either 6 volts or 12 volts output which can be selected at the flick of a panel switch. Use the BE-4 to service the new 12 volt car radios in addition to the conventional 6 volt radios.

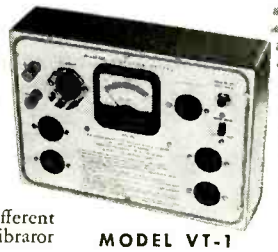
This new Battery Eliminator provides two continuously variable output ranges, 0-8 volts DC at 10 amperes continuously, or 15 amperes maximum intermittent; 0-16 volts DC at 5 amperes continuously or 7.5 amperes maximum intermittent. The output voltage is clean and well filtered as the circuit uses two 10,000 mf condensers. The continuously variable voltage output feature is a definite aid in determining the starting point of vibrators, the voltage operating range of oscillator circuits, etc. Panel mounted meters constantly monitor voltage and current output and will quickly indicate the presence of a major circuit fault in the equipment under test. The power transformer primary winding is fuse protected and for additional safety an automatic relay of the self-resetting type is incorporated in the DC output circuit. The heavy duty rectifier is a split type 18 plate magnesium copper sulfide unit used either as a full wave rectifier or voltage doubler according to the position of the panel range switch.

Here is the ideal battery eliminator for all of your service problems and as an additional feature, it can also be used as a battery charger. Another new application for the Heathkit Battery Eliminator is a variable source of DC filament supply in audio development and research. More than adequate variable voltage and current range for normal applications.

Heathkit VIBRATOR TESTER KIT

Your repair time is valuable, and service use of the Heathkit Vibrator Tester will save you many hours of work. This tester will instantly tell you the condition of the vibrator being checked. Checks vibrators for proper starting and the easy to read meter indicates quality of output on a large Bad-?-Good scale. The Heathkit VT-1 checks both interrupter and self rectifier types of vibrators. Five different sockets for checking hundreds of vibrator types.

The Heathkit Vibrator Tester operates from any battery eliminator capable of delivering continuously variable voltage from 4 to 6 volts DC at 4 amperes. The new Heathkit Model BE-4 Battery Eliminator would be an ideal source of supply.



MODEL VT-1

$14.50

SHIPPING WT. 6 LBS.

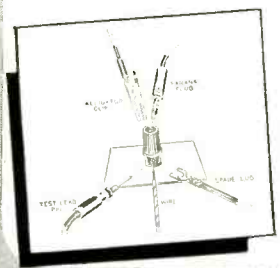
NEW *Heathkit* VARIABLE VOLTAGE ISOLATION TRANSFORMER KIT

The new Heathkit Isolation Transformer Kit provides line isolation for AC-DC radios (not an auto transformer), thereby eliminating shock hazard, hum problems, alignment difficulties, etc. The output voltage is variable from 90 to 130 volts AC and is constantly monitored by a panel mounted AC volt meter. Use it to increase AC supply voltage in order to induce breakdown of faulty components in circuits thereby saving service time. Use it also to simulate varying line voltage conditions and to determine the line voltage level at which oscillator circuits cease functioning, particularly in three-way portable radios. Rated at 100 watts continuous operation and up to 200 watts maximum intermittent operation. A useful radio and TV service tool.

MODEL IT-1

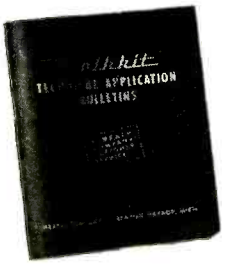
$16.50

SHIP. WT. 9 LBS.



Heathkit BINDING POST

Binding post kit now available so that standardization of all instrument connectors is possible. This new, five-way binding post will accommodate an alligator clip, banana plug, test lead pin, spade lug, or hook-up wire. Sold in units of 20 binding post assemblies. Each assembly includes binding post, flat and shoulder fiber washers, solder lug, and nut. 120 pieces in all. Kit 362, $4.00.



Heathkit TECHNICAL APPLICATION BULLETINS

An exclusive Heathkit service. Technical application bulletins prepared by recognized instrument authorities outlining various combinations of instrument applications. Available now with 40 four-page illustrated bulletins and an attractive flexible loose-leaf binder. Only $2.00. (No c.o.d. on this item, please.)

HEATH COMPANY · Benton Harbor 20, Mich.

CHECK THESE *Features*

- INCREDUCTOR controllable inductor sweep
- TV and IF sweep deviation 12-30 mc
- 4 mc- 220 mc continuous frequency coverage
- Oscillator operation entirely on fundamentals
- Output in excess of 100,000 microvolts
- Automatic amplitude circuit
- Voltage regulation
- Simplified operation

NEW *Heathkit*

TV ALIGNMENT GENERATOR KIT

MODEL TS-3

$44.50

SHIPPING WEIGHT 18 POUNDS

Proudly announcing an entirely new, advanced model TV and FM Sweep Generator, the Heathkit Model TS-3. This new design provides features and combinations of functions not found in any other service type instrument. Every design consideration has been given to the requirements of the TV service man to provide a flexible, variable sweep source with more than adequate RF output and complete frequency coverage throughout the TV and FM spectrum.

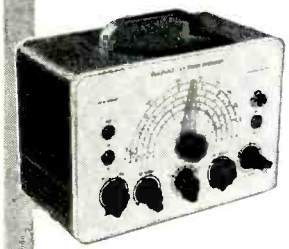
The frequency range of the TS-3 is from 4 mc to 220 mc in four switch selected ranges. All frequency ranges are overlapping for complete coverage. A particularly important feature of the instrument is that the oscillator operates entirely on fundamentals, thereby providing complete freedom from spurious oscillation and parasitics normally encountered in beat frequency type oscillators. This circuity assures a much higher total RF output level and simplifies attenuation problems.

The new TS-3 features an entirely new principle of sweep operation. Sweep action is entirely electronic with no moving parts or electro-mechanical devices so commonly used. The heart of the sweep system is a newly-developed INCREDUCTOR controllable inductor. With this system, the value of inductance of each oscillator coil is electrically varied with an AC control current, and the inductance variation is achieved by a change in the magnetic state of the core on which the oscillator coils are wound. This system provides a sweep deviation of not less than 12 mc on all TV frequencies, and up to a maximum of 30 mc on TV IF frequencies. The high RF output level throughout the instrument frequency range overcomes the most common complaint of the older type sweep generators. A new, automatic amplitude control circuit maintains the output level flat to ± 2 db throughout the instrument range. For convenience of operation a low impedance 50 ohm output is used.

Operation of the instrument has been simplified through the reduction of panel controls and separate panel terminals provide for external synchronization if desired. The circuit uses a voltage regulator tube to maintain stable instrument operation. A built-in variable oscillator marker further adds to flexibility of instrument operation. Provisions are also made for the use of an external marker, such as your service type signal generator, if desired. Use the Heathkit TS-3 for rapid, accurate TV alignment work, and let it help you solve those time consuming, irksome problems so frequently encountered.

NEW *Heathkit*

SIGNAL GENERATOR KIT



MODEL SG-8

$19.50

SHIPPING WEIGHT 8 POUNDS

Announcing the new Heathkit Model SG-8 service type Signal Generator, incorporating many design features not usually found in an instrument in this price range. The RF output is from 160 kc to 100 mc in five ranges, all on fundamentals, with useful harmonics up to 200 mc. The RF output level is in excess of 100,000 microvolts throughout the frequency range.

The oscillator circuit consists of a 12AT7 twin triode tube. One half is used as a Colpitts oscillator, and the other half as a cathode follower output which acts as a buffer between the oscillator and external load. This circuity eliminates oscillator frequency shift usually caused by external circuit loading.

All coils are factory wound and adjusted, thereby completely eliminating the need for calibration and the use of additional calibrating equipment. The stable low impedance output features a step and variable attenuator for complete control of RF level. A 6C4 triode acts as a 400 cycle sine wave oscillator and a panel switching system permits a choice of either external or internal modulation.

The transformer operated circuit is easy to assemble, requires no calibration, and meets every service requirement for an adjustable level variable frequency signal source, either modulated or un-modulated.

NEW *Heathkit*

BAR GENERATOR KIT

MODEL BG-1

$14.50

SHIPPING WEIGHT 6 POUNDS

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing, and the bar generator is the logical answer to the TV service man's problem in obtaining quick, accurate adjustment information without waiting for test patterns.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test. Panel switch provides "stand-by position" — "horizontal position" — "vertical position." The oscillator unit utilizes a 12AT7 twin triode for the RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will not only produce bar patterns but will also provide an indication of horizontal and vertical sync circuit stability, as well as overall picture size.

Instrument operation is extremely simple, and merely requires connection to the TV receiver antenna terminal. The unit is transformer operated for safety when used in conjunction with universal or transformerless type TV circuits.

HEATH COMPANY • Benton Harbor 20, Mich.

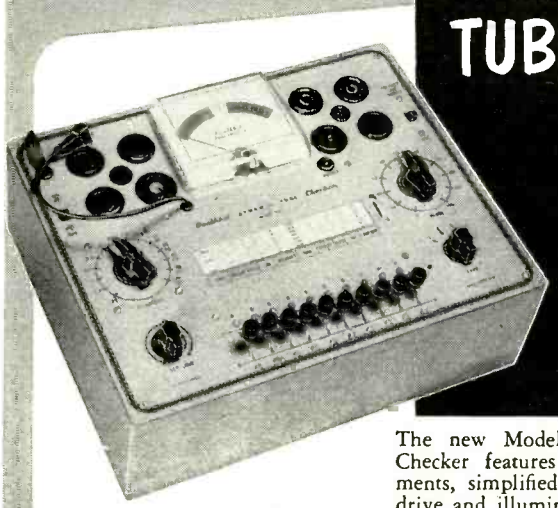
NEW *Heathkit*

TUBE CHECKER KIT

MODEL TC-2

$29.50

SHIP. WT. 12 LBS.



CHECK THESE NEW *Features*

- Simplified harness wiring
- Improved, smooth, anti-backlash roll chart action
- Optional roll chart illuminatian
- Individual element switches
- Portable or counter style cabinet
- Spare blank socket
- Contact type pilot light test socket
- Simplified test set-up procedure
- Line adjust control
- 4½" three-color meter

The new Model TC-2 Heathkit Tube Checker features many circuit improvements, simplified wiring, new roll chart drive and illumination of roll chart. The instrument is primarily designed for the convenience of the radio and TV service man and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron and a blank socket for new tubes. Built-in neon short indicator, individual three-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line set control to compensate for supply voltage variations, all represent important design features of the TC-2. Results of tube tests are read directly from a large 4½" Simpson three-color meter, calibrated in terms of Bad-?-Good. Information that your customer can readily understand. Checks emission, shorted elements, open elements, and continuity.

The use of closer tolerance resistors in critical circuits assures correct test information and eliminates the possibility of inaccurate test interpretation. Improvement has been made in the mechanical roll chart drive system, completely eliminating diagonal running, erratic operation, and backlash. The thumb wheel gear driven action is smooth, positive, and free running. As an additional feature, the roll chart is illuminated for easier reading, particularly when the tube checker is used on radio or TV home service calls.

Wiring procedure has been simplified through the extended use of multicable, color coded wires, providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts that "factory built" appearance to instrument construction. Completely detailed information is furnished in the new step-by-step construction manual, regarding the set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

The new Heathkit Tube Checker will prove its value in building service prestige through usefulness — simplified operation — attractive professional appearance. Don't overlook the fact that the kit price represents a savings of $40.00 to $50.00 over the price of a comparable commercially built instrument. At this low price, no service man need be without the advantages offered by the Heathkit Tube Checker.

New

HEATHKIT

PORTABLE TUBE CHECKER KIT

MODEL TC-2P

$34.50

SHIP. WT. 14 LBS.

The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon, proxylin impregnated, fabric covering with a contrasting gray on the inside cover. Detachable cover, brass-plated hardware, sturdy plastic handle help to impart a truly professional appearance to the instrument.

PORTABLE TUBE CHECKER CABINET as described above will fit all earlier Heathkit TC-1 Tube Checkers. Shipping weight 7 lbs. Cabinet only, 91-8, $7.50.

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

Heathkit TV PICTURE TUBE

TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker will quickly check for emission, shorts, etc., and determine picture tube quality. Consists of standard 12 pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

Heathkit POWER SUPPLY KIT

MODEL PS-2

$33.50

SHIPPING WT. 17 LBS.

The Heathkit Laboratory Power Supply features continuously variable, regulated voltage output with good stability under wide load variations. A 4½" Simpson plastic enclosed panel mounted meter provides accurate meter output information of voltage or current. All panel terminals completely isolated from the cabinet. Separate 6.3 volt AC supply at 4 amperes for filament requirements. Ripple component exceptionally low, stand-by switch provided to eliminate warm-up time of the five tube circuit.

LABORATORY AND SERVICE SHOP

BOOKLETS

"Planning Your Service Business" by John T. Frye, and "Establishing the Industrial Electronics Laboratory" by Louis B. Garner, Jr., are booklets available to Heathkit customers at no charge. These booklets, written by nationally recognized authorities, outline the various requirements and considerations for establishing your own service business or for setting up an industrial electronics laboratory. Full attention is given to various details that are frequently overlooked when projects of this nature are undertaken. Just write in to the Heath Company requesting your free copy, or attach a memo to your next order.

HEATH COMPANY • Benton Harbor 20, Mich.

CHECK THESE *Features*

- Visual and aural signal tracing
- Two channel input
- High RF sensitivity
- Unique noise locater circuit
- Calibrated wattmeter
- Substitution test speaker
- Utility amplifier
- RF, audio probes and test leads included

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

MODEL T-3

$23.50

SHIPPING WEIGHT 10 POUNDS

An entirely new type of signal tracer incorporating a combination of features not found in any other instrument. Designed expressly for the radio and TV service man, particularly for the servicing of AM, FM, and TV circuits. Here in a five tube, transformer operated instrument are all of the useful functions so necessary for speedy, accurate isolation of service difficulty.

This new signal tracer features a special high gain RF input channel, used in conjunction with a newly-designed wide frequency range demodulator probe. High RF sensitivity permits signal tracing at the receiver antenna input. A separate low gain channel and probe available for audio circuit exploration. Both input channels are constantly monitored by an electron ray beam indicator, so that visual as well as aural signal indications may be observed. The instrument can also be used for comparative estimation of gain per stage.

A decidedly unusual feature is a noise localizer circuit in conjunction with the audio probe. With this system, a DC potential is applied to a suspected circuit component and the action of the voltage in the component can be seen as well as heard. Invaluable for ferreting out noisy or intermittent condensers, noisy resistors, controls, coils, IF and power transformers, etc. A built-in calibrated wattmeter circuit is very useful for a quick preliminary check of the total wattage consumption of the equipment under test. Separate panel terminals provide external use of the speaker or output transformer for substitution purposes. Saves valuable service time by eliminating the necessity for speaker removal on every service job. The terminals also permit the utilization of other shop equipment, such as your oscilloscope or VTVM. The T-3 Signal Tracer can be used as a high gain amplifier for checking tuners, record changers, microphones, phono crystals, etc.

Don't overlook the interesting service possibilities provided through the use of this new instrument and let it work for you by saving time and money. The kit is supplied complete with all tubes, circuit components, demodulator probe, audio probe, and additional test leads.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1

$19.50

SHIP. WT. 4 LBS.

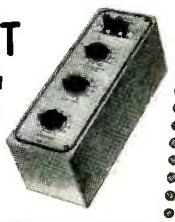
The Decade Resistance Kit provides individual switch selection of resistance values using twenty 1% resistors providing a choice of 1 to 99,999 ohms in 1 ohm steps. Ceramic wafer switches, silver-plated contacts, smooth, positive detent action, baked enamel panel, and handsome, polished birch cabinet.

Heathkit DECADE CONDENSER KIT

MODEL DC-1

$16.50

SHIP WT 4 LBS.



The Heathkit Decade Condenser Kit features silver mica, precision condensers with a rated accuracy of ± 1%. Capacity values are arranged in three decades from 100 mmf to .111 mf in steps of 100 mmf. Ceramic wafer switches with silver-plated contacts and smooth detent action. Useful in laboratory work, for circuit development.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

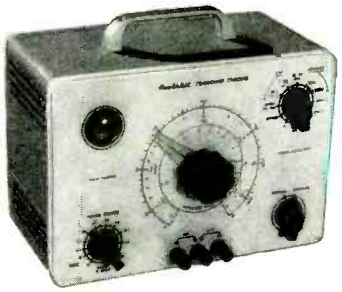
MODEL RS-1

$5.50

SHIP. WT. 2 LBS.

The Heathkit Resistance Substitution Box provides individual switch selection of any one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 meghoms. Many applications in circuit development work, and also in radio and TV service work. Ideal for experimentally determining resistance values and for quickly altering circuit operating characteristics. Entire unit housed in attractive Bakelite cabinet, featuring the new universal type Heathkit binding posts to simplify circuit connections.

Heathkit CONDENSER CHECKER KIT



MODEL C-3

$19.50

SHIPPING WT. 8 POUNDS

Use the Heathkit C-3 Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings are taken directly from the calibrated panel scales without requiring any involved calculation. Capacity measurements in four ranges from .00001 mf to 1,000 mf. Checks paper, mica, ceramic, and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser measurements. A leakage test switch with switch selection of five polarizing voltages, 25 volts to 450 volts DC, will indicate condenser operating quality under actual load condition. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard to the operator.

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

For safety of operation the circuit is entirely transformer operated and the instrument is housed in the attractive, newly-styled Heathkit cabinet, featuring rounded corners, and drawn aluminum panel. The outstanding low kit price for this surprisingly accurate instrument includes necessary test leads. Good service shop operation requires the use of this specialized instrument, designed for the express purpose of determining unknown condenser values and operating characteristics.

HEATH COMPANY • Benton Harbor 20, Mich.

Heathkit AMATEUR TRANSMITTER KIT

MODEL AT-1

$29.50

SHIPPING WEIGHT 16 POUNDS

CHECK THESE NEW *Features*

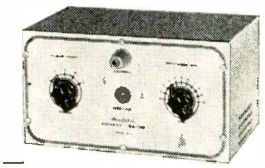
- Single knob band switching
- Pre-wound coils
- Metered operation
- 52 ohm coaxial output
- Crystal or VFO excitation
- Built-in power supply
- Rugged, clean construction

Here is the latest Heathkit addition to the ham radio field, the AT-1 Transmitter Kit, incorporating many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, AC line filtering, good shielding, etc. VFO or crystal excitation — up to 35 watts input. Built-in power supply provides 425 volts at 100 ma.

This kit features pre-wound coils, single knob band switching, 52 ohm coaxial output, plug in chassis provisions for VFO or modulator and rugged clean construction. Frequency range 80, 40, 20, 15, 11, and 10 meters. Tube line-up 6AG7 oscillator-multiplier, 6L6 amplifier-doubler, 5U4G rectifier. Physical dimensions 8⅛" high x 13⅛" wide x 7" deep.

This amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual. The ideal kit for the novice just breaking into ham radio. It can be used later on as a stand-by rig or an all band exciter for higher powered transmitter.

NEW *Heathkit* ANTENNA COUPLER KIT



New Heathkit Antenna Coupler, specially designed for the Heathkit AT-1 Transmitter. The Antenna Coupler can be used with any 52 ohm coaxial input — up to 75 watts power. Low pass filter with cut-off frequency of approximately 36 mc — L section tuning network — neon tuning indicator — rugged, compact construction — transmitter type variable condenser, and high Q coil are all outstanding features. The AC-1 has both inductance and capacity tuning for maximum operating versatility. Dimensions 8⅛" wide x 4⅜" high x 4⅞" deep.

MODEL AC-1

$14.50 SHIP. WT. 3 LBS.

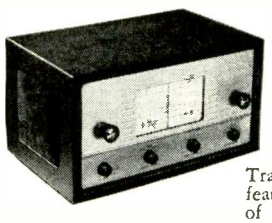
Heathkit ANTENNA IMPEDANCE METER

Use the Heathkit Antenna Impedance Meter for measuring antenna impedance for line matching purposes — adjustment of beam antennas — phone monitor, etc. It will determine antenna resistance at resonance, match transmission line for minimum SWR, determine receiver input impedance, and provide a rough indication of SWR. Precision resistors, germanium diode, 100 microampere Simpson meter. Dial calibrated from 0-500 ohms. Shielded aluminum cabinet. 7" long x 2½" wide x 3¼" deep.

$14.50 SHIP. WT. 3 LBS.

MODEL AM-1

Heathkit COMMUNICATIONS RECEIVER KIT



MODEL AR-2

$25.50 SHIP. WT. 12 LBS.

Here is the new receiver kit you have repeatedly asked for, the Heathkit Communications Receiver. The perfect companion piece for the AT-1 Transmitter kit. Many outstandingly desirable features have been incorporated in the design of the AR-2; such as, electrical bandspread for logging and tuning convenience — high gain miniature tubes — IF transformers for high sensitivity and good signal to noise ratio — separate RF gain control with optional automatic volume control or manual volume control, in addition to the conventional audio gain control. Noise limiter — stand-by switch — stable BFO oscillator circuit — headphone jack — transformer operation, etc., all contribute to a high performance standard.

Frequency coverage is continuous from 535 kc to 35 mc in four ranges. For added convenience, various ham bands have been separately identified in respect to their relative placement on the slide rule tuning scale. A chassis mounted, 5½" PM speaker is included with this kit. Tube line up 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector AVC audio, 12BA6 BFO oscillator, 12A6 beam power output, 5Y3GT rectifier.

RECEIVER CABINET

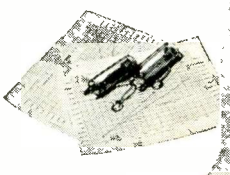
Proxylin impregnated, fabric covered, plywood cabinet with aluminum panel designed expressly for the AR-2 Receiver. Part 91-10, shipping weight 5 lbs., $4.50.

IMPROVED *Heathkit* GRID DIP METER KIT

$19.50 SHIP. WT. 4 LBS.

MODEL GD-1B

The invaluable instrument for service men, hams, and experimenters. Useful in TV service work for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages, use it for neutralization, locating parasitics, correcting TVI, measuring C, L, and Q of components, and determining RF circuit resonant frequencies. With oscillator energized, useful for finding resonant frequency of tuned circuits. With the oscillator not energized, the instrument acts as an absorption wave meter. Variable meter sensitivity control, head phone jack, 500 microampere Simpson meter. Continuous frequency coverage from 2 mc. to 250 mc. Pre-wound coil kit and rack, new three prong coil mounting, 6AF4 high frequency triode.



Two additional plug-in coils are available and provide continuous extension of low frequency coverage down to 355 kc. Dial correlation curves included. Shipping weight 1 lb., kit 341, $3.00.

HEATH COMPANY • Benton Harbor 20, Mich.

CHECK THESE *Features*

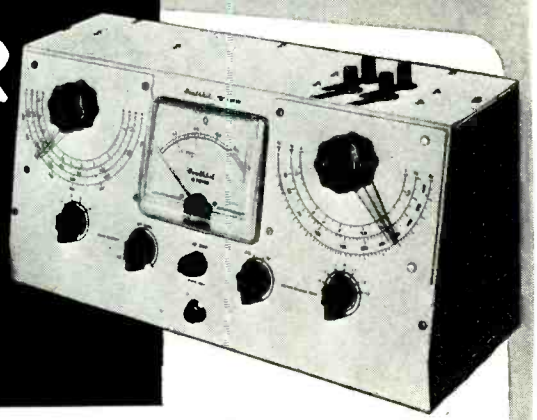
- First popular priced Q Meter
- Reads Q directly on calibrated scale
- Oscillator supplies RF frequencies of 150 kc to 18 mc
- Calibrate capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf
- Measures Q of condensers, RF resistance, and distributed capacity of coils
- Many applications in design and development work
- Useful in TV service work for checking deflection yokes, coils, chokes, etc.

Heathkit "Q" METER KIT

MODEL QM-1

$44.50

SHIPPING WT. 14 POUNDS



Another outstanding example of successful Heathkit engineering effort in producing a Q Meter Kit within the price range of TV service men, schools, laboratories, and experimenters. This Q Meter meets RF design requirements for rapid, accurate measurement of capacity, inductance, and Q at the operating frequency and all indications of value can be read directly on the meter calibrated scales. Oscillator section supplies RF frequencies of 150 kc to 18 mc. Calibrate capacitor with range of 40 mmf to 450 mmf, with vernier of ± 3 mmf.

Particularly useful in TV service work for checking peaking coils, wave traps, chokes, deflection coils, width and linearity coils, etc. At this low kit price research laboratory facilities are within the range of service shops, schools, and experimenters.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

$39.50

SHIPPING WT. 17 POUNDS

The Heathkit IM-1 is an extremely versatile instrument specifically designed for measuring the degree of inter-action between two signals in any portion of an audio chain. It is primarily intended for making tests of audio amplifiers, but may be used in other applications, such as checking microphones, records, recording equipment, phonograph pick-ups, and loud-speakers. High and low test frequency source, intermodulation unit, power supply, and AC vacuum tube volt meter all in one complete instrument. Per cent intermodulation is directly read on the calibrated scales, 30%, 10%, and 3% full scale. Both 4:1 and 1:1 ratios of low to high frequency easily set up. With this instrument the performance level of present equipment, or newly developed equipment can be easily and accurately checked. At this low price, you can now enjoy the benefits of intermodulation analysis for accurate audio interpretation.

Heathkit AUDIO GENERATOR KIT

A Heathkit Audio Generator with frequency coverage from 20 cycles to 1 mc. Response flat ± 1 db from 20 cycles to 400 kc, down 3 db at 600 kc, and down only 8 db at 1 mc. Calibrated, continuously variable, and step attenuator output controls provide convenient reference output level. Distortion is less than .4% from 100 cps through the audible range. The ideal controllable extended frequency sine wave source for audio circuit investigation and development.

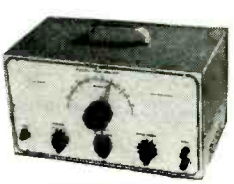
MODEL AG-8

$29.50

SHIP. WT. 11 LBS.

Heathkit AUDIO OSCILLATOR KIT

Sine or square wave coverage from 20 to 20,000 cycles in three ranges at a controllable output level up to 10 volts. Low distortion, 1% precision resistors in multiplier circuits, high level output across entire frequency range, etc., readily qualify this instrument for audio experimentation and development work. Special circuit design consideration features thermistor operation for good control of linearity.



MODEL AO-1

$24.50

SHIP. WT. 11 LBS.

Heathkit AUDIO FREQUENCY METER KIT

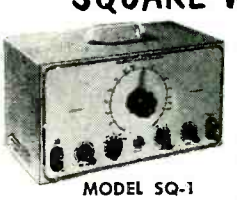
MODEL AF-1

$34.50

SHIP. WT. 12 LBS.

The Heathkit Audio Frequency Meter provides a simple and convenient means of checking unknown audio frequencies from 10 cycles to 100 kc at any voltage level between 3 and 300 volts rms with any non-critical wave shape. Instrument operation is entirely electronic. Just set the range switch, feed an unknown frequency into the instrument, and read the frequency directly on the calibrated scale of the Simpson 4½" meter.

Heathkit SQUARE WAVE GENERATOR KIT



MODEL SQ-1

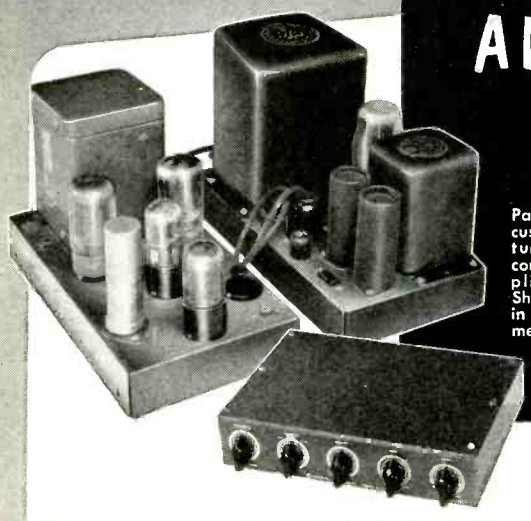
$29.50

SHIP. WT. 12 LBS.

The Heathkit Square Wave Generator provides an excellent square wave frequency source with completely variable coverage from 10 cycles to 100 kc. This generator features low output impedance of 600 ohms and the output voltage is continuously variable between 0 and 20 volts, thereby providing the necessary degree of operating flexibility. An invaluable instrument for those specialized circuit investigations requiring a good, stable, variable square wave source.

HEATH COMPANY • Benton Harbor 20, Mich.

Heathkit
WILLIAMSON TYPE
AMPLIFIER KIT
MODEL W-2



Particularly designed for custom installations, featuring separate cable connected units for simplicity of installation. Sheet metal work finished in attractive gray hammertone for smart appearance. All control shafts of the adjustable length break-off type.

$69.50

When selecting an amplifier for the heart of your high fidelity audio system, investigate the outstanding advantages offered by the Heathkit Williamson Type Amplifier. Meets every high fidelity audio requirement and makes listening to recorded music a thrilling new experience.

This outstanding amplifier is offered with optional output transformer operation, providing either the conventional triode output circuit or the new extended power circuity in which the screen supply voltage is obtained from separate transformer primary taps. Frequency response within ± 1 db from 10 cycles to 100 kc. Tube complement — 6SN7 cascade amplifier and phase splitter, 6SN7 push pull driver, two 5881 push pull power amplifiers, one 5V4G cathode type rectifier.

Matching preamplifier available providing three switch selected inputs, correct compensation, and individual bass and treble tone controls. Uses 12AY7 (or 12AX7) preamplifier — 12AU7 tone control amplifier.

Particularly designed for the novice kit builder and requires no specialized knowledge or equipment for successful assembly and operation.

PRICES OF COMBINATIONS

W-2 Amplifier Kit including main amplifier, power supply, and WA-P1 Preamplifier Kit. Shipping Weight 37 lbs. Shipped Express only. **$69.50**

W-2M Amplifier Kit includes main amplifier and power supply. Shipping Weight 29 lbs. Shipped Express only. **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 6 lbs. Shipped Express or Parcel Post. **$19.75**

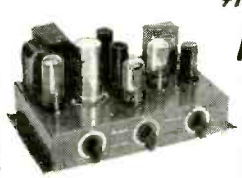
NEW *Heathkit* 20 WATT
High Fidelity AMPLIFIER KIT
MODEL A-9A

$35.50
SHIP. WT. 18 LBS.

A new 20 watt high fidelity amplifier, designed especially for custom audio installations demanding clean reproduction, adequate power, and flexibility to meet individual requirements. Separate treble and bass tone controls provide up to 15 db boost or cut. Four switch selected inputs, each with the necessary compensation for the service desired. Output transformer impedances of 4, 8, and 16 ohms.

Preamplifier, tone control, and phase splitter circuits utilize 9 pin twin triode miniature tubes for low hum and noise level. Two 6L6 push pull power output tubes provide full 20 watts power. Frequency response ± 1 db, 20-20,000 cycles. Total harmonic distortion 1% (at 3 db below rated output). Tube line-up: 12AX7 preamplifier, 12AU7 voltage amplifier and tone control, 12AU7 voltage amplifier and phase splitter, two 6L6 push pull pentode power output, 5U4G rectifier. Truly outstanding amplifier performance coupled with low cost.

Heathkit ECONOMY 6 WATT
AMPLIFIER KIT



MODEL A-7B
$15.50
SHIP. WT. 10 LBS.

The new Heathkit Model A-7B Amplifier offers many unusually fine features not normally expected in this low price range. Either of the two input circuits may be individually switch selected for phono or tuner operation. Separate bass and treble tone controls. Output impedances of 4, 8, and 15 ohms. Push pull beam power output stage for balanced reproduction. Excellent voltage gain characteristics, good frequency response, and full 6 watts power output. 12J5 amplifier, 12SL7 second amplifier and phase splitter, two 12A6 beam power output, one 5Y5 GT rectifier.

A-7C incorporates preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance or low output level phono cartridge. Circuit is properly compensated for microphone operation. $17.50.

NEW *Heathkit*
BROADCAST BAND
RECEIVER KIT

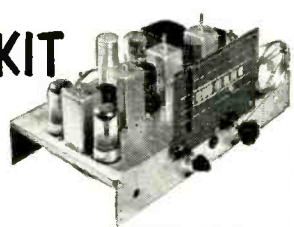
MODEL BR-2
$17.50 SHIP. WT. 11 LBS.

Another new Heathkit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit warrants your attention.

New high gain miniature tubes and IF transformers provide excellent sensitivity and good signal to noise ratio. A built-in ferrite core rod type antenna has been provided. A chassis mounted 5½" PM speaker provides excellent tone and volume. Convenient phono input. Can be operated either as a receiver or tuner. Simplified construction manual outlines circuit theory. Ideal for students. Tube line-up: 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector-AVC-first audio, 12A6 beam power output, 5Y3GT rectifier.

CABINET — Proxylin impregnated fabric covered plywood cabinet. Shipping weight 5 lbs. Part number 91-9, $4.50.

Heathkit
FM TUNER KIT



MODEL FM-2
$22.50
SHIP. WT. 9 LBS.

The Heathkit FM-2 Tuner was specifically designed for simplified kit construction. Can be operated through the "phono" portion of your radio or with a separate amplifier. The kit features a pre-assembled and adjusted tuning unit, three double tuned IF transformers, and a discriminator transformer in an 8 tube AC operated circuit. Frequency coverage 88 to 108 mc. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

Free CATALOG

Write for free catalog containing latest price information, schematics, specifications, and descriptions of all Heathkits.

HEATH COMPANY • Benton Harbor 20, Mich.

BRITISH AUDIO CIRCUITS

High-quality circuits result primarily from the application of time and effort to improve conventional circuits; obtaining optimum circuit values.

By NORMAN H. CROWHURST

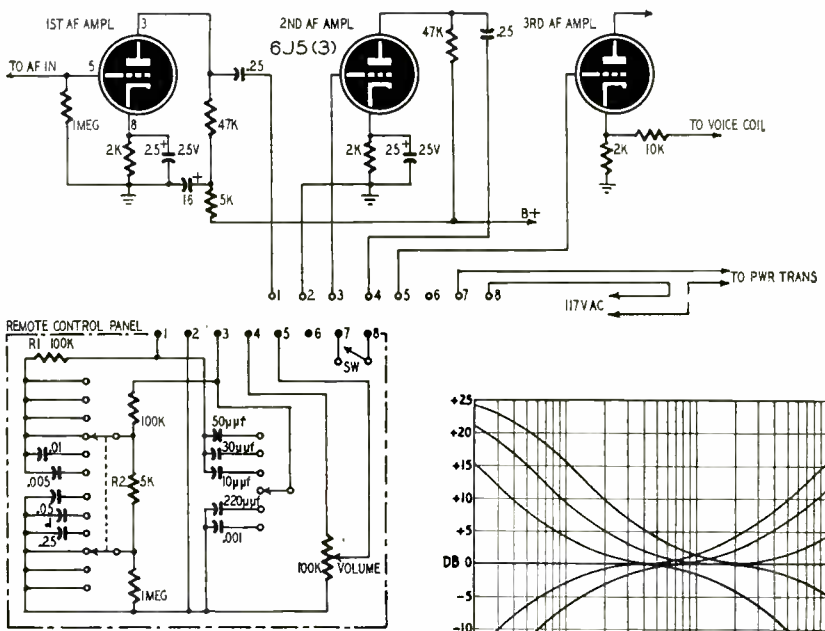


Fig. 1—Telrad remote-control circuit.

Fig. 2—Curves for six control positions.

IT has been said, on both sides of the Atlantic, that the British appear to lead the audio field. When asked to gather material on British audio circuit features, I naturally asked myself the questions: *Why* do the British lead in this field? In what does this leadership consist? Is it more advanced know-how, or is it just doing an ordinary job a little better?

The consensus is that there is nothing particularly clever about our circuitry in most instances. Rather, it is that more time and effort is put into getting the best out of well-tried circuits or their variations. Until recently, there was very little interest in audio. American production-minded concerns did not find it attractively profitable to invest in research for such small volume. However, some British outfits, working on a smaller scale, found the outlay worth while.

The market is growing with the widening interest, and it may be that the concerns who manufacture in large quantities will soon take the lead from our small-timers. But it is probable that we shall hold our own, for, even with the market bigger, it will remain essentially an individualist one. Audio enthusiasts are connoisseurs, and ears, like palates, vary. So there should continue to be room for everybody who is prepared to do a really good job.

Probably the connoisseur aspect of the audio fan (or should it be audiophile?) is best evidenced in the variety of circuits for quality control, tone compensation, or whatever name you like to give it. The author recently questioned a statement to the effect that bass boost and treble cut have the *same* effect, and vice versa. He was immediately shown higher authority for this opinion. The truth would appear to be that the difference is indistinguishable to some, while to the more discriminating ear the finer details of frequency response require some control to obtain a satisfying effect.

Most modern audio equipment incorporate the control features in a preamplifier remote from the main amplifier. An exception to this is an equipment made by Telrad Electronics, where to produce many of the advantages of more expensive contemporaries the whole amplifier is carried on one chassis. The controls are remote and are connected to the main chassis by a relatively short length of multiconductor cable, terminated in an octal plug. Fig. 1 shows the remote panel

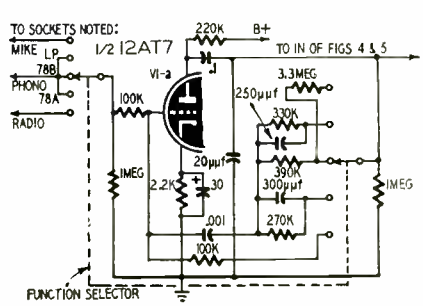


Fig. 3—Leak input compensation.

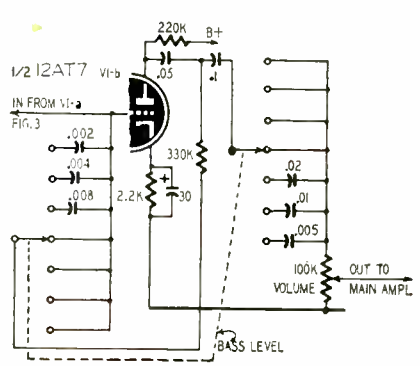


Fig. 4—Leak bass control circuit.

roof top magic from your TV set and it's magic in sales too

the C•D•R Rotors

NATIONALLY PROMOTED IN TELEVISION

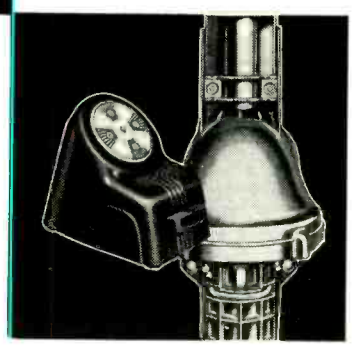
★ There's real MAGIC to the CDR ROTOR! The way it IMPROVES any TV picture is magic ... the way it sells ... is magic! BUT ... the real answer is quality manufacture of a proven design! That adds up to continued dependable performance ... CDR ROTORS ARE BUILT TO LAST ... built to perform under any conditions!

NOW ... MORE IN DEMAND THAN EVER BEFORE with the BIG consumer advertising campaign in full swing ... if you don't have your BIG CDR PROMOTION KIT with selling and advertising aids ... write us for your kit ... to help you sell EVEN MORE!

TR-2 . . . the HEAVY DUTY rotor especially suited for special TV antenna installations. Complete rotor with "Compass Control" cabinet having illuminated "perfect pattern" dial. **$49.95**

TR-12 . . . a special combination value consisting of complete rotor including thrust bearing ... handsome modern design cabinet with meter control dial **$47.95**

TR-11 . . . same as TR-12 without thrust bearing **$44.95**



THE RADIART CORPORATION
CLEVELAND 13, OHIO

THE CORNELL-DUBILIER ELECTRIC CORP.
SOUTH PLAINFIELD, N.J.

circuit for this equipment. The tone correction circuit is between the first and second stages, and the volume control between the second and third. The circuit consists of a basic voltage divider, R1 and R2, which provides an attenuation of about 26 db. Both bass and treble controls provide a level position (as shown), three lifts and two cuts. The boost gives an ultimate lift at either end of about 26 db. The position of the lift is varied by altering the capacitor values. Similar change of values alters the two possible cutoffs provided for each end. The combined range of control provided is shown at Fig. 2. The makers say this arrangement provides sufficient variation to satisfy all practical quality compensation required, and they claim an advantage in that the difference between steps is perceptible.

Preamplifiers of more conventional type generally provide somewhat wider facilities. The Leak *Vari-slope* separates the function of compensating for recording characteristic, etc., from the compensation for studio or room acoustics and noise content, by adjustment of bass and treble controls. The input selector switch has five positions, marked RADIO, 78A, 78B, L.P., and MIC. This compensation is achieved by a feedback arrangement over the first stage of the preamplifier, as shown in Fig. 3.

Over the second stage, the bass-boost positions are achieved by different values of series capacitor in the feedback. The cut positions insert different values of series capacitor in the lead to the output volume control. (The combined bass control is shown at Fig. 4.)

The treble lift is conventional, but the cut positions employ the Vari-slope technique from which the unit gets its name. Three turnover frequencies are provided by the switch. At each, a conventional two-stage roll-off response is provided between the first and second amplifier stages. Combined with this is a further correction introduced into the feedback over the second stage, using a form of adjustable twin-T network. Capacitor values are selected by switch to suit the turnover frequency chosen. Variation of the slope control shunts the T to varying degree, thereby changing the shape of correction applied at the roll-off frequency. Thus turnover frequencies are selected in steps, but the rate of cutoff can be adjusted continuously. Fig. 6 shows a range of possible slopes for the lowest cutoff, 5 kc. Fig. 5 shows the basic circuit for treble control, leaving out the components that affect only bass response and the muting arrangements. Muting consists, quite simply, of shunting the switch contacts with suitable high-value resistors to prevent residual charges being left on capacitors not in use, so that switching them into use would produce a click.

The final circuit this trip will be the Q.U.A.D. quality control unit. A very nice feature of this unit is the mechanical arrangement of the panel, facilitating touch control. The volume control employs negative feedback over the second stage, using the circuit shown in Fig. 7. At minimum volume, the second stage operates at unity gain with 100% feedback, or nearly so, while at maximum volume the feedback is considerably reduced.

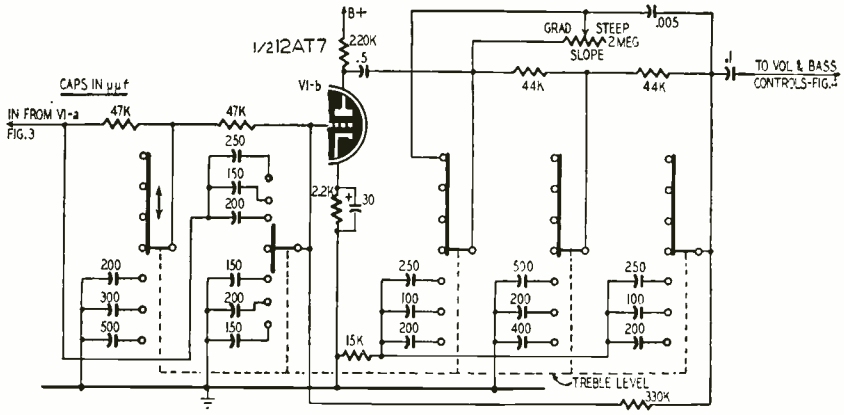


Fig. 5—Vari-slope treble control.

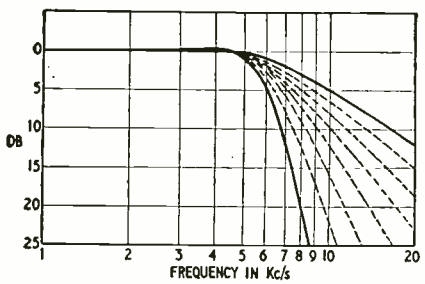


Fig. 6—Possible slopes for 5 kc cutoff.

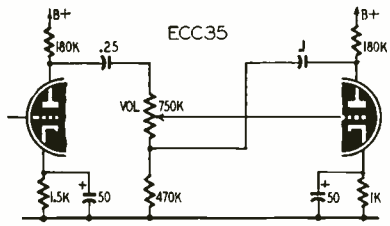


Fig. 7—Q.U.A.D. volume control uses feedback.

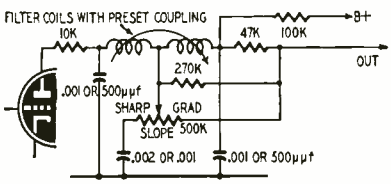


Fig. 8—The Q.U.A.D. basic filter circuit.

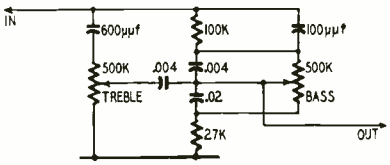


Fig. 9—The treble and bass controls.

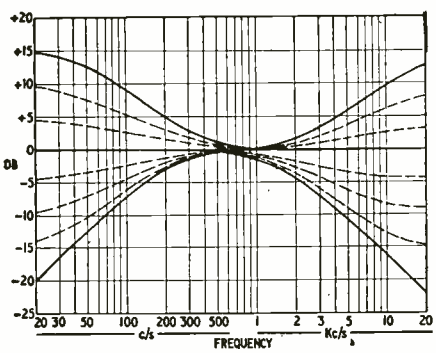


Fig. 10—Response range of Fig. 9 controls.

Tone compensation is again divided into two parts, but the functions are not separated in quite the same way as in the Leak unit. Two different input sockets arrange for flat response or correction for velocity type pickups. The main compensation is in the output circuit. This consists first of a filter with variable slope characteristics, but using a conventional filter circuit modified for this purpose, as shown in Fig. 8. Two turnover frequencies are available by switching capacitor values, at each of which the slope can be varied very much like the "cut" part of the Leak treble control. Following the filter in the circuit arrangement are the treble and bass controls, which are fairly conventional, as in Fig. 9, giving the response variation of Fig. 10. In the panel arrangement the physical position of the controls is reversed, as this is considered more logical from the psychological viewpoint.

The filter switch has four positions:

1. Flat, cutting out filter and top and bass circuits, so that a check can quickly be made against level response at any time;

2. Bringing in treble and bass controls only;

3-4. Different filter turnovers.

Well there you are. Three completely different ways of doing virtually the same thing. Each does its job well because of the work that has gone into getting the right circuit values for the purpose, rather than because its circuit is so much better than its fellows. I dare not express my opinion as to which I think serves the purpose best—it doesn't do to get partial with connoisseurs! But I do feel that each achieves the ideal of providing its own degree of quality control facility with the minimum of knobs. END

NO OTHER UHF ANTENNA COMBINES ALL 3

1 Extra high gain

2 All channel reception

3 Sharp vertical and horizontal directivity

Model 4450 List $14.50

WALSCO CORNER REFLECTOR

Not 1...Not 2...but all 3 combined for amazing picture clarity

NOTHING . . . *absolutely nothing* compares with Walsco's Corner Reflector. It's the only UHF antenna that offers a 3-way *combination* that produces sharper, clearer TV pictures. Truly a masterpiece in precision electronic engineering.

COMPARISON CHART

	High Gain	All channel Performance	Sharp Directivity
WALSCO CORNER REFLECTOR	YES	YES	YES
ANTENNA B	NO	YES	NO
ANTENNA C	NO	YES	NO
ANTENNA D	YES	NO	YES

WALSCO *A Model to Fit Every Installation*

Walter L. Schott Co.
3225 Exposition Place
Los Angeles 18, California

Overseas Representative: Ad Auriema, Inc., 89 Broad St., New York 4, New York

Velocity Microphone

This little job will sound good if well made

By GENE BRIZENDINE*

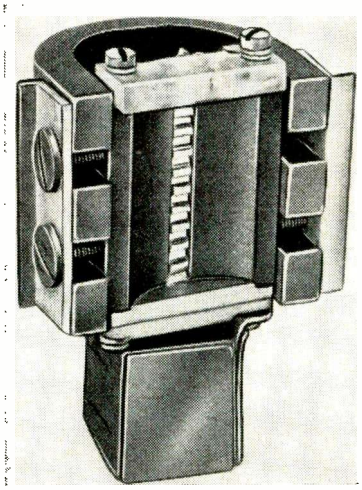


Fig. 1—The home-made velocity microphone. Magnets were taken from a war-surplus field telephone; the ribbon was cut from an aluminum-foil chocolate-bar wrapper. The matching transformer is in the black box at the bottom.

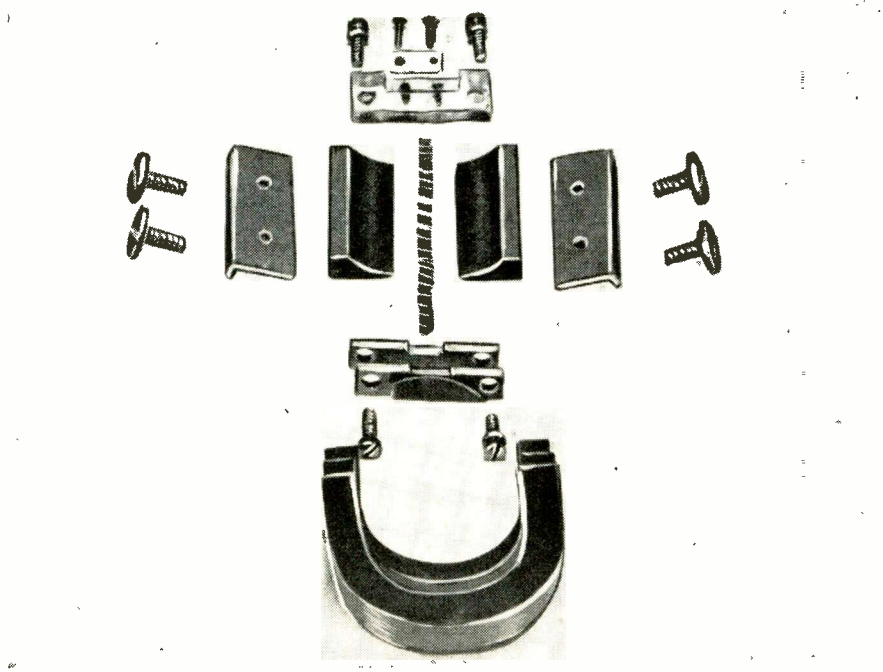


Fig. 2—All the parts of the velocity microphone before final assembly. See text for instructions in cutting pole pieces, side clamps, and end brackets.

ALTHOUGH the velocity microphone was developed quite a number of years ago, it is still used more than any other type for high-quality sound pickup in broadcasting and recording. The velocity unit built by the writer provides faithful reproduction and high output, and may be duplicated by anyone with only simple hand tools. Actually, the unit shown in Fig. 1 may be assembled by drilling only four holes!

Basically, the velocity or ribbon microphone is simply a thin strip of metal suspended in a strong magnetic field. Any motion of the ribbon at right angles to the lines of force induces a voltage across the ends of the ribbon, which is an electrical reproduction of the original sound. The ribbon is corrugated and hangs rather loosely, so that its mechanical resonant frequency is below audibility. This arrangement prevents peaks from appearing in the usable audio spectrum. The corrugations also increase the output, since they cut more magnetic lines of force than would be the case with a flat, shorter ribbon.

The microphone shown in Fig. 1 was

*c/o CAA, Berry Field, Nashville, Tenn.

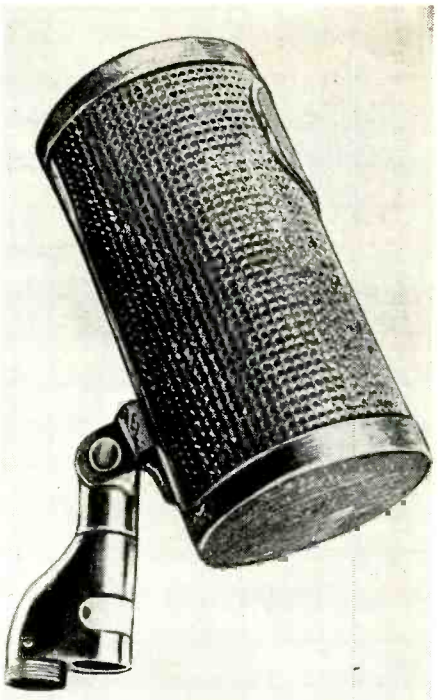


Fig. 3—The finished microphone housed in an air-freshener can. All-around perforations are essential to allow free passage of air through the microphone.

built with magnets from a war-surplus type EE-8-A field telephone. Magnetos from small gasoline engines or other telephone ringers would contain magnets equally suitable. Before dismantling the original magnet assembly, mark the poles so that like poles may be placed adjacent in the microphone.

The concaved pole pieces are soft iron and should be handled with care. The magnets, one pole piece, and the end plates are the only items needed from the surplus unit.

After the parts are separated, saw *one pole piece lengthwise*, through its thinnest section. The two parts thus obtained will eventually form the microphone pole pieces. These can be seen on either side of the ribbon in Fig. 2, with their concave faces forward.

The two flat magnet clamps next to the pole pieces may be made from brass, aluminum, or any *nonmagnetic* metal These should be at least 1/16-inch thick. The holes are spaced to match the tapped holes already in the sides of the pole pieces. The four large-headed screws are used to clamp the magnets to the pole pieces, and are the type used to hold panels to standard equipment racks.

Immediately below the pole pieces, one ribbon clamp is seen. This is made by simply sawing two strips from the original magneto end plates, or from *nonmagnetic* metals, so that the holes accept screws which thread into the pole-piece ends. The same screws also clamp one end of the ribbon. This end of the ribbon is thus grounded. At the top end of the pole pieces in Fig. 2, is an insulating ribbon clamp. This is a simple assembly, and may be made from bakelite, polystyrene, or any other suitable insulating material.

The small brass clamping strip immediately above forms the other ribbon terminal. It is necessary only that the ribbon clamps hold the ribbon between and parallel with the pole pieces. Actual mounting of the ribbon should be the last step of assembly.

Assemble the pole pieces first by running screws through the end plates into the tapped pole-piece ends, leaving the screws rather loose. Next, align the magnet and pole pieces, and clamp the assembly into final position with the large-headed screws, so that the inner faces of each magnet are pressed flat against the pole pieces. Interchanging magnets may be necessary to obtain best alignment.

With the unit thus assembled, dress the sawed edges of the pole pieces, filing lengthwise and keeping the filed faces as nearly parallel as possible. The tang of the file may be used to gauge the width of the gap during this process. The final width of the gap will of course depend upon the width of ribbon used. These dimensions do not appear too critical, and a spacing of about 1/32 inch on each side of the ribbon proved satisfactory in this unit.

A replacement-type ribbon may be purchased reasonably, or you can make your own easily from aluminum foil. The ribbon used in this model was made by cutting a foil strip about 5/32" inch wide from a *Nestle's* chocolate-bar wrapper, using a straightedge and razor blade. The corrugations were formed by rolling the strip between two small gears held in the hands. Tooth spacing was about 1/8 inch. This dimension is not critical either, but the foil should be at least as thin as that mentioned above.

The matching transformer may be any ribbon-to-line or ribbon-to-grid type and should be mounted near the ribbon terminals. Be sure the transformer core is not positioned so that it forms a magnetic path across the magnet poles. This would bypass a large part of the flux around the ribbon gap. Ground one secondary terminal of the transformer to the magnet assembly, using a lug under any convenient screw.

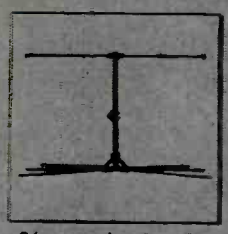
At this point the ribbon may be mounted, and stretched just enough to prevent it from rubbing against the pole pieces when the unit is in its normal upright position.

The outside case may be of any material, the major requirement being that it permits free passage of sound past the ribbon. The writer's microphone is mounted in a salvaged air-freshener container which was given a coat of brown wrinkle varnish. See Fig. 3.

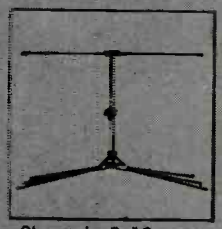
The magnet-ribbon assembly is simply "floated" inside the case on strips of sponge rubber, preventing disturbances to the case or stand from reaching the ribbon.

If hum pickup is encountered, it may be minimized by orienting the microphone while watching the volume-level indicator, or listening to the hum level in the output. For most natural reproduction, the source of sound should be at least 12 to 18 inches from the ribbon. END

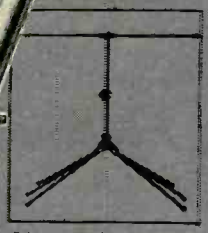
FALCON *Introduces -*



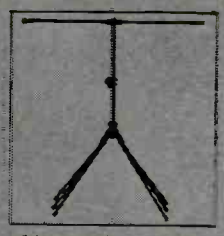
Channels 2-13, peaked for low channels (2 thru 6)



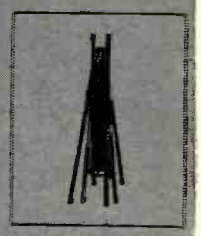
Channels 2-13, normal position, peaked for all VHF channels (2 thru 13)



Channels 2-13, peaked for high channels (7 thru 13)



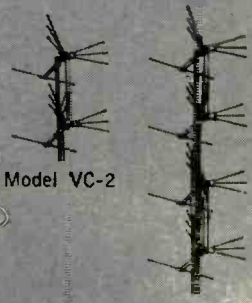
Channels 2-83, peaked for UHF channels



Falcon "VARI-CON" folded for packing

Model VC-1

Model VC-2



Model VC-4

Stack them for added gain

FALCON easiest of all antennas to assemble merely open like an umbrella and tighten wing nuts

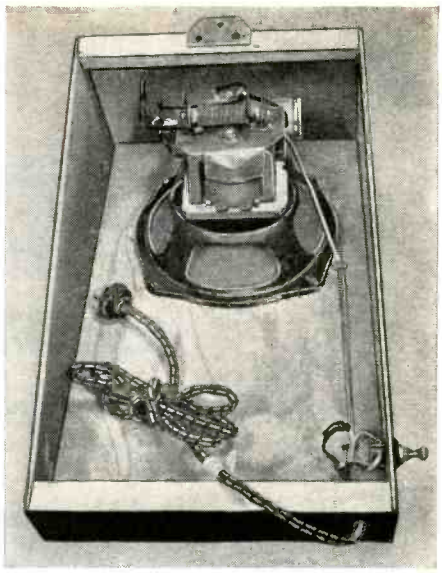
There is NO ASSEMBLY problem with a FALCON "VARI-CON". It takes longer to explain the operation than to accomplish it! Your FALCON "VARI-CON" comes folded into one compact unit. You need only swing the reflector into position and tighten the wing nuts. Move the sliding sleeve to the calibrated channel setting you desire and tighten. The butterfly springs snap the elements into position and lock them securely. The FALCON "VARI-CON" is ready to install, ready to provide peak performance. *Changing the channel peaking of the "VARI-CON" is just as simple and easy as making the original setting. No tools are needed for either operation.*

Calibrated sleeve for quick peaking of antenna.

THE HEART OF THE "VARI-CON"

Above is a view of the new mechanism which enables anyone to adjust the peaking of the FALCON "VARI-CON" to any range of channels desired. The sliding sleeve, on the calibrated boom, automatically fans out the elements to their correct position.

A simple, trouble-proof, snap-action spring in the butterfly keeps the elements solidly in place. The insulated hinge assembly is extremely strong, durable and weather-resistant and has an extra long leakage path. Weight has been kept to a minimum, strength at a maximum in order to assure long life and freedom from wind and weather damage. A heavily plated mast clamp is supplied.



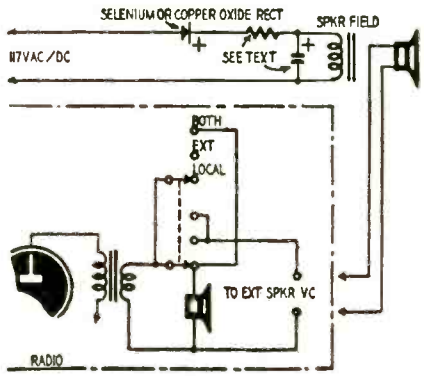
The author's remote-speaker assembly. The sloping-front wood baffle can stand by itself or hang on a wall. Mounting the speaker off-center helps to flatten out the frequency response.

Handy remote speaker from "useless" dynamic

By H. J. M. DUNSCOMBE

HERE'S a use for that perfectly good field-coil dynamic speaker that's lying in the junk box. All you need to turn it into a handy remote speaker is the simple a.c.-d.c. field supply shown in the diagram, and a pair of terminals connected to the voice-coil leads on your radio.

If the resistance of the field coil is 2,500 ohms or more, simply connect a selenium or copper-oxide rectifier that will handle 50 to 70 ma in series between the power line and the field. Then connect a 150-volt electrolytic capacitor

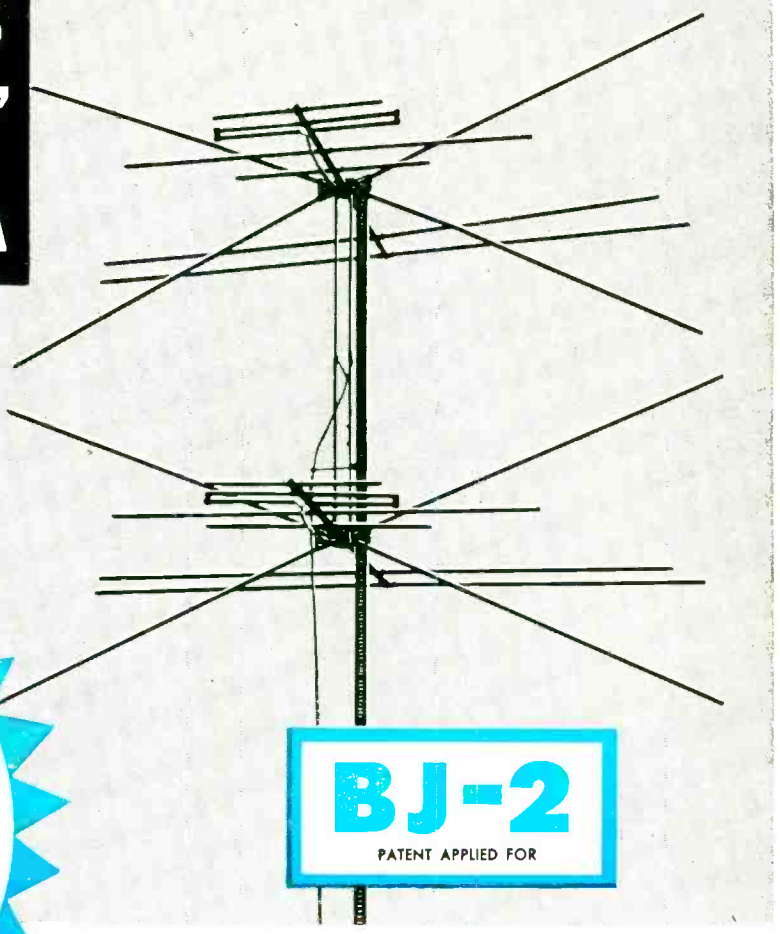


Circuit diagram of the power supply for the field-coil speaker, and one method of switching speakers at the receiver. The series resistor may be needed with low-resistance field coils to limit the current to a safe value.

THE BEST SET IS ONLY AS GOOD AS ITS ANTENNA!

The KAY-TOWNES "BIG JACK" IS *not* A NEW ANTENNA

The "BIG JACK", recognized even by competitive manufacturers as the best performing VHF antenna design ever developed HAS BEEN ON THE MARKET FOR MORE THAN 1½ YEARS!



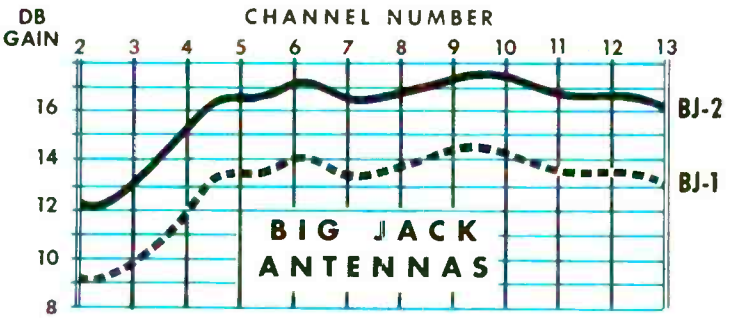
WE CHALLENGE

any other manufacturer who claims this design as *his* original idea!

Model	Type	List Price
BJ-1	single bay	$16.78
BJ-2	2-bay	$35.05

- *HIGH GAIN ON ALL VHF CHANNELS*
- *PREASSEMBLED*
- *1" HEAVY ALUMINUM BOOM*
- *CRIMPED & DOWEL REINFORCED HEAVY (7/16" O.D.) ALUMINUM TUBING*
- *"SURE-GRIP" CAST ALUMINUM MAST CLAMP WILL NOT SPREAD, BEND OR COLLAPSE.*

THIS GAIN CHART *Proves* THE SUPERIORITY OF THE K-T "BIG JACK" VHF ANTENNA

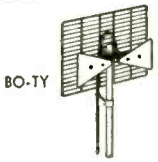


NO OTHER VHF ANTENNA CAN HONESTLY CLAIM THESE "BIG JACK" RATINGS AS A RESULT OF THEIR OWN ORIGINAL ENGINEERING AND DEVELOPMENT

KAY-TOWNES ANTENNA CO. ROME, GEORGIA

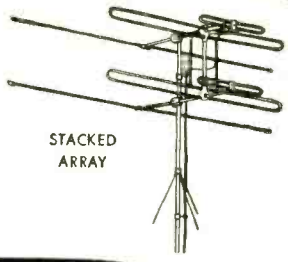
Recognized leaders in the field of fringe area antenna design

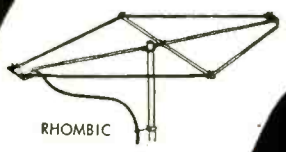
AMPHENOL

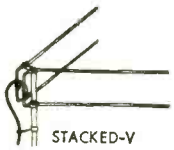

BO-TY


CORNER REFLECTOR


INLINE*
*Reissue Pat. 23,273


STACKED ARRAY


RHOMBIC


STACKED-V


YAGI

a sure prescription for

Better TV Picture Quality

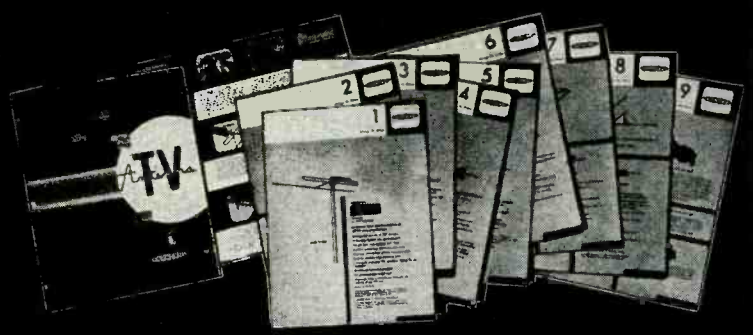
AMPHENOL UHF/VHF ANTENNAS

The finest picture a set is capable of delivering—this is the advantage that AMPHENOL UHF and VHF antennas give every discriminating TV set owner. And this extra dividend in better TV picture quality is unique with AMPHENOL—the result of AMPHENOL engineering and craftsmanship construction.

Because of AMPHENOL engineering, each antenna is characterized by superb electrical performance—backed up by published gain charts and radiation patterns made in accordance with proposed RETMA standards and, therefore, a *reliable* index to antenna performance.

Because of AMPHENOL construction, fine materials assembled into rugged examples of craftsmanship and quality checked throughout every phase of manufacture, each antenna will give long years of trouble-free service.

For every installation, new or replacement, the surest prescription for better TV picture quality is the specification of an AMPHENOL *quality* antenna.



read the story of television

the "TVAntenna Folio"

A new and instructive AMPHENOL guide to the problems of television is the "TV Antenna Folio." Printed in full color with Kodachrome illustrations from the AMPHENOL film "The UHF-VHF Television Antenna Story," it stories and compares UHF and VHF television waves from the transmitting antenna to the antenna on the rooftop. Write today for your free copy.

mail coupon now

AMERICAN PHENOLIC CORPORATION
1830 South 54th Ave., Chicago 50, Illinois

Please send me the "TVAntenna Folio."

Name _____

Company _____

Street _____

City _____ Zone _____ State _____

(16 μf or larger) across the field coil to filter out the hum. An ordinary line-cord lead to the voice coil of the rehabilitated speaker completes the job.

You may want to cut out the local speaker on your radio when the remote speaker is in use. In that case a two-pole, three-position switch wired as shown will allow you to select either speaker, or both if you wish.

Field-coil dynamics with lower field resistances can be used in the same way, provided you insert enough series resistance between the rectifier and the filter capacitor to limit the current to a safe value. A good general rule is that the d.c. input to the field coil should be at least equal to the audio power fed to the voice coil, but there's no need to overexcite the field, especially where the speaker is merely an extension on the average home radio.

To find the proper d.c. voltage for the field use the following formula:

$$E = \sqrt{WR}$$

Where W is the maximum audio power in watts, and R is the field-coil resistance. Then adjust the series resistance to keep the d.c. voltage as far under this value as possible without affecting the sound quality.

If the resistance of the field coil is extremely low (say 10 ohms or less) the speaker was probably part of an auto radio originally, and you will have to excite it with a 6-volt storage battery or an equivalent eliminator. This would hardly be practical for home use, but it might make a fine rear-seat speaker for a car. (Some television speakers have field-coil resistances of around 60 to 75 ohms. These require about 200 ma at about 12 to 15 volts for full excitation. Unless you have the parts lying around, a power supply for this type would probably cost more than a new PM speaker.)

Don't worry too much about a possible impedance mismatch between the voice coil of the extra speaker and the output transformer in your radio or amplifier. In most cases—especially with the average small radio—even a three-to-one mismatch won't make much difference in the sound quality. But if you want to know the nominal impedance of the voice coil, there's an old rule-of-thumb that works out pretty well: Multiply the *voice-coil resistance* by 1.25.

The rectifier-filter assembly for this speaker was mounted on an aluminum bracket bent to fit over the magnet yoke, as shown in the photograph. The extension speaker was then installed in a simple sloping-front wooden baffle fitted with a small plate at the top for hanging on the wall. Note that the speaker is mounted off-center vertically and horizontally. This helps smooth out the frequency response.

The uses for a remote speaker are too numerous to mention. There is usually a need for it anywhere from basement to attic. Most of the field-energized speakers that can be found lying around are of good quality, and will provide many hours of "found" entertainment. END

Send for Your **FREE** Copy of the NEW 1954 MIDWEST TELEVISION and RADIO Catalog

MIDWEST *Presents*

For 1954 a Completely NEW LINE of

21" and 27" TELEVISION

CONSOLES
TABLE MODELS
and
COMPLETE CHASSIS
at
LOW FACTORY PRICES

YOUR CHOICE OF EITHER 12 CHANNEL VHF or All-Channel VHF-UHF Models

Buy your Television or Radio Direct from the Midwest Factory . . . on 30 DAYS TRIAL . . . Easy Terms . . . and at LOW FACTORY PRICES. For 34 years Midwest, the world's largest and oldest exclusive Factory-To-You radio and television manufacturer, has served hundreds of thousands of satisfied customers all over the world.

EASY TERMS
—•—
30 DAYS TRIAL

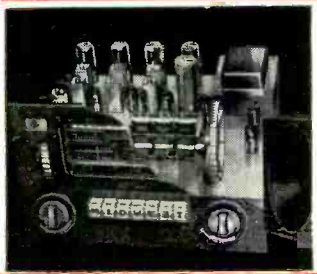
All models available in your choice of mahogany, walnut finish or bleached limed oak.

FACTORY-TO-YOU

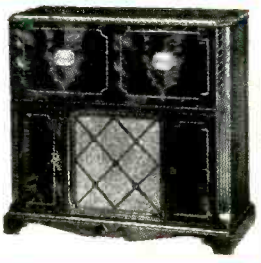
Also—Powerful New 1954 World-Ranging

MIDWEST Series 16 RADIOS

In Beautiful Consoles and Complete Chassis



Once again Midwest offers its famous series 16 five band AM-FM radio chassis and the magnificent new Symphony Grand Radio-Phonograph with 3-Speed Automatic Intermix Record Player. Also, a complete line of clock radios, table radios, and portables.



MIDWEST RADIO & TELEVISION CORP.
DEPT. C-38 909 BROADWAY, CINCINNATI 2, OHIO

WRITE IN NAME AND ADDRESS (PLEASE PRINT) ON COUPON OR 2c POSTCARD

MIDWEST RADIO & TELEVISION CORP.
Dept. C-38 909 BROADWAY • CINCINNATI 2, OHIO
Please send me your new FREE 1954 Catalog.

NAME _____

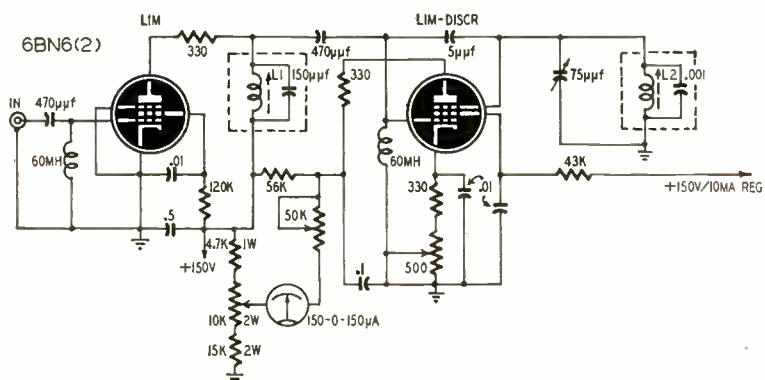
ADDRESS _____

CITY _____ ZONE ____ STATE _____

SIMPLE INSTRUMENT MEASURES FREQUENCY DEVIATION

TO provide more reliable and sensitive receiving and recording instruments for communications signals, Norris Hekimian of the National Bureau of Standards Central Radio Propagation SMLaboratory has developed this comparatively simple frequency deviation meter. The instrument indicates the deviations of a signal from a reference frequency to better than 0.5%. It performs the same function as the tuning eye on regular broadcast receivers but with sufficient precision to be used in the laboratory or as part of the production inspection procedure in a manufacturing operation.

The circuit consists of a limiter-discriminator arrangement and a means of driving an indicator from the discriminator output. The 6BN6 gated-beam tubes are used to simplify the circuit and to hold the tube complement to two in number. The second 6BN6 stage provides additional limiting and with quadrature-grid discrimination. The indicating device—a 150-0-150 microammeter—is driven through a d.c. bridge circuit by the current resulting from unbalance in the plate circuit of the discriminator. The circuit unbalance arises when the input signal differs from the zero-set or reference signal.



To avoid plate-current cutoff by self-bias, 60-millihenry chokes are used instead of resistors in the signal grid returns of the 6BN6 tubes. The 330-ohm resistors in the plate leads dampen the plate surges and aid in obtaining a flat limiter characteristic. The unit draws 10 ma at 150 volts d.c. from a well-regulated supply. For more stable operation, the heater supply is also regulated. Circuit components are not critical, but stable elements reduce maintenance problems. The d.c. bridge resistors in the indicator circuit are well ventilated to avoid changes in resistance from overheating. The tank coil (L1) in the plate circuit of the first stage is set to resonate at the center or reference frequency (450 kc in this instance) and has a Q of about 60 when adjusted on a meter external to the circuit. The quadrature-grid tank coil L2 also resonates near the center frequency and has a Q of 100 when measured out of the circuit. The quadrature tank determines the reference frequency of the deviation meter, so it is enclosed to protect it from harsh handling and from being overheated by neighboring power resistors.

The NBS circuit has two inherent disadvantages: (1) Because the current flow in the grid of the first 6BN6 is limited, the input impedance of the meter varies with the level of the input signal and has a minimum value of about 10,000 ohms. This relatively large minimum is generally acceptable, but a low-output impedance driver—such as a cathode follower—may be used when necessary as a buffer between the signal source and the deviation meter. (2) This unit shows considerable interaction between discriminator adjustments, so the initial aligning procedure is tedious.

The alignment procedure is as follows: (1) Replace the indicating meter with a high-impedance voltmeter, and then note the direction of the needle swing for increasing input signal from 0 to 1 volt. Tune the plate coil of the first stage for maximum voltmeter reading in the noted direction. During this period, keep the input potential at the lowest value that will allow readable output changes. (2) Adjust the zero control of the d.c. bridge and the tank capacitor in the quadrature grid simultaneously for approximately a normal discriminator curve as the signal generator frequency is slowly varied about 10 kc on either side of the desired mean frequency. (3) With the input signal set at the desired mean frequency, slowly vary the input level from about 0.2 to 2.0 volts, and adjust the cathode resistor in the output stage for the flattest limiter characteristic obtainable. Monitor the signal generator frequency continuously with a stable receiver and beat oscillator to insure that the frequency does not vary when the output is changed. (4) Replace the indicating meter and repeat steps (2) and (3) to obtain the desired symmetrical discriminator characteristic and good limiting.

For further technical details, see "Frequency-Deviation Meter Plots Drift," *Electronics*, June 1952. END

SELLING OUT!

$100,000. STOCK

of Nationally Advertised Radio & Television Testing Equipment, Parts, and Electrical Appliances.
Complete Stock of Radio and Television Testing Instruments and Parts to be sold regardless of cost.

This is the opportunity of a lifetime!

PRICES REDUCED UP TO 80%

Below mentioned units are not kits, but all factory wired and brand new. **Some models have been discontinued by the manufacturer, but every one is factory sealed and carries a one year, factory guarantee.**

			Dealers Net Price		Our Selling-Out Price
SUPERIOR	Model	1553 Multitester	29.25		14.50
"	"	PB-100 Multitester	28.40		15.00
"	"	680—5000 Ohms per volt Multitester	27.65		14.50
"	"	670 Supermeter	28.40		22.75
"	"	TV-10 Tube Tester	47.50		37.95
"	"	660 Signal Generator	42.95		34.50
"	"	TV-20, 20,000 ohms per volt Multimeter	49.95		34.50
TEST RITE	"	B-45, A.M., F.M. and Television Signal Generator, battery operated	27.75		14.50
METROPOLITAN	"	111, A.C.-D.C. Multitester	21.50		11.50
"	"	999, A.M.-F.M. & Television Signal Generator and Signal Tracer, battery operated	39.50		19.50
TEST CRAFT	"	TC-10, A.C.-D.C. Multitester	14.85		9.85
"	"	TC-50, Combin. Tube and Set Tester	49.50		29.50
"	"	TC-75, Combin. Test Speaker and Signal Tracer	39.50		24.50
SUPREME	"	543-S, Multitester	24.50		14.50
RADIO CITY PRODUCTS	"	322, Tube Tester	41.50		29.50
"	"	668, Electronic Multitester	74.50		39.50
"	"	665, A.C.-D.C. V.T. Volt-Ohm Capacity	95.40		59.50
MONITOR	"	200, Crystal operated Signal Generator	59.50		29.50
WESTON	"	689-IF, Multitester, incl. case	31.50		19.85
SHALLCROSS	"	630, Wheatstone Resistance Bridge	145.00		75.00
"	"	637, Kelvine Wheatstone Res. Bridge	185.00		100.00
REINER ELECTRONICS	"	333, D.C. Volt-Ohm Milliammeter	26.95		14.50
ELECTRONIC MEASUREMENTS CORP.	"	102, Volometer	14.90		11.90
"	"	205, Tube Tester	47.50		37.50
"	"	206, Mutual Conductance Tube Tester	83.50		67.50
"	"	600, Oscilloscope	99.50		79.50
GRUEN	"	2½" D.C., D'Arsonval Type, 1 Milliammeter, Meter	9.95		2.95
WESTON	"	Model 606, 1 Milliam. Meter	12.95		3.95
SIMPSON	"	2½" square, 5 Milliam. Meter	7.95		1.95
WESTON	"	Model 507, F.S.-1.2 Milliam. Meter	12.95		3.95
TRIPLETT	"	Model 331-JP 30 Amperes, Meter	12.95		4.95
MARION	"	3" D'Arsonval Type, 1 Milliam. with calibrated Volt-Ohm Current Scale, Meter	12.95		4.95
ACRO	"	Radio & Phonograph Chassis Cradles	6.95		2.95
PHILCO	"	6½" Paper Recording Discs, sold only in cartons of 100	.15	each	.03
DUOTONE	"	8" Glass Recording Discs, sold only in cartons of 24	.75	each	.15
"	"	10" Glass Recording Discs, sold only in cartons of 24	1.00	each	.20
DUOTONE	"	6½" Metal Recording Discs, sold only in cartons of 100	.60	each	.10
"	"	12" Metal Recording Discs, sold only in cartons of 50	1.50	each	.30
HOLYOKE	"	180 ohm resistance line cords, 6 feet with plug	1.25	each	.35
"	"	No. 22, stranded, tinned, copper push-back wire on 500" spools	each spool 5.00		2.50
DUOSONIC	"	3 speed recordplayers, with life-time needle, portable case, speaker & amplifier	39.50	each	14.95
MAGUIRE	"	Recordchanger	37.50	each	9.95
V-M	"	Model 950, 3 speed Recordchanger, Tri-O-Matic, intermixed	46.50	each	24.50
V-M	"	3 speed Recordchanger, automatic, with life-time needle, portable case, speaker and amplifier	79.50	each	39.50
CAPITOL	"	Automatic Pop Up Toaster, fully guaranteed	19.95	each	9.95
NELSON	"	Model 441, double, twin-sized electric Waffle Maker	14.95	each	7.95
CUCKOO CLOCK	"	Genuine, imported Black Forest, hand-carved, cuckoos every 15 minutes	19.95	each	7.95
GLO	"	Electronic, oscillating massager with infra-red heat combined	8.95	each	3.95
ROTO-BROIL 400 MODEL "RIVIERA"	"	Fully Automatic Rotisserie and Broiler Combination, 7 way, with time clock, 3 heat element, double powered	69.50		37.95

All prices are f.o.b. New York, 20% deposit with order, balance C.O.D., or full remittance with order

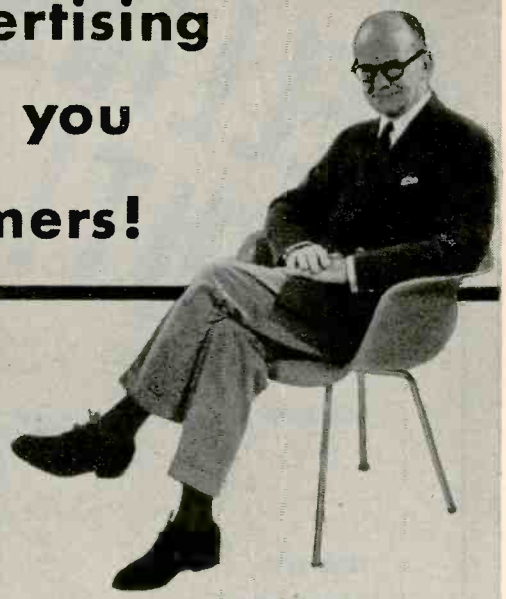
WRITE, PHONE OR WIRE YOUR ORDER FOR IMMEDIATE DELIVERY, QUANTITIES ARE LIMITED.

METROPOLITAN ELECTRONICS & INSTRUMENT CO.

106 Fifth Ave., New York 11, N.Y.

Telephone: OREGON 5-1707
Cable Address: METRONICS

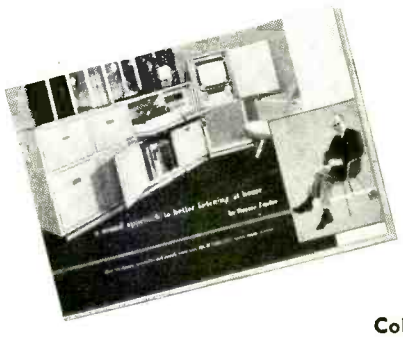
craftsmen national advertising is Taylor made to bring you new high fidelity customers!



Deems Taylor . . . known to millions of Americans as the world's greatest authority on music . . . once again spearheads Radio Craftsmen national advertising with the High Fidelity Story. Through Craftsmen full page advertisements in scores of the nation's leading magazines Mr. Taylor, in interesting and informative columns, will be telling more than 2,500,000 readers—*key prospects for you*—the distinct advantages of *unit* High Fidelity. Plan now to squeeze every ounce of value out of this great promotion by featuring the complete Craftsmen line. Write today for details.

Month After Month in popular magazines, carefully selected to reach your customers and prospects, smashing *full page* advertisements like these will be pounding home the Taylor story . . . the High Fidelity Story . . . the Craftsmen Story!

Cash in on craftsmen advertising— order these sales helps today!

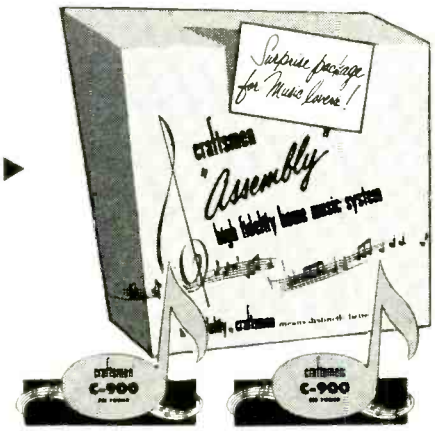


Deems Taylor Booklet

Revised edition including new installation photos and complete Craftsmen line. Lithographed in color, 24 pages of information on High Fidelity so basic, so clear you'll want to use it as a selling tool!

Color Displays

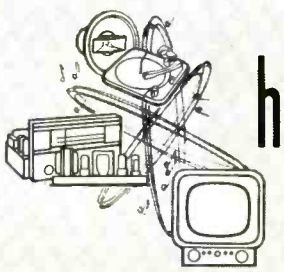
Outstanding new window and counter display materials for the complete Craftsmen "Assembly," individual units, Deems Taylor booklet. Die-cut, attention getting cards that stop them in their tracks—and *sell!*



Consumer Literature

Attractive, hard-selling folders promoting the Craftsmen "Assembly" and the complete Craftsmen line. Useable as envelope stuffers, imprint space provided. Complete technical literature available in quantity.

the craftsmen line is the shortest distance between sales



high fidelity by craftsmen®

means distinctly better listening

the radio CRAFTSMEN, inc., Dept. L-10, 4401 N. Ravenswood Ave., Chicago 40, Ill.

BEST WAVE FOR URBAN USE

What is the best frequency for communication in urban areas? This important question is of interest to radiotelephone, TV, ham, and other services often concentrated in and around cities. The Bell Telephone System has the answer, at least for mobile radiotelephone using FM. After extensive tests and comparisons over a frequency range from 150 to 3,700 mc, Bell scientists conclude that 500 mc is optimum. Furthermore, they find that 900 mc is better than 150 mc. These and other facts are presented in the Bell System Technical Journal for November, 1952.

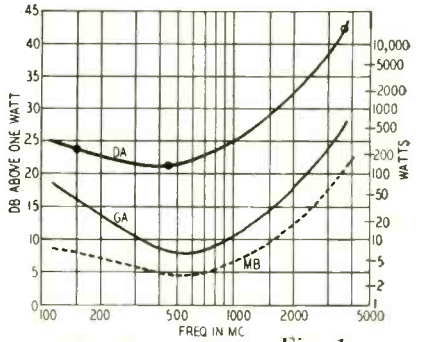


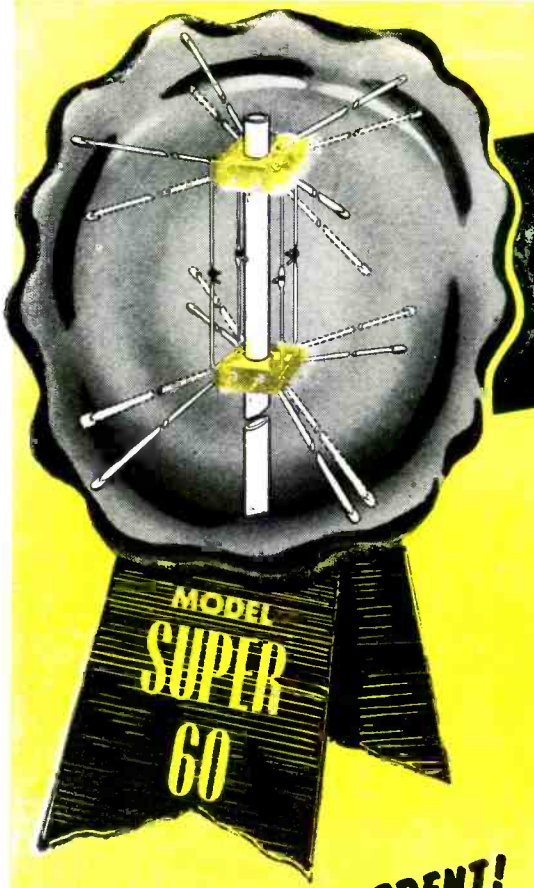
Fig. 1

It is a basic truth that transmission efficiency drops as frequency rises. For example, 450 mc is less effective than 150 mc by 7 db. At 900 mc, reception would be off by 11 db, and at 3,700 mc the loss is 31 db. There are other factors, however. At higher frequencies there is less noise. In this respect, 900 mc is better than 150 mc by 13 db. Also, directional antennas benefit the upper bands. The higher the frequency, the more practical it is to build directional radiators.

Fig. 1 shows power required for reliable communication in urban and suburban districts. A quarter-wave whip antenna is used at the receiver. The upper curve is for a dipole radiator. It shows that 150 watts at 450 mc is equivalent to 250 watts at 150 mc and to 270 watts at 900 mc. The frequency difference is more marked when a "gain" antenna is used. This concentrates power in the horizontal plane. Note the optimum near 500 mc.

An important factor in evaluating mobile radio transmission is the strength of the r.f. path. The mobile units of a mobile system are either moving around or, if stationary, are located at random. Since the effects of the many geographical features, buildings, and the like, which influence propagation can combine differently for different locations of a car, even where the locations are only a fraction of a wavelength apart, the only meaningful measure of signal strength is a statistical one.

The Bell experiments were carried on in New York City. The radiator was 450 feet high, atop the Long Lines Building in Manhattan. A station wagon carried the receiving and measuring equipment.—*I. Queen*



GUARANTEED PERFORMANCE

MONEY BACK GUARANTEED TO RECEIVE *All* UHF and *All* VHF STATIONS IN *All* DIRECTIONS FOR 60 MILES
WITHOUT A ROTORMOTOR OF ANY KIND!!

SO NEW! SO DIFFERENT! IT'S PATENTED!

#2,585,670
#2,609,503
#2,625,655
#2,644,091
OTHERS PENDING

WORLD'S MOST POWERFUL UHF—VHF TELEVISION ANTENNA

While antenna reception is guaranteed for 60 miles, perfect pictures have been consistently received as far as 160 miles from stations.

NEW **POLYMICALENE 4 CONDUCTOR TRANSMISSION LINE**

- Low Loss External - Air Dielectric
- Matched Impedance
- Eliminates End Sealing
- Eliminates Condensation
- Up to 50% Less Loss Than Tubular When Wet
- Easily Spiraled
- No Breaking or Shorting
- Patents Pending - T. M. Reg.

All NEW DESIGN FOR '54

- LOW-LOSS SWITCH
- LOW-LOSS PHENOLIC INSULATORS
- USES NEW 4-CONDUCTOR MATCHED IMPEDANCE LINE
- ONLY 10 INCH SPACING BETWEEN ANTENNA BAYS

The 9 position selector switch electronically rotates the antenno in a stationory position.

Money Back Guarantee
IN EVERY AREA
IN ALL LOCATIONS
WITH STATIONS IN ALL DIRECTIONS

The new All Channel Model Super 60 is guaranteed to bring in, immediately on installation, every UHF and every VHF station within 60 miles in any direction, giving clearer and sharper pictures than any antenna or combination of antennas with or without rotor motors.

If, immediately on installation, it fails to do this, we agree to refund to the jobber to whom we sold and shipped it, his full purchase price.

LIST PRICE
$36.75
SEE YOUR LOCAL JOBBER

PRICE INCLUDES
Complete stacked array • 4 stacking bars • 9 position switch • Switch-to-set coupler • 2 - 7½" stand offs • Individually boxed in mailable carton

ALL CHANNEL ANTENNA CORP.
70-07 Queens Blvd., Woodside 77, N. Y. Hickory 6-2304

FINAL EDITION **Test Equipment Good News** FINAL EDITION

PHILCO TEST EQUIPMENT SPECIFICALLY DESIGNED FOR THE SERVICEMAN

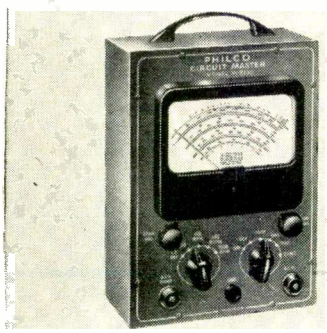
AGAIN PHILCO LEADS THE INDUSTRY

Serviceman's needs seen as Philco's Engineering Goal

This new Philco VHF to UHF adapter pioneers a whole new approach to service problems and at the same time is the most economical and practical unit ever offered. Servicemen are taking full advantage of the introductory demonstrations of this amazing piece of equipment now offered by Philco distributors coast to coast.

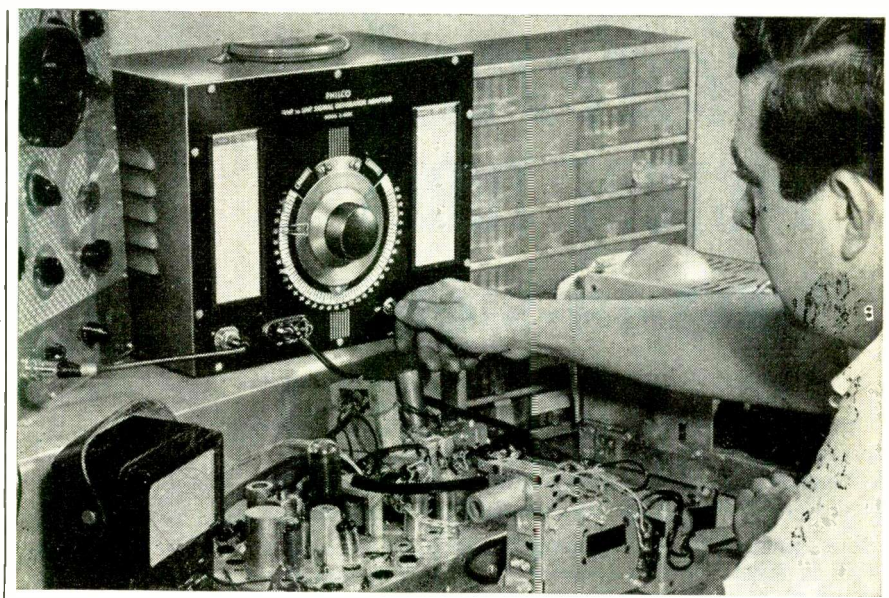
The First and Only VHF to UHF Signal Generator Adapter

Continuing its engineering program designed to provide the serviceman with the best possible test equipment Philco Corporation now offers at a fraction of the usual cost an exclusive highly specialized adapter unit for converting the output of VHF TV servicing test equipment to UHF.



One of the Finest Vacuum Tube Voltmeters ever Designed

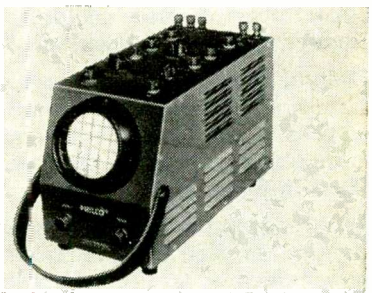
Facing up to the task of measuring high impedance circuits where loading effect must be kept to a minimum Philco has again designed a unit which meets the most rigid engineering specifications. All reports indicate this unit is unexcelled for complete and accurate measurements.



Under the trained eye of a Philco Serviceman the amazing model G-8000 VHF to UHF signal generator adapter is shown in action.

Practical Portable 3-inch Television Oscilloscope

The tremendous growth of television requires the most practical and versatile types of equipment to answer service needs. Philco has such equipment, particularly in its 3″ scope which is 2½ times smaller than other 3″ units, making it adaptable to either bench use or field servicing. High sensitivity and wide response make it ideal for TV work.



"Philco Test Equipment Specifically designed for the serviceman!" That's the theme of Philco's engineering program. A program which you, the serviceman, can depend upon to supply the very finest in service test equipment. Discover how easy it is to own a complete Philco Test Equipment Laboratory. Your Philco Distributor is eager to serve you by offering his new special payment plan to best accommodate your needs. Fill out the attached coupon as shown and mail to Philco Accessory Div.

PHILCO CORPORATION
Accessory Division
Allegheny Ave. & "A" St., Phila. 34, Pa.

☐ I am interested in the Philco Test Equipment shown here. Please send me details of your SPECIAL PURCHASE PLAN for obtaining these units.

☐ Please send FREE copy of your new booklet on Philco Test Equipment.

NAME.....

ADDRESS.....

CITY.....STATE.....

over 99%* hit the bull's-eye for quality!

that's why we call

Federal PICTURE TUBES "BEST-IN-SIGHT"

Thousands of famous-name picture tubes were quality-tested by a famous-name TV set manufacturer.* When the scoring was over, Federal led all the brands tested . . . with an "OK" on over 99% of its tubes!

Here's proof, Mr. Serviceman, that it pays to replace with *Federal* . . . here's assurance of top performance . . . of less time wasted on call-backs . . . of more profit per tube replaced!

Federal quality brings to servicemen a tremendous opportunity to create customer-goodwill . . . to build steady replacement business.

Federal quality *stands by* servicemen, because it *stands up* in service . . . backs up their years of experience and know-how . . . their *trained* judgment. That's one of many big reasons why more and more servicemen are specifying Federal "Best-in-Sight" picture tubes.

Join the trend today . . . ask your Federal Distributor about the popular-size line that takes care of over 90% of all TV replacements . . . ! For information, write to Dept. N-363.

"Federal always has made better tubes"

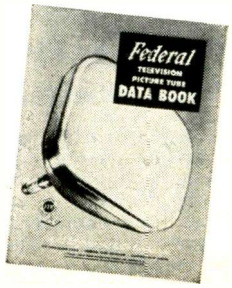
Federal *Telephone and Radio Company*

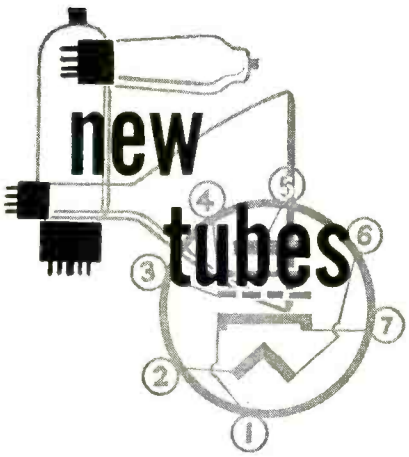
100 KINGSLAND ROAD, CLIFTON, N. J.

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

Get Your Copy of Federal's TV Picture Tube DATA BOOK

12-page booklet with information on interchangeability, basing diagrams, bulb outlines, dimensions, characteristics. Address your inquiry to Dept. listed above.

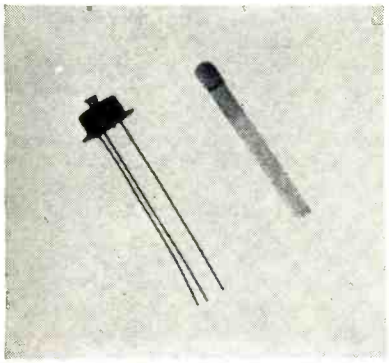




(and Transistors)

AS might be expected of a relatively new product, transistors continue to undergo rapid and basic development.

General Electric has announced new all-welded junction transistors with essentially infinite life expectancies. The new units, type 2N43 for high-gain, 2N44 for intermediate-gain, and 2N45 for medium-gain, are evacuated, hermetically sealed, and of all-welded metal construction. This eliminates the aging effects of moisture and trapped solder-flux fumes. The new construction also allows power ratings up to three times those of any previously announced transistors (almost 1 watt, with two units in a class-B push-pull circuit).

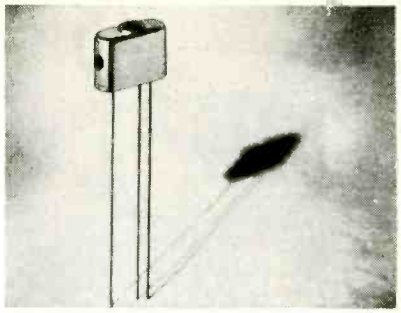


GE hermetically sealed all welded junction transistor, now in production.

In a novel exhibit at the West Coast Electronics Show in San Francisco, the transistor was operated as the heart of a miniature radio transmitter while frozen in a cake of ice which was then melted and turned into boiling water. This demonstrated the transistor's ability to perform efficiently under extreme variations in temperature and humidity.

The germanium fused junction transistors are triode P-N-P units. The absolute maximum ratings are: collector voltage (referred to base)—45; collector current—10 ma; emitter current 10 ma.

Transistor Products, Inc., has announced the development of a type X-25 germanium N-P-N junction photo transistor said to be the first commercially available amplifying photo transistor



X-25 amplifying photo transistor.

ever made. Its immediate applications will include use in automatic equipment such as punch-card accounting machines, dimmers for automobiles, and brilliance controls on television receivers.

The X-25 photosensitive transistor has sufficient power output to operate a relay. Maximum operating power is 60 mw and maximum nondestructive power is 400 mw. The X-25 may be considered as a light-sensitive device with an incorporated amplifier.

RCA has announced production of three premium-type tubes. The 5719 is a high-mu triode of the subminiature type for use primarily as an audio amplifier in mobile and aircraft receivers where dependable performance under shock and vibration is a prime consideration. In audio use as a resistance-coupled amplifier, the 5719 is capable of providing high voltage gain. A pure tungsten heater is used to give long life under conditions of frequent on-off switching.

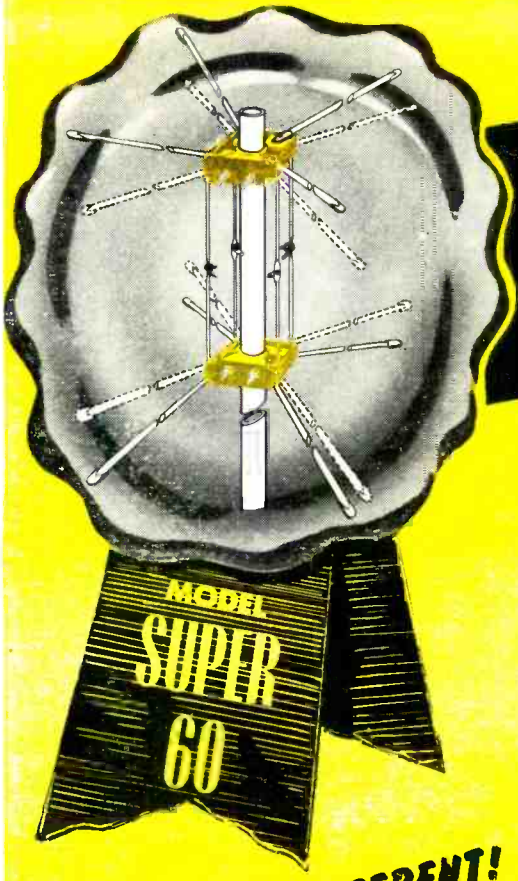
The 5814 is a medium-mu twin triode of the 9-pin miniature type for use in many diversified applications including mixers, ocsillators, multivibrators, synchronizing amplifiers, and industrial control devices where performance under shock is important. The 5814 has electrical characteristics similar to those of the 12AU7, but differs in that it has higher heater current and a lower heater-cathode voltage rating. The 5814 also has a pure tungsten heater for frequent on-off switching, a mid-tapped heater to permit operation from either a 6.3-volt or a 12.6-volt supply, and separate terminals for each cathode for flexible circuit arrangement.

The 5840 is a sharp-cutoff pentode of the subminiature type for use as a broad-band r.f. or i.f. amplifier in mobile and aircraft receivers. Like the 5719 and the 5814, the 5840 has a pure tungsten heater. The 5840 has three leads to the cathode to permit isolation of the input and output circuit returns and to reduce the cathode lead inductance.

Another RCA relase is the 12AQ5, a beam power amplifier of the 7-pin miniature type intended primarily for use in the output amplifier of automobile radio receivers operating from a 12-volt storage battery. The 12AQ5 is identical in characteristics with the 6AQ5 with the exception of its filament voltage of 12.6, and filament current of .225 amperes.

Five new tubes have been added to

GUARANTEED PERFORMANCE



MONEY BACK GUARANTEED TO RECEIVE *All* UHF and *All* VHF STATIONS IN *All* DIRECTIONS FOR 60 MILES

WITHOUT A ROTORMOTOR OF ANY KIND!!

SO NEW! SO DIFFERENT! IT'S PATENTED!

#2,585,670
#2,609,503
#2,625,655
#2,644,091
OTHERS PENDING

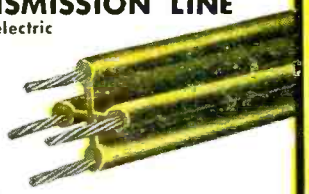
WORLD'S MOST POWERFUL UHF—VHF TELEVISION ANTENNA

While antenna reception is guaranteed for 60 miles, perfect pictures have been consistently received as far as 160 miles from stations.

NEW

POLYMICALENE 4 CONDUCTOR TRANSMISSION LINE

- Low Loss External - Air Dielectric
- Matched Impedance
- Eliminates End Sealing
- Eliminates Condensation
- Up to 50% Less Loss Than Tubular When Wet
- Easily Spiraled
- No Breaking or Shorting
- Patents Pending - T. M. Reg.



100 Ft. .....$8.90 Minimum quantity

All NEW DESIGN FOR '54

- LOW-LOSS SWITCH
- LOW-LOSS PHENOLIC INSULATORS
- USES NEW 4-CONDUCTOR MATCHED IMPEDANCE LINE
- ONLY 10 INCH SPACING BETWEEN ANTENNA BAYS

The 9 position selector switch electronically rotates the antenna in a stationary position.

Mfg. solely by

ALL CHANNEL ANTENNA CORP.
Woodside 77, N. Y.

Dealer Price
$22.05
LIST PRICE
$36.75

PRICE INCLUDES
Complete stacked array • 4 stacking bars • 9 position switch • Switch-to-set coupler • 2 - 7½" stand offs • Individually boxed in mailable carton

GREYLOCK ELECTRONIC SUPPLY CO., Inc.
115 Liberty Street, N.Y.C. 6, N.Y.

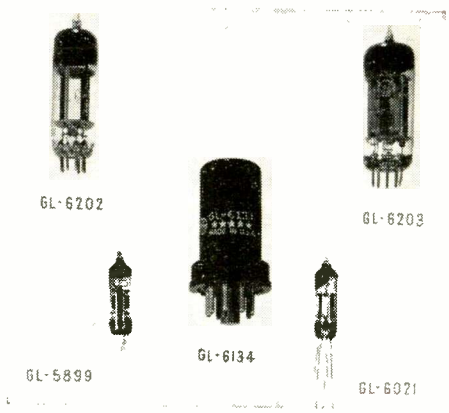
Please send me.....amount at $36.75 list price.
Please send me.....amount at $22.05 dealer net. Dealers order on letterhead.
Please send me ..... feet of Polymicalene 4 Conductor.
Name_____
Address_____
City_____State_____
☐ Check Enclosed ☐ Money Order Enclosed
☐ C.O.D. enclosed please find 25% of total purchase price . . . check . . . Money Order. Please send new 8 page cat. supplement ☐
☐ Please put my name on your mailing list.
( ) Enclosed find $..... in full. Send prepaid.

GREYLOCK ELECTRONICS SUPPLY COMPANY

• NEW YORK 6, N. Y. • BEekman 3-0224

NEW DESIGN

General Electric's "Five-Star" line to bring the total of available types to 31, capable of performing all typical electronic functions in receiving-tube applications. Specifically designed for use in equipment in which extreme electrical and physical dependability is essential, the newest group of "Five-Star" tubes includes a twin diode, two twin triodes, and two pentodes.



Additions to GE "Five-Star" line.

The GL-5899 is a subminiature, semi-remote-cutoff pentode for use as a wide-band, high-frequency amplifier. Its semi-remote-cutoff characteristic makes it suitable for use in automatic-gain-control circuits. The tube is especially suited for compact military applications because of its dependable performance, stable operating characteristics, and small size.

The GL-6021 is a subminiature medium-mu twin triode suitable for use in general-purpose amplifier applications. Each section has an individual cathode and is electrically independent. The tube is designed for service under severe conditions of mechanical shock and vibration, high ambient temperatures, and is especially suited for compact military applications.

The GL-6134 is a sharp-cutoff pentode intended for service as a wide-band radio-frequency or intermediate-frequency amplifier, or as a video amplifier. Features include a high degree of mechanical strength and a heater-cathode construction designed to withstand many thousand cycles of intermittent operation. Electrically and physically, the GL-6134 is a replacement for the 6AC7.

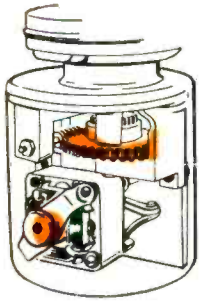
The GL-6202 is a miniature full-wave high-vacuum rectifier for use in power supplies in which the d.c. current requirements do not exceed 50 milliamperes. Within the limits of its maximum ratings, it is a replacement for the 6X4. The GL-6202 may be used at altitudes as high as 60,000 feet, and will withstand a peak impact acceleration of 700 g.

The GL-6203 is a miniature full-wave high-vacuum rectifier intended for use in power supplies of a.c. and storage battery operated equipment. Like the GL-6202, the tube may be used in applications which are subject to altitudes as high as 60,000 feet, and will withstand a peak impact acceleration of 700 g. END

Why didn't someone do this before?

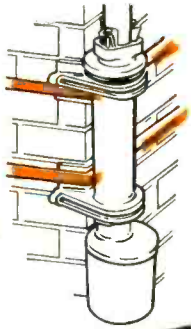
Only Superotor® has the Quick Detachable Drive Unit

"TERRIFIC!" say TV servicemen — and you'll echo their words when you see the amazing new **Superotor.** Imagine — a drive unit as easy to replace as a light bulb! Strictly a one-man job! No fussin', no cussin', — no need to dismount the antenna — no need to interrupt TV viewing while the drive unit is being serviced. Great? Yes! — and this is just one of FIVE major advances that put **Superotor** years ahead of anything on the market. **No wonder the big switch is to Superotor!**



● Double Lock Stop Prevents Drift & Coast

A Leader FIRST!



● Built-in Chimney Mount Design

A Leader FIRST!

● Steel Reinforced Construction

A Leader FIRST!

VP* Tuning

*Vernier Precision

A Leader FIRST!

Patent Applied for
Copyright

Leader ELECTRONICS INC.

2925 EAST 55th ST., CLEVELAND 27, OHIO

... LEADING THE WAY TO BETTER PRODUCTS

CREDIT FOR REPAIRS

A plan for providing credit for radio and TV repairs as well as purchases has been worked out by the Radio-Television Association of Kalamazoo, Michigan, in co-operation with a local finance company. Under the plan, approved customers will receive loans to pay their repair bills. Service organizations will receive cash, thus saving the expense of mailing statements, keeping charge accounts on their books, and making collections.

The Kalamazoo RTA has just finished a newspaper advertising campaign which explained to the TV-owning public the many problems facing the TV repairman, the service performed by ethical service firms, and the reasons why TV repairs sometimes can be expensive.

SELF-SERVICE TV

A Brooklyn components store is catering to the trade created by the "fix-it-yourself" propaganda widely distributed by publishers of so-called "TV guidebooks." Calling itself Self-Service TV, the firm has distributed leaflets like the one illustrated, urging TV owners to bring their troubles to the store. The customer, according to Charles Schlosser one of the proprietors, describes his symptoms, and in cases where tubes appear to be at fault, is given tubes covering the suspected portion of the receiver. Nine times out of ten, says Schlosser, the trouble is cured. Customers can also make a few other minor repairs, he says, but where major service work is required, they are referred to service shops in their neighborhoods. Self-Service does no repair work on its own.

OPPOSE ANTENNA LAWS

Proposed regulations governing installation of TV antennas are opposed by technicians of Kansas City, Mo. The Television and Radio Technicians section of the Electric Association of Kansas City pointed out several reasons

easy . . . split second installation!

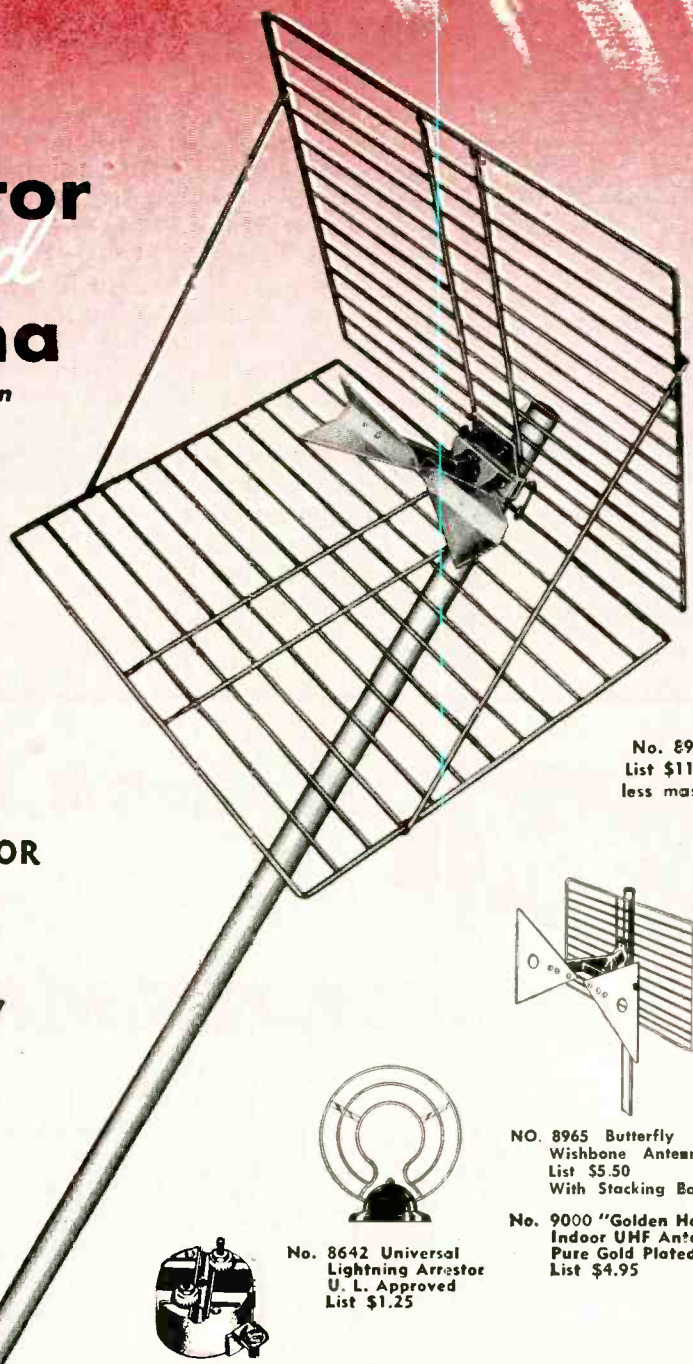
TELCO

corner reflector Golden Grid uhf antenna

Identified by its golden screen

FACTORY-ASSEMBLED

- vibration-proof
- ready to install
- reduces installation cost
- sturdily constructed
- only 1 mast b ket to attach
- anti-corrosion plating meets government specifications



No. 8984
List $11.75
less mast

Exclusive

UHF "WISHBONE" INSULATOR

Only Telco gives you this remarkable "plus" feature

NO. 8965 Butterfly Wishbone Antenna
List $5.50
With Stacking Bar

1-2-3 Ready To Go!

1 OPEN CARTON . . . REMOVE FACTORY-ASSEMBLED UNIT

2 OPEN LIKE A BOOK . . . FASTEN STRUT WIRES

3 MOUNT ON MAST . . . JOB COMPLETE

No. 9000 "Golden Halo" Indoor UHF Antenna
Pure Gold Plated
List $4.95

No. 8642 Universal Lightning Arrestor
U. L. Approved
List $1.25

WRITE FOR FREE TELCO CATALOG

TELCO

television hardware mfg. co.

DIVISION OF GENERAL CEMENT MFG. CO.
910 TAYLOR STREET, ROCKFORD, ILL.

for their stand to the City Plan Commission:

Kansas City has had less TV service trouble than any city of similar size in the country, according to the technicians—and qualified technicians in the city are vitally interested in safety. As proof, they cite the convincing argument that no complaints, damage suits, or reports of injuries related to TV antennas have been registered in Kansas City.

As minor arguments, the technicians point out that with power increases for transmitters coming in the near future, the problem of the large outside antenna will become less and less important. Improvement in television receivers and tuners—especially u.h.f. receivers and tuners—will still further decrease the need for outdoor antennas.

BUFFALO ACTIVE

The Radio Television Service Association of Buffalo, N. Y., is meeting regularly every month at the Hotel Lafayette, according to a communication recently received from that organization. The present officers are: Ferdinand J. Lynn, president; Clarence Thielke, vice-president; John G. Wick, secretary; William Harrington, treasurer; William Wagner, sergeant-at-arms.

TWO NEW CODES

Two codes of ethics, one used by the Radio-Television Service Association of western New York, the other by the Albany, N. Y., Television Service Association, have been published recently. The western New York group (centering on Buffalo) are pledged to perform as follows:

1. Guarantee radio and television repair work for 90 days and replacement parts for 90 days.
2. Use only parts of recognized quality in repair work.
3. Charge no more than list price for parts installed.
4. Test customers' tubes as accurately and reliably as possible.
5. Keep charges for labor in such repair work at a fair and reasonable level.
6. Perform only such repair work as is necessary or authorized.
7. Maintain and use service equipment essential to good repair work and reliable tube testing.
8. Subscribe to the principles of the Buffalo Better Business Bureau in the public interest.

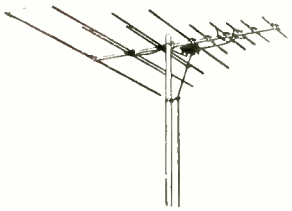
The Albany group, made up of 11 retailers and service agencies, adopted a code which differs in some respects:

1. We will maintain proper test equipment and service information libraries to keep abreast of the rapid electronic advances.
2. We will not advertise or offer service or sell materials that are questionable or unfair to customers or ourselves.
3. Protect our customers and ourselves with insurance coverage on property, personal liability and service contracts.
4. We will give estimates before shop repairs, return defective parts along with an itemized bill and standard guarantee.
5. Render prompt service (in the home when possible) using standard brand parts and replacing only necessary parts.
6. We will charge fair prices for our services and will answer to our association regarding any complaints brought to its attention.
7. We will employ qualified personnel and be responsible for proper training in service methods, courtesy and honesty.

The group has set up a schedule of service prices and formed a complaint committee to work with the Albany Chamber of Commerce on customers' service complaints. END

NEW ANTENNAS

LaPointe Electronics, Inc., Rockville, Conn., has added new items to its Vee-D-X line. Among these are the *Special*, an all-channel Yagi antenna with five elements for high-channel reception and four elements for low; broad-band Yagis in 10- and 5-element models; isolation filters; and a lightning arrestor.



ANTENNA ROTOR

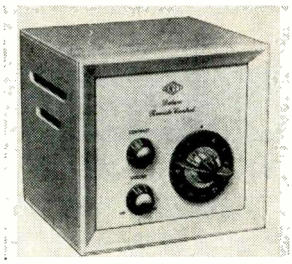
Jeb Sales Corp., 41 Wycoff Ave., New York 37, N. Y., has introduced a new antenna rotor. The unit develops 40 foot-pounds torque at the antenna mast. The model's electrical braking system results in instant stopping of the rotor, without drift.

The rotor makes 1 r.p.m. through an arc of 365° and is stopped at the end of travel by electrically actuated switches.

REMOTE CONTROL

Gonset Co., 801 S. Main St., Burbank, Calif., is producing a universal TV remote-control unit which may be attached to any conventional TV receiver.

Featuring a Standard Coil cascode tuner ahead of a booster amplifier, the unit not only permits channel selection from the viewing position (including volume, contrast, and fine-tuning adjustments), but also provides improved reception in weak-signal areas, particularly on older sets. The unit thus takes the place of both a booster and a u.h.f. converter, as the turret

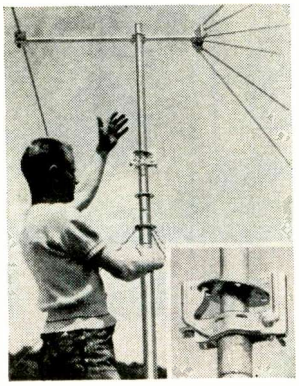


tuner has provision for snap-in coil strips.

A sound-output connection is provided for headphones, for silent-set viewing in hospitals, apartments, or wherever else desired. The unit is available in a choice of cabinets for either 21 or 40 mc. i.f. amplifier.

ANTENNA MAST

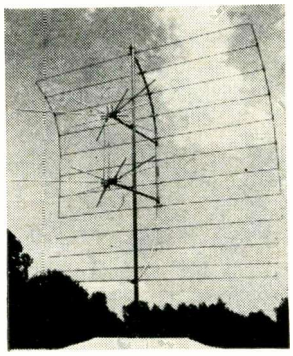
Channel Master Corp., Ellenville, N. Y., is producing an antenna mast, the Strato-Matic, featuring a safety device called the "Third Hand," which permits one-hand extension.



An automatic, removable locking device holds mast sections up when you let go. Both hands can be removed from the mast at any time during elevation and sections cannot slide down.

UHF-VHF ANTENNA

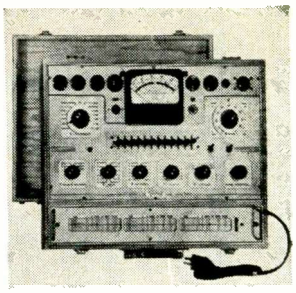
Neal Electronic Co., P.O. Box 376, Huntsville, Ala., has announced the *Paraborav*, for channels 2–83. The antenna is based on the radar parabolic type, and is designed for high average gain, with only one transmission line for both v.h.f. and u.h.f.



TUBE TESTER

Triplett Electrical Instrument Co., Bluffton, Ohio, has released a proportional mutual-conductance tube tester, model 3423. Tubes are tested by applying a high-frequency signal to the grid and measuring the signal component in the output by a special instrument circuit.

In the plate circuit a high-Q tuned circuit which responds only to 4 kc is used to extract the amplified signal. Tubes with widely varying characteristics can be checked without overloading or other damage to the tube because of a wide selection of tube parameters.



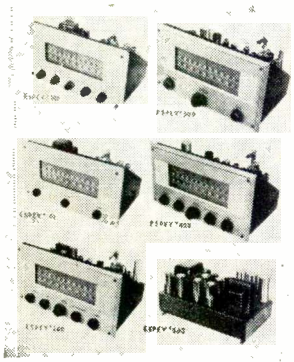
The case is wood, gray leatherette covered, and measures 14¾ x 18¾ x 6½ inches.

VOLTAGE BOOSTER

Service Instruments Co., 422 So. Dearborn St., Chicago, Ill., has announced the *Up-Ten* voltage booster, which is designed to add 10 volts to the existing line voltage when used with any television set or electrical appliance, up to 300 watts.

HI-FI COMPONENTS

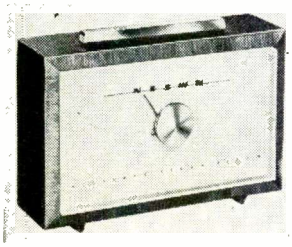
Espey Manufacturing Co., Inc., 528 E. 72 St., New York 21, N. Y., is producing a new line of AM-FM high-fidelity components. The units, known as the *Trophy* models, consist of model 100 AM-FM



radio chassis; model 101 AM-FM tuner; model 200 AM-FM radio chassis; model 300 AM-FM tuner; model 400 AM-FM de luxe tuner; and model 500 de luxe audio amplifier.

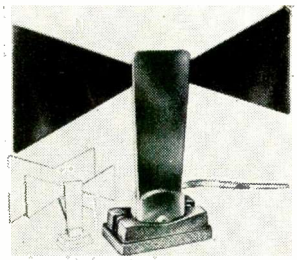
ANTENNA ROTATORS

Alliance Manufacturing Co., Alliance, Ohio, has added two new *Tenna-Rotors* to its present line. The U-83 is fully automatic, and supplies rotation to any preselected stop position. Model T-10 (control unit shown) is manually operated.



INDOOR BOWTIE

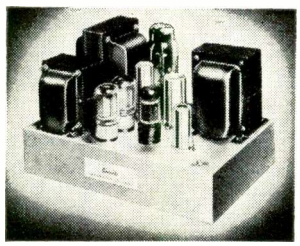
Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 62, N. Y., has developed an indoor bowtie, model IBT-500. The *NevaTip* is designed for u.h.f. and stands about 8½ inches high in a heavy metal base.



Gain is doubled by the addition of a reflector, model R-500, which plugs into the fitting at the back of the antenna.

POWER AMPLIFIER

Shields Laboratories, Inc., 315 Shields Bldg., 810 N. Lincoln Ave., Pittsburgh 12, Pa., has introduced a power amplifier, the SPA-25.

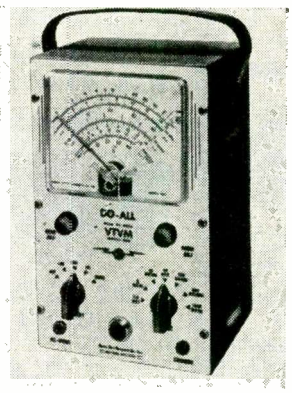


This 25-watt audio power amplifier has a frequency response of ± 1 db from 7 cycles to 100 kc. Power response is ± 1 db from 18 cycles to 40 kc. Intermodulation distortion is 0.7% at the rated output and 0.09% at the 1-watt level.

The model SPA-25 amplifier has an internal impedance of less than 1 ohm.

PEAK-TO-PEAK VTVM

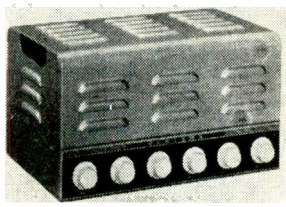
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y., has announced a peak-to-peak v.t.v.m., model 655. This meter features peak-to-peak a.c. measurements of 0.2–4,200 volts; a.c. r.m.s. measurements of 1–1,500 volts; d.c. measurements of .02–1,500 volts; and resistance measurements of 0.2 ohm to 1,000 megohms, all on 7 ranges.



TWO AMPLIFIERS

Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif., has two new amplifiers. The E-245 has a cellulose acetate insulated output transformer for maximum protection against the effects of humidity. This 25-watt amplifier has a 4-channel mixer with 3 microphone inputs and a phono input. It delivers 30 watts maximum at less than 5% distortion. Frequency response is ±2 db 40–15,000 cycles.

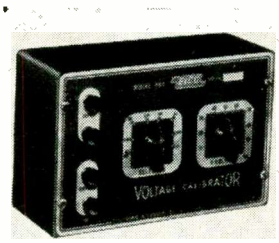
Model E-504 is similar, but provides 50 watts of power.



VOLTAGE CALIBRATOR

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y., has announced the model 495 oscilloscope voltage calibrator. The unit provides accurate peak-to-peak voltage measurement of complex waveforms required to test and align TV receivers according to manufacturer's specifications.

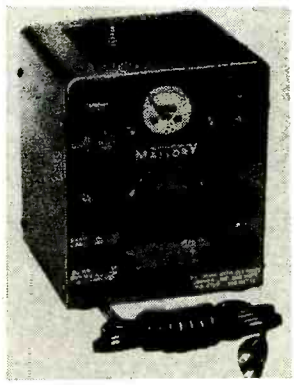
The calibrator has a square-wave output at power-line frequency with full-scale readings of 0.1, 1, 10, or 100 volts peak-to-peak. Amplitude is variable from zero on each range. Input is 105–125 volts a.c., 50–60 cycles. Over-all dimensions are 7⅝ x 5 x 4½ inches. The 495 weighs four pounds.



VOLTAGE ADJUSTER

P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind., has announced a line-voltage adjuster and isolation transformer, type LVA2.

Completely enclosed in an enameled metal case, the LVA2 provides infinitely variable a.c.-line adjustment from 90 to 130 volts at 1,200 watts; infinitely variable low voltage from 0 to 40



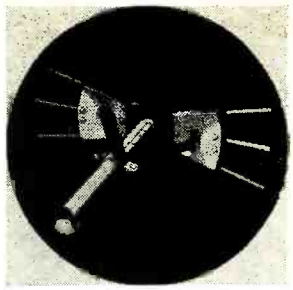
volts a.c. at 4 amp in the isolation position, or 0 to 40 volts a.c. at 8 amp. in the common line position; and an isolated, infinitely variable 90- to 130-volt a.c. output at 350 watts.

The LVA2 case dimensions are 7⅞-inches high x 5¾-inches deep x 6½-inches wide. It is supplied complete with a 6-foot, rubber-covered line cord, and has been designed to operate from a line voltage of 115 volts ± 10 volts, 60 cycles, single phase.

UHF-VHF ANTENNA

Falcon Electronics Co., 2003 Cedar St., Quincy, Ill., has announced the *Vari-Con*, an all-channel antenna peaked for top performance on any channel range.

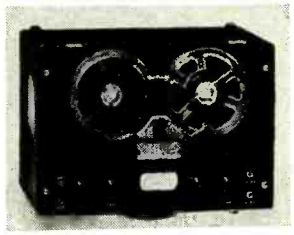
Element heads are coupled to a sliding sleeve on the boom, and the sleeve is moved to the calibration mark corresponding to the channel peaking desired.



TAPE RECORDER

TapeMaster, Inc., 13 W. Hubbard St., Chicago 10, Ill., has developed a professional tape recorder obtainable at moderate cost. The model HF-500 has an internal amplifier and 6-inch extended range speaker, but can be switched to external amplifier and speaker.

The unit is single-speed (7.5 i.p.s.). There are inputs for microphone and radio-phonograph. Brush professional



head is used. Power output is 2 watts. The recorder operates on 105–125 volts, 60 cycles a.c. It comes in a leatherette carrying case, and measures 19¾ x 8¾ x 13 inches. END

All specifications given on these pages are from manufacturers' data.

NEW PATENTS

PHOTOTRANSISTOR CONTROL UNIT

Patent No. 2,641,712
Reymond J. Kircher, Summit, N. J.
(Assigned to Bell Telephone Laboratories, Inc.)

When light falls on a junction-type germanium transistor, a voltage is generated between the ends of that crystal. Current will flow through a load without the need of a power supply. Output varies with the intensity of the light. It also depends upon the spot on which the light falls. Output is maximum if light is focused on the junction between N-type and P-type germanium. Fig. 1 shows how output varies with distance from a junction.

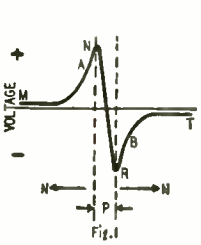


Fig.1

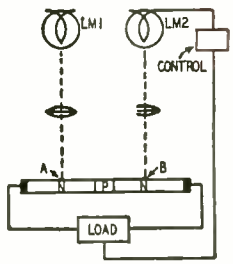


Fig.2

Fig. 2 shows one application of this invention. Beams from lamps LM1, LM2 are focused on the crystal. LM1 may be a standard lamp with fixed intensity; the intensity of LM2 is variable. The lamps illuminate points A and B, which are equidistant from the junctions. When the lamps are equally brilliant, they generate equal and opposite voltages (see Fig. 2). No current flows through the load. If LM2 grows dimmer, the net output from the crystal will be *positive*; more light from LM2 will cause a net voltage that is *negative*.

Part of the output voltage is fed to a control unit. This increases the illumination from LM2 when the load voltage is positive. When the output is negative, LM2 is decreased. Thus the circuit tends to maintain the lamps equally brilliant.

The combination used in Fig. 2 may be used in photographic exposure control processes, in stage light intensity control systems and in infra-red baking processes. It may be used also in translating or transcribing systems for coding, decoding, and information blending systems.

One general object of this invention is to improve the performance characteristics of semiconductor photoresponsive devices, and to expedite the realization of relatively large responses from photosensitive semi-conductor devices.

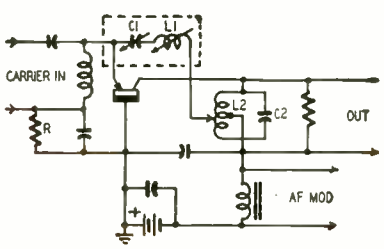
TRANSISTOR MODULATOR

Patent No. 2,644,925
Leslie L. Koros, Camden, N. J.
(Assigned to Radio Corp. of America)

Transistors can replace vacuum tubes in many types of circuits. Generally, the circuit needs some sort of modification because transistors need different supply voltages, impedance matching, and circuitry. This modulator uses a transistor instead of a tube, but must be redesigned to take into account leakage from emitter to collector. There is no corresponding leakage between elements of a tube.

The modulator is shown in the figure. A high-frequency carrier is impressed between emitter and ground. Rectified current through this circuit flows through R to generate bias for the emitter. An a.f. signal feeds the collector and modulates the carrier.

Ohmic leakage causes a carrier component to



NO INTEREST!!

Buy on our radically new

Time Payment Plan

NO CARRYING CHARGES!!

Measures 6¼" x 9½" x 4½"

Superior's new Model 670-A

SUPER METER

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

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover

$47.50 NET

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The Model 660-A comes complete with coaxial cable test lead and instructions.

Superior's New Model 660-A **AN AC OPERATED**

SIGNAL GENERATOR

PROVIDES COMPLETE COVERAGE for AM-FM & TV Alignment

SPECIFICATIONS:

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and Stability are assured by the use of permeability trimmed Hi-Q coils. • R.F. available separately or modulated by the internal audio oscillator. — Built in 400 cycle sine wave audio oscillator used to modulate the R.F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R.F. Oscillator Circuit: A high transconductance heptode is used as an R.F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A.F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a High-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

Tubes used: 1—6BE6 as R.F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier.

$42.95 NET

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-83, 38 Murray Street, New York 7, N. Y.

Please send me the units checked. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

Address.....

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

☐ **MODEL 670-A** .....Total Price **$28.40** **$7.40** down payment. Balance **$3.50** monthly for 6 months.
☐ **MODEL TV-11** .....Total Price **$47.50** **$11.50** down payment. Balance **$6.00** monthly for 6 months.
☐ **MODEL 660-A** .....Total Price **$42.95** **$12.95** down payment. Balance **$5.00** monthly for 6 months.
☐ I enclose $.....as down payment.
☐ Ship C.O.D. for the down payment.

arrive at the collector out of phase with the desired amplified signal. To cancel this phase distortion, part of the carrier input is fed directly through network L1-C1 to the L-C tank L2-C2. Complete cancellation is effected by tuning L1-C1 and choosing the correct tap-point on L2.

SEMICONDUCTOR PHOTOCELL

Patent No. 2,641,713

John N. Shive, Plainfield, N. J.
(Assigned to Bell Telephone Labs., Inc.)

When light strikes germanium, charges are liberated within the crystal. Normally a single electron and one positive charge are released for each photon absorbed. Due to current multiplication, a transistor greatly increases this effect. This invention discloses methods of obtaining maximum efficiency from a phototransistor. A junction-type crystal of this type can release as many as 100 electrons for each photon absorbed.

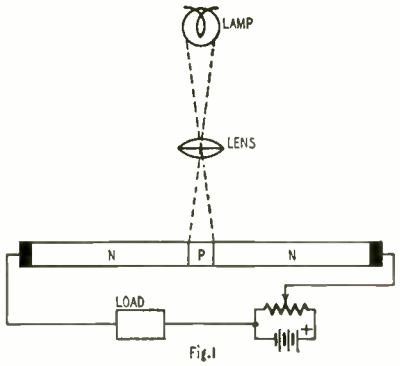


Fig. 1—Bias is in series with load.

Fig. 1 shows an NPN-type crystal with a bias supply in series with a load. Light is focused on or near its P region. This decreases the impedance of the crystal and permits more current to flow through the load.

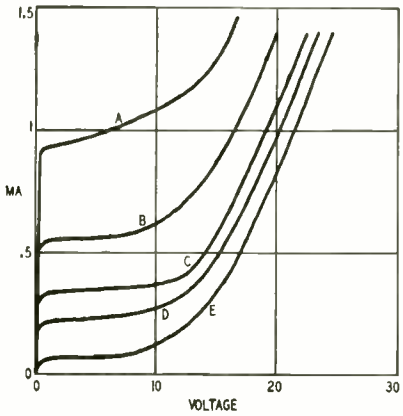


Fig. 2—Output is in foot-candles.

For maximum efficiency, the germanium must be specially treated to reduce the rate at which charges recombine with it. The P zone must be very thin (a few tenths of a millimeter). The N zones, particularly the emitter, must have low resistivity.

Fig. 2 shows various outputs for different light intensities in foot-candles. The light source is a tungsten lamp. The load is 4,000 ohms.

PULSE MODULATOR SWITCH

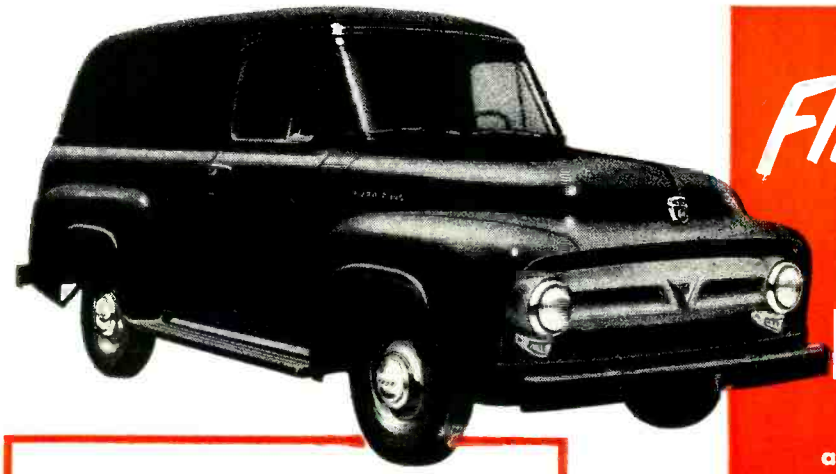
Patent No. 2,633,528

Leroy S. Hutson, Bronx, N. Y.
(Assigned to United States of America as represented by the Secretary of the Army)

This invention uses tubes in a modulating switch circuit. It can turn a high-power transmitter on and off at a rapid rate. Such a switch is needed to generate radar pulses, for example.

Negative pulses are fed to an inverter which excites the triode grids in opposite phase. At the instant shown, V1 receives a positive pulse, V2 a

FREE! A FAMOUS CBS-HYTRON Soldering Aid to *every* contestant in this, your BIG *Certified* QUALITY SERVICE CONTEST!



FIRST PRIZE ...FORD PANEL TRUCK

(painted with your name and address and delivered to your door)

9 Other BIG Prizes!

Second Prize:	**$1000 in Savings Bonds**
Third prize:	**600 in Savings Bonds**
Fourth prize:	**500 in Savings Bonds**
Fifth prize:	**400 in Savings Bonds**
Sixth prize:	**300 in Savings Bonds**
Seventh prize:	**200 in Savings Bonds**
Eighth prize:	**100 in Savings Bonds**
Ninth prize:	**50 in Savings Bonds**
Tenth prize:	**25 in Savings Bonds**

Get an ENTRY BLANK with the EASY CONTEST RULES from your CBS-HYTRON DISTRIBUTOR

On this entry blank, complete in 25 additional words or less: "I like the CBS-Hytron *Certified* Quality Service plan because . . ." Sign your name, then *print* your name and address below your signature. Ask your Distributor's Salesman or Counterman to help you. *Be sure to print his name and company on line indicated.* (If you win, he wins.) Mail to CBS-Hytron, Dept. (A), A Division of Columbia Broadcasting System, Inc., Danvers, Massachusetts.

FACTS ABOUT *YOUR* *Certified* QUALITY SERVICE Plan

If *you* could advertise nationally, chances are *you'd* do just what CBS-Hytron is doing for *you*. *You'd* tell the world in LIFE and the POST that *you* promise quality TV and Radio service, parts, and tubes . . . and at fair charges. And that's just what CBS-Hytron is doing for *you* with advertisements that sell *you* as a *Certified* Quality Service dealer . . . a dealer in whom the public can have confidence.

You'd identify *your* service repair shop as the one people are reading about in the magazines.

You'd use a *Certified* Quality Service decalcomania on *your* door. *You'd* use a *Certified* Quality Service window streamer and the big LIFE and POST easel display blow-up. Above all *you'd* use *Certified* Quality Service tags that tell *your* customer he is getting more for his money when he calls *your* service repair shop . . . because *you Certify* the quality of service, parts, and tubes . . . and at fair charges.

Yes, by using all this material, and more to come, *you* cash in on *your* big *Certified* Quality Service advertising campaign. Get *your* kit. It contains all the material *you* need to identify *you* as a *Certified* Quality Service dealer. Ask your CBS-Hytron distributor for *special deal.*

To be eligible for Contest prizes, you *must* be actively participating as a *Certified* Quality Service dealer by using the CBS-Hytron *Certified* Quality Service Promotion Kit; including tags, decalcomania, window streamer, and easel display blow-up. Awards will not be made to any dealer or serviceman not participating by December 15, 1953.

GET YOUR KIT AND CONTEST ENTRY BLANK TODAY! ASK YOUR DISTRIBUTOR . . . OR MAIL COUPON, BUT DO IT NOW!

CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON, Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

CBS-HYTRON, Danvers, Mass.

Please rush me the *Certified* Quality Service promotion kit, containing:

1. 18- by 28-inch LIFE and POST easel display . . .
2. New *Certified* Quality Service decal . . .
3. 8- by 23-inch window streamer . . .
4. AND 250 *Certified* Quality Service tags imprinted with MY name and address.

HERE IS MY 3-LINE IMPRINT:

Name _____
(please print)

Street _____

City _____ *State* _____

I enclose $2.00 to cover the cost of imprinting.

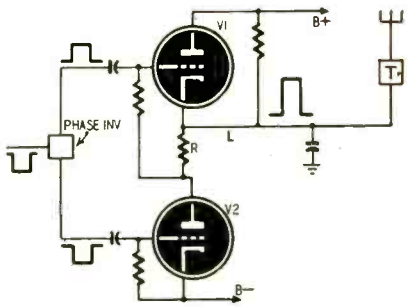
Signed: _____

P.S. Please send me also entry blank with easy Contest rules.

A member of the CBS family . . . CBS Radio • CBS Television • Columbia Records, Inc. CBS Laboratories • CBS-Columbia, Inc. • and CBS-Hytron

negative pulse. Under these conditions V1 has low plate resistance and the resistance of V2 becomes very high, practically isolating the lead L from B minus. Therefore L transmits a large positive pulse to a transmitter T.

When the signal pulse goes off, V2 passes considerable current since it is unbiased. The large



current through R biases V1 at or near cutoff. L is nearly isolated from the B plus terminal, while its resistance to B minus is low. Thus a large negative pulse feeds T to block the transmitter.

The output lead L may be connected to the transmitter screen grids. When it is positive, full power is radiated from T. When L goes sufficiently negative, it blocks the transmitter.

POCKET RADIATION METER

Patent No. 2,634,374

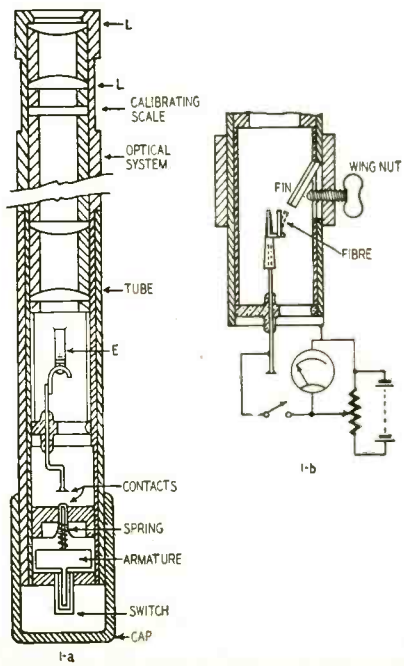
Francis R. Shonka, Riverside, Ill.

(Assigned to United States of America as represented by the U.S. Atomic Energy Commission)

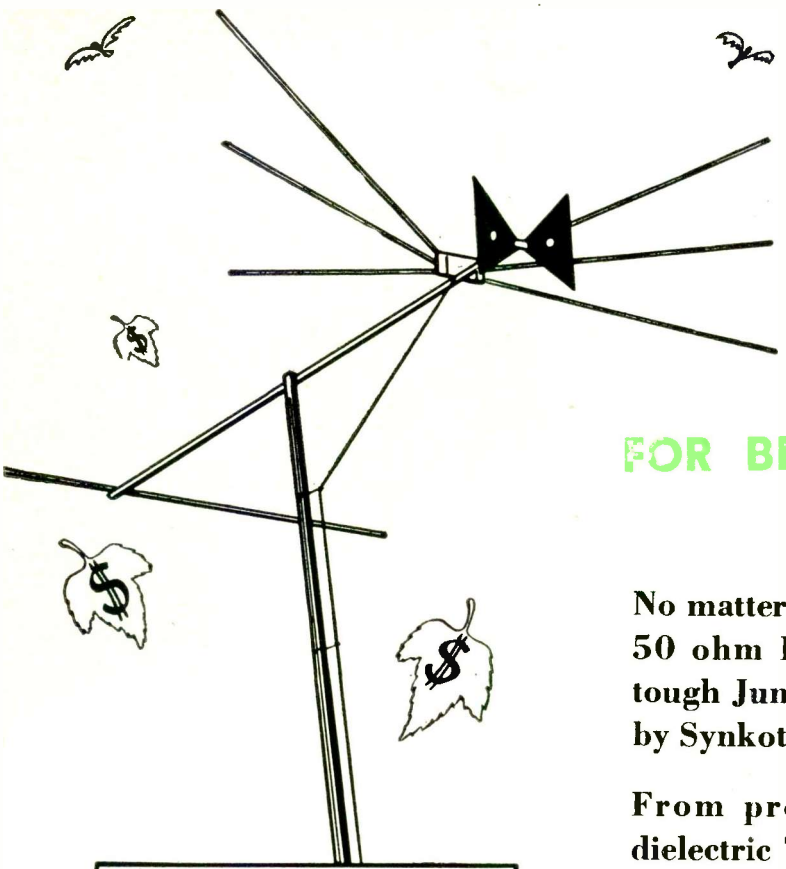
Handling and working near radioactive material can be very dangerous. The radiation passes through the human body, destroying living tissue in its path. Ill effects may not be noticed until long after the damage is done. Therefore radiation must be measured at frequent intervals to determine whether an individual is in danger. For protection, the technician may carry a dosimeter to indicate total exposure during a given period. This patent discloses a dosimeter that is convenient to carry, easy to calibrate, and inexpensive to make.

Fig. 1-a shows the instrument, which is a combined microscope and electrometer. It is housed within a metal cylinder with a removable cap at the bottom. An optical system with four lenses is focused on E, a quartz fiber. The position of E is observed on a calibrated scale through the lenses.

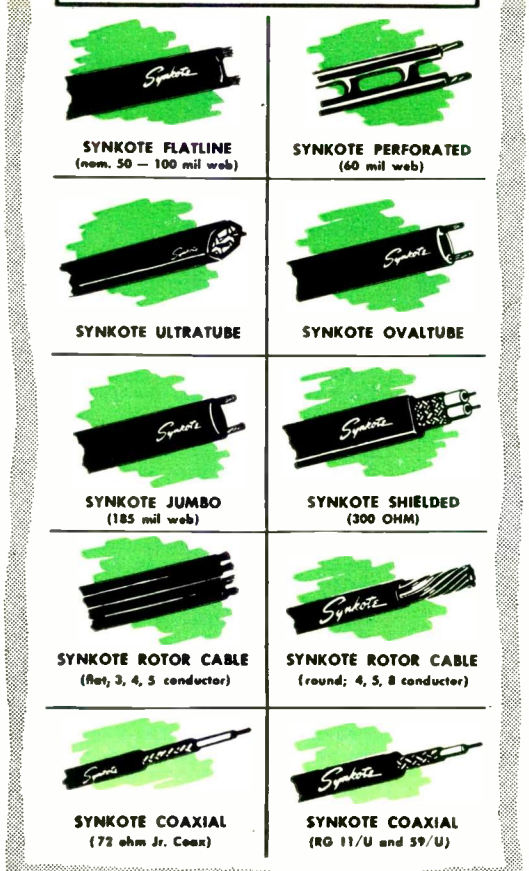
The quartz fiber and metal housing constitute an electrometer for measuring electric charge. The fiber, insulated within an ionization chamber, terminates in a contact. Below it is a second contact, normally in the position shown. The lower



1-a 1-b



SYNKOTE DEPENDABLE TV WIRE
for every purse . . . for every purpose



FOR BETTER WIRE— SPECIFY SYNKOTE

No matter what your needs . . . from 50 ohm Flatline to heavy, rough-tough Jumbo Ovaltube . . . it's made by Synkote . . . and it's made better!

From precisely constructed air-dielectric TV wires . . . from the inside to the outside . . . physically or electrically—Synkote wire is superior. Get the best—at no added cost.

Discover how *you* can benefit by giving and getting better service . . . make more profits . . . if you use Synkote TV wires. Call your Plastoid representative or write us—Now!

Synkote®
DEPENDABLE
Wire and Cable

"Manufactured by the mile . . . tested by the inch"

PLASTOID Corporation

42-61 24th St., Long Island City, N.Y.

contact may be pushed upward (against the force of a spring) by a switch. Since the switch is enclosed in an airtight chamber, it is closed by an external magnet. This is done by removing the cap, placing the dosimeter between the poles of an electromagnet (not shown), and energizing the latter to attract the armature.

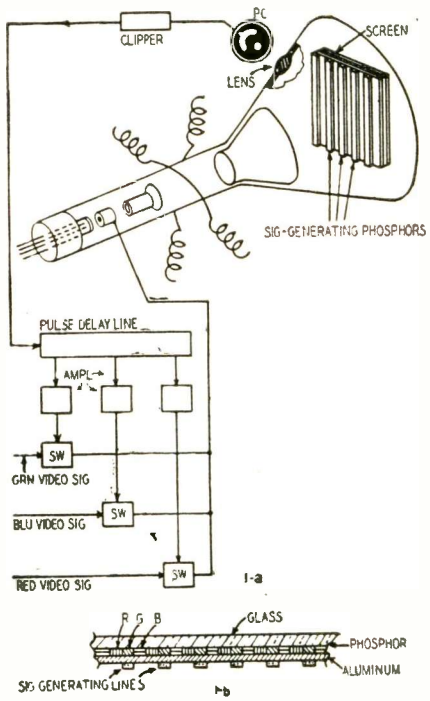
Fig. 1-b shows a more detailed section of the instrument. The electrometer is charged from a d.c. source of predetermined voltage. The charge between the fiber and the outer cylinder deflects the fiber as shown by the dotted lines.

Radiation through the ionization chamber causes a loss of charge. With continued exposure, the fiber gradually returns to its normal position. The position of the fiber may be observed at any time through the optical system, so that the technician may continue to work as long as his dosimeter does not show excessive exposure to radiation.

KINE CONTROL FOR COLOR TV

Patent No. 2,633,547
Harold B. Law, Princeton, N. J.
(Assigned to Radio Corp. of America)

Multicolor kinescopes have individual phosphor lines or dots which must be excited at precisely the correct instants. For example, the green phosphor must be excited only when the signal representing green is present. The same is true for the red and the blue.



The two-sided screen is shown in Fig. 1-a. The front surface is glass. Behind it are phosphor layers in groups of three. Each group contains a vertical line of phosphor for red (R), one for green (G), and one for blue (B). The lines extend from top to bottom of the screen. Behind the phosphors is an aluminum layer for reflecting light. Finally, signal-generating phosphor lines are placed behind each green phosphor, as shown.

Fig. 1-b shows a multicolor kinescope with the special two-sided screen. As the beam is deflected horizontally it cuts across the signal-generating phosphor lines, and the impact results in light emission. The aluminum backing prevents the light from reaching the face of the tube, but reflects a large portion of it through a lens to a photocell PC. The signal is clipped and fed to a delay line. Separate amplifiers energize switches which pass the video signals.

As the electron beam strikes any signal-generating phosphor, a signal arrives at the relay line and immediately operates the first switch. This switch transmits the video signal representing green. Thus correct timing is maintained since only the green video signal should excite a green phosphor. An instant later, the delay line will feed a signal to the second switch which passes the blue signal. This delay is equal to the time required for the beam to move from the green phosphor to the blue. **END**

PHILCO 48-1270 RADIO

A few of these sets have been brought in with complaints that the power switch doesn't work, thus making it impossible to turn the set on or off. In most cases, this trouble is caused by an error in assembling the push-button assembly and not by a defective switch as might be suspected.

Two rivets were supposed to be used to fasten the trigger to the push-button arm, but in some receivers only one was used. When the second rivet is left out, the trigger eventually loosens up so it will not operate the switch. One way to correct the trouble is to remove the entire push-button assembly and install a second rivet. This is a difficult, time-consuming job.

It is much easier to make the repair by soldering the trigger to the arm. Insert a piece of wire of the correct size into the holes provided for the second rivet and then solder the trigger to the arm. You must use a small soldering iron for the job because working space is limited. Do a good soldering job and the switch will work perfectly.

If you should find it necessary to remove the push-button assembly, realign the set when the assembly is reinstalled. Realignment is not required if the repair is made by soldering the arm to the trigger.—*Ross Harris*

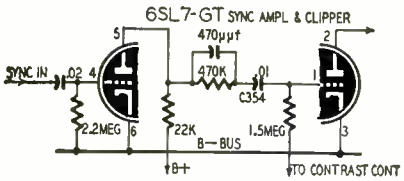
INTERMITTENT HUM

Recently, I came across a regulated power supply that had a bad case of intermittent 60-cycle hum. Checking the tubes showed the 5V4-G rectifier to have intermittent emission from one plate. A further check showed that one section of the heater was intermittent. The trouble was eliminated by replacing the tube.—*Charles Erwin Cohn*

G-E 16C113

The symptoms were unstable vertical sync, horizontal pulling, and failure of the constrast control to operate properly.

The trouble, which may also occur in G-E models 16T3, 16T4, and 16C116, was traced to a high-resistance short



in the .01-μf coupling capacitor between the sync amplifier and clipper sections of the 6SL7-GT. This capacitor is shown as C354 in the manufacturer's diagram. Replace the defective component with a 600-volt molded capacitor.—*Edgar B. Kastelberg*

CAPEHART 320, 322 & 324

In some areas, the vertical hold adjustment is critical. To improve vertical stability, try replacing the 6CB6 first sync amplifier with a 6AU6. After inserting the 6AU6, note the broadening of the vertical lock-in range by slowly rocking the vertical hold control.—*Donald A. Weiler*

TRUETONE A.C.-D.C. SETS

Unusually short tube life in some Truetone a.c.-d.c. sets using a 35W4 or 35Z5-GT rectifier may be caused by an error in wiring the rectifier heater circuit. I've found several cases where the hot side of the line connects to the pilot lamp tap instead of to one side of the filament. This applies excessive voltage to the heater string and shortens tube life.

This condition can be cleared up by changing the line cord connection from the pilot lamp tap to the high side of the rectifier filament—usually pin 2 on the 35Z5-GT and pin 4 on the 35W4.—*J. E. Ryan*

MORE WIDTH FOR GE801

You can increase the width of the picture about 1 inch by replacing the 5Y3-GT rectifier with a 5V4-GT and connecting a 30-μf electrolytic capacitor in parallel with the 30-μf input filter capacitor C63. (Better install a 20-ohm, 2-watt resistor in series with each plate lead to bring the plate-supply impedance up to the minimum value specified for the 5V4-GT.—*Editor*)—*Lyle Briggs*

ZENITH H401 PORTABLE

The complaint was hum with slight distortion all over the band when the set was plugged into a 117-volt a.c. outlet.

After the usual tests and substitutions failed to clear up the trouble, I tried shielding the 1S5 detector. This didn't help, so I rewired the socket and substituted a 1U5 in place of the 1S5. This eliminated the hum and distortion. The 1U5 is an improved electrical equivalent of the 1S5. The new internal structure and pin connections reduces any tendency toward microphonics and hum and minimizes play-through from the diode detector to the control grid.—*Albert L. Sohl*

HUM IN MOTOROLA 52R

Modulation hum when a station is tuned in may be caused by insufficient bypassing action of the .047-μf capacitor between the 35W4 plate and the B minus bus. It can be eliminated by removing the capacitor from the plate and connecting it to pin 6 on the 35W4. This circuit change was made in the HS-289 plated chassis using the same circuit. (See "Plated Chassis" in the December, 1952, issue.)

The complaint can be cleared up, without removing the chassis from the cabinet, by simply connecting a .05-μf, 400-volt molded-paper capacitor across the male part of the line interlock connector.—*G. P. Oberto*

WHINE IN AUTO RADIOS

A high-pitched whine heard over an auto radio is not always an indication that the auto's generator or noise-filter capacitors are at fault. This has also been traced to a leaky oscillator-mixer or i.f. amplifier tube in the receiver. Replacement of the leaky tube will eliminate the trouble. Also check the r.f. amplifier.

—*John A. Comstock.* END

TRIPLETT 630 Volt-Ohm-Mil-Ammeter "speaks" for itself in any company

TRIPLETT 630 Volt - Ohm - Mil - Ammeter has many significant advantages and features that make it stand distinctly apart from similar instruments in its price class. Actually in components, in engineering, in minutely accurate performance, Triplett 630 closely approaches laboratory standards.

Since the scales of any VOM comprise the means by which it makes its multiple services most valuable, the legibility and easy-read-ability are of prime importance. Triplett engineers have created in Triplett 630 the longest scales available in this size tester. (The upper arc by actual measurement is four and three-eighth inches.)

This long-scale factor accounts for the ease with which precise readings are easily made. Further legibility is gained by use of black and red scale markings. D.C. and D.B. are black and white. A.C. and Ohm markings are red on white. Ohms from one hundred million to one-tenth ohm mark the range of this amazing scale. On low ohms, center scale reading is 4.5 ohms.

The Single Switch

Further indication of the practical skill and engineering "know-how" behind Triplett 630 is the Single Switch. Its simplicity of operation assures no burn-outs thru momentary memory lapses. There is instant switching to desired circuit thru a single 2½" knob flush with the face panel. The molded switch itself embodies the most advanced engineering practices. Fully enclosed, the silvered contacts are kept permanently clean. Its rugged construction means stronger performance and longer life.

These two factors are but samples of the many ways in which on-the-job needs have been anticipated and provided for in a beautiful streamlined tester. It provides A.C.-D.C. Volts, D.C. Micro-amperes, Milliamperes, Amperes, Ohms, Megohms, Decibel and Out Put readings in a no-short design embodying interior construction with all direct connections; no harness cabling. Its fool-proof unit switch construction houses precision resistors in insulated recesses in direct connection with switch contacts.

Study the following Ranges and descriptions and compare them point by point with *any* similar instrument for conclusive proof that Triplett 630 "speaks" for itself in *any* company.

Ranges

D.C. Volts: 0-3-12-60-300-1200—at 20,000 Ohms/Volt
(For Greater Accuracy on TV and other High Resistance Circuits)
A.C. Volts: 0-3-12-60-300-1200-6000—at 5,000 Ohms/Volt
(For Greater Accuracy in Audio and other High Impedance A.C. Circuits.)
Decibels: —30, +4, +16, +30, +44, +56, +70.
(For Direct Reading of Output Levels.)
D.C. Microamperes: 0-60—at 250 Millivolts.
D.C. Milliamperes: 0-1.2-12-120—at 250 Millivolts.
D.C. Amperes: 0-12—at 250 Millivolts.
***Ohms:** 0-1,000-10,000—(4,4-44 at center scale).
***Megohms:** 0-1-100—(4,400-440,000 center scale).
Output: Condenser in series with A.C. Volt ranges.

**Resistance ranges are compensated for greatest accuracy over wide battery voltage variations. Series Ohmmeter circuits for all ranges to eliminate possibility of battery drain when leaving switch in Ohms position.*

Get a Triplett 630 into your own hands at your distributor.
U.S.A. Dealer Net $3950

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
BLUFFTON, OHIO

TRIPLETT

tv dx IN NOVEMBER

NOVEMBER will be a generally quiet month for the TV dx enthusiast. There will be slightly more sporadic-E dx than in the past two months, but, in nearly every instance, the periods of dx reception will be shorter and the reception inferior to the summer season.

Receiving conditions will be tapering off toward the winter minimum, and fringe-area reception can be expected to deteriorate in average quality as the colder weather approaches. The more northerly parts of the country will be feeling this more than in the South, where tropospheric reception can be expected to hold up well for at least another month.

The newcomer to TV dx may get the idea that only the summer months provide anything of interest. Nothing could be farther from the truth. TV dx can occur at any time or season; it just shows up less often in the next few months. Tropospheric propagation can be very good in November, too, though there may be only one or two periods in the month when the weatherman will be working for us. Watch for the mild, calm, "Indian summer" days, with high barometer and a gradually thickening haze in an otherwise clear sky. The evening and early-morning hours are almost certain to provide above-average signals over distances up to about 300 miles during such typical fall weather.

High-band propagation will fall off considerably with the coming of cold weather, and it is likely that u.h.f. reception will not be as good as during the summer. However, our experience to date with u.h.f. has been so limited, that we don't really know much of what to expect from winter weather. Observations on the comparison between low-band, high-band, and u.h.f. reception at various distances are welcomed. With the opening of so many new u.h.f. stations, large viewing audiences will be developed. This will probably lead to a great deal of information on TV dx in the u.h.f. band. We'll pass it on as we get it. It should prove very interesting.

November should see some aurora borealis displays. Here is another opportunity for the dx observer. We need more detailed reports on any unusual reception experienced while aurora lights the northern skies. Turn those arrays toward the flickering lights, and try all the v.h.f. channels. What you pick up may be hard to identify, because of the diffused nature of the auroral reflection, but don't let that keep you from trying! END

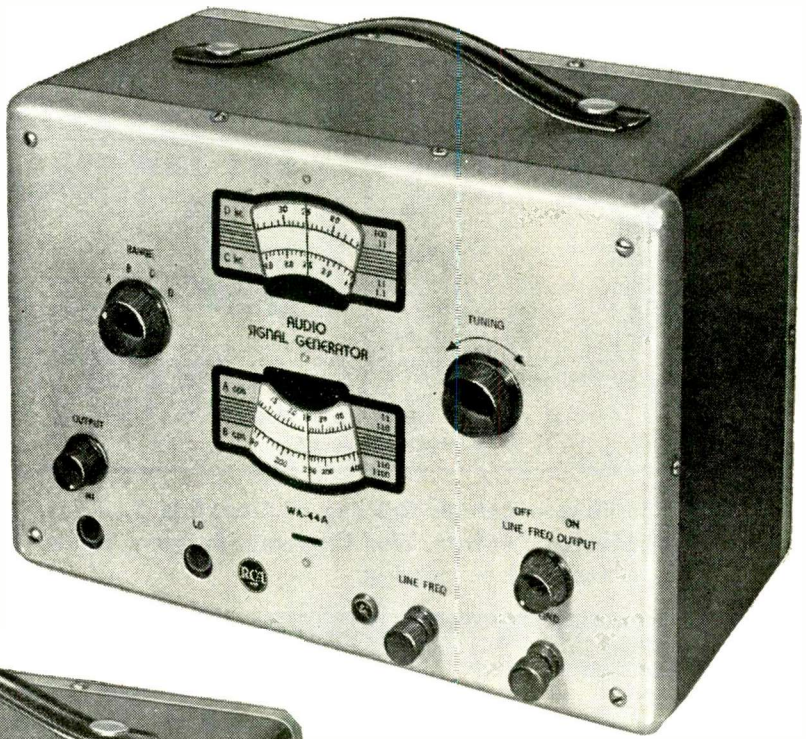
11 CPS to 30 Mc

. . . covered by two *new* RCA Companion Signal Generators for testing and trouble-shooting audio, AM, FM and TV equipment

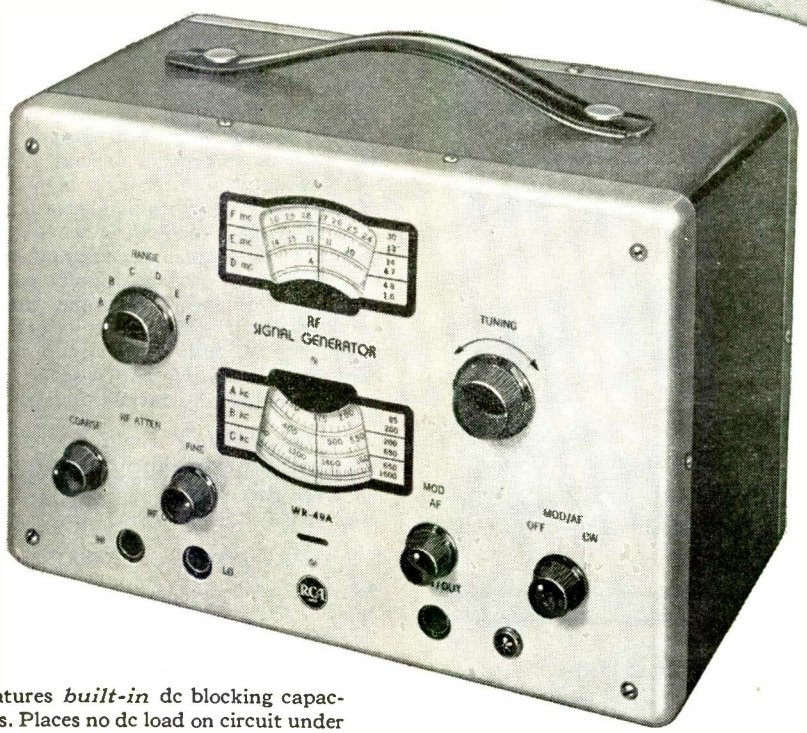
RCA WA-44A
Audio Signal Generator

Continuous sine-wave coverage from 11 cps to 100 kc

ONLY $87.50 Suggested User Price



Features new RCA-type oscillator having wide frequency range, and frequency stability of ± 3% or better. Regulated power supply. Amplified agc circuit insures an output uniform within ± 1 db over entire frequency range. Total harmonic distortion, 2% or less. Has direct-reading scales. Can be used with high- or low-impedance circuits. Useful for all response measurements. Has separate line-frequency output for inter-modulation distortion measurements. Compact, weighs only 10 lbs. Ac-operated.



Features *built-in* dc blocking capacitors. Places no dc load on circuit under test . . . protects instruments when connected to B-plus circuits. Cathode-follower output stage isolates oscillator from effects of load reactance and resistance, thereby maintaining good output waveform, voltage regulation, and frequency stability of the oscillator.

Built-in 400-cycle oscillator for internal modulation. Modulation percentage continuously variable. Dial calibrations accurate to ±1% on all six bands. Complete shielding of copper-plated cabinet and of cables for minimum leakage. Compact, weighs only 8 lbs. Ac-operated.

RCA WR-49A
RF Signal Generator

Continuous coverage on fundamentals from 85 Kc to 30 Mc

ONLY $59.50 Suggested User Price

Get full details today from your RCA Distributor or clip the coupon and mail to

RCA Commercial Engineering
Section 49KX
Harrison, N. J.

Please send me complete information on (check)

☐ RCA WA-44A Audio Signal Generator
☐ RCA WR-49A RF Signal Generator

Name_____

Address_____

City_____ State_____ Zone_____

RADIO CORPORATION of AMERICA
TEST EQUIPMENT **HARRISON, N. J.**

THE FUND REACHES $10,823.59

HELP - FREDDIE-WALK FUND

As most of our readers know, Freddie Thomason, the five-year-old son of Herschel Thomason, radio technician of Magnolia, Arkansas, was born without arms and legs. Through the generosity of many hundreds of wonderful people, the Help-Freddie-Walk Fund has been able to send over $18,000 to Freddie and his parents during the past three years.

However, we have been dismayed to note that during the past several months the number of donations received has constantly dwindled, until now what was once a flood has become merely a trickle.

We are well aware of the fact that money today is "tight," and that each of us has something of a struggle to make ends meet, but we would like to impress on you all the fact that rehabilitation of Freddie is a longtime project. Throughout his life, he will be dependent upon mechanical appliances in order to perform simple acts, like walking and eating, that we all take for granted. During the years of his growth, these appliances must be changed regularly to keep up with him. All of this costs money—thousands and thousands of dollars.

May we ask each and every one of our readers to make a special effort to send in a contribution this month, and to send them in as regularly as possible thereafter. No amount is too small to warrant our sincere thanks and appreciation, as well as the thanks and appreciation of the Thomasons, and receipt of every contribution is acknowledged by us. *Make all money orders, checks, etc., payable to Herschel Thomason.* Address all contributions to

Help-Freddie-Walk Fund
RADIO-ELECTRONICS MAGAZINE
25 West Broadway
New York 7, New York

FAMILY CIRCLE CONTRIBUTIONS

Balance as of August 18, 1953	$ 602.50
FAMILY CIRCLE Contributions as of September 18, 1953	602.50

RADIO-ELECTRONICS CONTRIBUTIONS

Bolance as of August 18, 1953	$10,205.09
Anonymous, Folly Beach, S.C.	1.00
B & S Radio & Television, Inc. Springfield, Ohio	5.00
Cpl. R. Bacon, Phoenixville, Pa.	2.00
Joseph P. Cavedine, Solvay, N. Y.	5.00
Merle Haase, Ashby, Minnesota	2.00
Lauraville Radio Service, Baltimore, Md.	1.00
RADIO-ELECTRONICS Contributions as of September 18, 1953	$10,221.09
FAMILY CIRCLE Contributions as of September 18, 1953	602.50
TOTAL Contributions as of September 18, 1953	$10,823.59

"HIGH-FIDELITY"?

The radio-phonograph industry was cautioned "to use the phrase 'high-fidelity' with discretion, or risk a loss of public confidence at a time when the entire nation is becoming high-fidelity conscious."

The warning came from Frank Freimann, president of the Magnavox Company, at the annual Trade Show of the National Association of Music Merchants. He declared that "growing public interest in the faithful reproduction of sound in phonograph, television, and radio sets must not be nipped in the bud by the careless use of the term "high-fidelity."

Leonard Carduner, president of British Industries Corp., referring to the Trade Show stated: "There I saw and heard a large number of new "high-fidelity" radio phonograph combinations, many of which will be the subject of extensive advertising and promotion this fall. Most of these are an improvement over previous sets. It is with concern and apprehension that I found that many of these units are *not* really high-fidelity; not at all capable of reproducing sound with the lifelike qualities which genuine high-fidelity imparts."

CORRECTION NOTICE

We have been informed by Amperex Electronic Corp. that the 1N tube recommended for the simple Geiger counter described on page 119 of our October issue is no longer obtainable. A tube with closely parallel characteristics is the 75N. It is slightly larger than the 1N, and is rated at 700 volts instead of the 1N's 600.

The 75NB3 is electrically identical with the 75N, but uses a pee-wee 3-pin base. If construction details are slightly modified, this might be a more convenient tube.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

November 1919 ELECTRICAL EXPERIMENTER

Interplanetary Communication, by Dr. C. S. Brainin, Ph.D., of the Columbia University Observatory
Submarine's Under-Water Radio
Nauen Radio Opened Again
New Kolster Decremeter and Wave Meter
Improving the Amateur Receiving Set, by Edward T. Jones
High Tension Condenser Switch
Code Teacher Made of Knotted String, by Alton D. Spencer END

TV SERVICE MIRROR

On most TV service calls, it is customary to touch-up the rear-panel controls to assure that the set is working at its best. Since these adjustments must be made while watching the screen, it is important to have a suitable mirror.

It is inconvenient to carry a large mirror on every service call. Too, the mirror is always subject to breakage. It is sometimes embarrassing to ask the set owner for a mirror as he may not have one or the one he has is so small that it is practically useless for the purpose. Also, it is important to maintain a professional appearance. A service technician doesn't add to his prestige by coming improperly equipped.

I always carry a 10 x 14-inch photo-finisher's ferrotype plate in my tube kit. These highly polished plates make good mirrors and do not break. You can purchase ferrotype plates from a photographic supply store. They come in various sizes which will fit conveniently into almost any TV tube and service kit.—*Orville Hellman*

CLAPBOARD DIALS

Experimenters who need a good flat white material for dials, meter scales, and small panels which require accurate marking will find the popular white aluminum siding an ideal material. The metal is light, thin, and stiff, and works well. Its flat enamel coating takes both pencil and India ink readily, and is washable for correction and reuse. A scale made of this material is far superior in appearance to the usual paper or cardboard makeshifts.

Having such a good material handy encourages construction of many small units with other inexpensive materials and components. For example, with a small piece of siding, the 50-to-1 ratio vernier dial used on BC–375 tuning units can be converted into an excellent dial for a v.f.o., mobile converter, signal generator, or communications receiver. A round, rotating dial can be fastened directly to the hub of the drive mechanism, replacing the small scale originally provided, or a fixed scale may be fastened to the panel by the same screws that attach the drive unit, and a sweeping pointer of transparent plastic attached to the hub. On one receiver we built, we extended the horizontal drive shaft to permit use of a 6-inch rotary dial scale with excellent results.—*Wm. Bruce Cameron, W8IVJ*

WEAK U.H.F. TV SIGNALS

Recently a new u.h.f. TV station began operating in our area. Signal strength was generally satisfactory, but in my location, it was too weak and the pictures were snowy with little or no contrast. I installed an all-channel v.h.f. booster in the transmission line between the u.h.f converter output and the antenna terminals of the set. Now the picture is remarkably clear when the booster is tuned to the converter i.f.—*Max P. Vineski*

TRY THIS ONE

PICTURE-TUBE CHECKERS

I use two simple adapters to make preliminary checks on brightness and contrast controls and to check for video signal and grid-2 voltage at the base of the picture tube. If the circuits check O.K., then the fault is very likely to be in the picture tube.

The adapters consist of electron-ray indicator tubes which plug into the picture-tube socket and indicate circuit performance by changes in shadow area and brightness of the fluorescent glow.

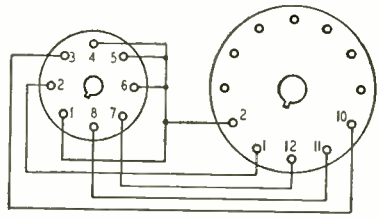


Fig. 1

Fig. 1—Adapter using 6AL7 indicator.

The circuit in Fig. 1 uses a 6AL7 and Fig. 2 uses a 6E5. The tubes plug into Eby sockets mounted in bases removed from old picture tubes. The socket fits loosely in the tube base, so four segments were cut from the base of an old 5U4-G and placed around the inside wall of the picture-tube base to make a snug fit for it. The sockets can also be mounted on long extension cables for use on test benches.

When the set is turned on and the tester is plugged into the picture-tube socket a bright glow indicates B plus voltage on grid (pin 10). The intensity

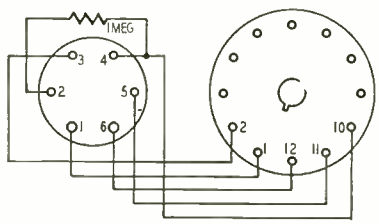


Fig. 2

Fig. 2—Adapter using 6E5 indicator.

of the glow and the shadow area should change with the settings of the contrast and brightness controls. The edges of the shadow area will appear blurred if video signal reaches the picture-tube socket. This will change with the setting of the fine-tuning control when the set is tuned to a telecasting channel.

—*Hyman Herman*

(All modern TV picture tubes use 6.3-volt, 600-ma heaters, so it is advisable to connect a 20-ohm, 5-watt resistor across the heater pins inside the adapter. This protects the indicator tube when the adapter is plugged into a set using a series heater string.

—*Editor*)

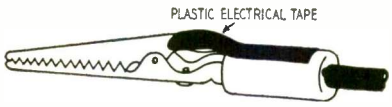
AMPLIFIERS FOR TV SETS

Quality-conscious music fans often feed the audio output of their TV sets into wide-range amplifiers and speaker systems. Before undertaking a job of this type, check the TV set carefully for the slightest trace of intercarrier buzz, because the increased bass response will greatly accentuate it. Since it is prac-

tically impossible to eliminate residual traces of buzz from intercarrier sets, it is wise to restrict your conversion jobs to split-sound sets or intercarrier sets which do not have a perceptible trace of buzz. The only other alternative, is to use an amplifier with a bass response attenuator. —*Charles Erwin Cohn*

HOOKLESS ALLIGATOR CLIPS

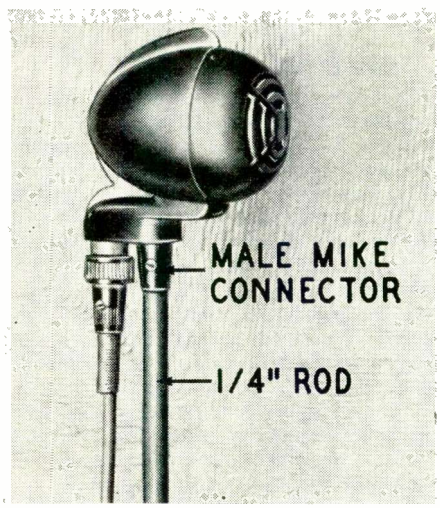
Test leads, cables, antenna lead-ins, and test instrument wires equipped with insulated alligator clips often become an entangled mess on the bench because the built-in "hook" on the backside of the alligator clip snags the other wires on the bench. It is aggravating to attempt to unsnarl a mass of leads by pulling, twisting, and looping the various leads in and out and through one another.



The drawing shows how a small piece of Scotch electrical tape may be placed across the open hook portion of the clip to keep this from happening. When cleanup time comes, the various leads and test wires untangle with ease. —*Geo. D. Philpott*

MIKE ADAPTER FOR PHOTOLAMP STAND

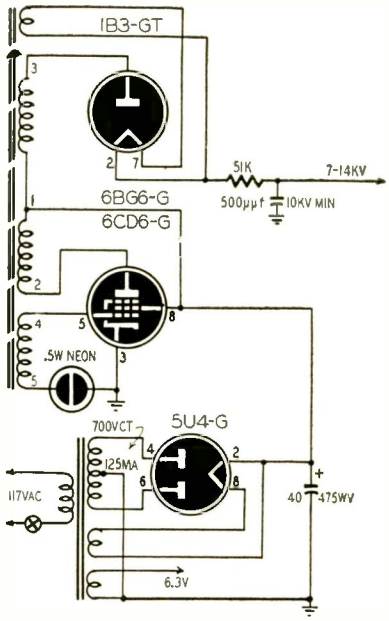
The simple adapter shown in the photo will permit almost any photolamp or music stand to be used as a stand for your microphone. The stand, need not be altered and the adapter allows it to be used interchangeably for a photolamp or a microphone.



Remove the cable-protecting spring from an Amphenol type 75-MC1M male microphone cable connector, insert a 3-inch length of ¼-inch diameter brass rod, and tighten the set-screw. Screw the cable connector into the socket of the mike and insert the rod into the top draw-tube of the stand. In some cases it may be necessary to reduce the diameter of the rod slightly with a file, so that the rod will slip into the draw-tube easily but snugly.—*Arthur Trauffer* END

REVISED HIGH-VOLTAGE SUPPLY

I constructed the high-voltage generator described on page 62 of the December, 1951, issue and found it necessary to add additional capacitors between terminal 4 of the transformer and the plate circuit to make it operate. The capacitance value was critical and it



took quite a bit of experimenting to get it to work properly. I made a number of experimental changes in the circuit and finally developed a circuit which uses fewer components than the original and works every time. I have used it with several flyback transformers with good results. The modified circuit is shown in the diagram.—*F. D. Whitten*

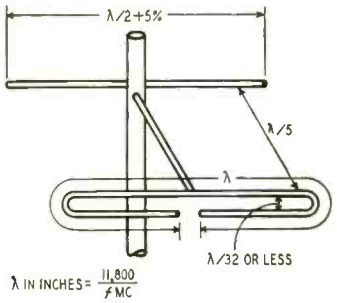
ANTENNA FOR U.H.F. TV

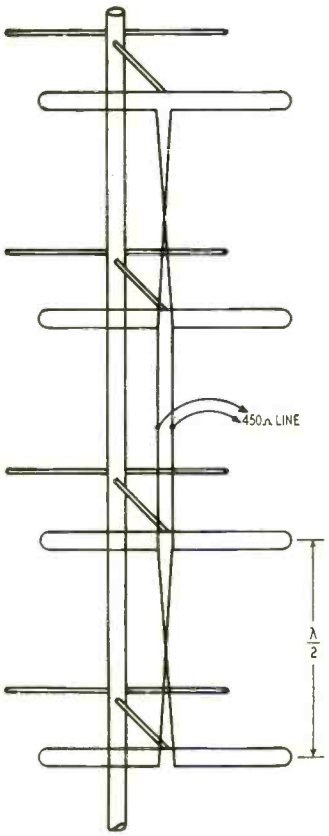
In many u.h.f. TV installations, a high-gain antenna must be used to compensate for losses in the transmission line and to assure an adequate signal at the receiver in fringe areas. Since a full wavelength in the u.h.f. TV band varies from about 25 inches on channel 14 to about 13 inches on channel 83, a high-gain array for u.h.f. TV is inexpensive and is not cumbersome to construct. The 4-bay array shown in the diagram was described in *Sylvania News*. It has a forward gain of nearly 12 db over a single folded dipole cut for the same frequency. Response is broad enough to cover several channels on each side of the center frequency.

The antenna is designed to feed a 450-ohm transmission line. If the receiver or converter has a 300-ohm input, use a 368-ohm quarter-wavelength matching stub between the lead-in and the receiver or use a tapered matching section. The latter consists of a section of transmission line which is spaced to have a characteristic impedance of 450 ohms at one end and 300 ohms at the other. This section should be at least two wavelengths long.

The antenna may be made from aluminum, brass, or copper tubing or

rod. No. 8 aluminum wire (clothes line) will probably work nicely. The phasing lines between the dipoles should have an impedance of 280 ohms. Lengths of 300-ohm ribbon line will be close enough





to the required impedance, but you can use any size wire as long as the ratio of wire diameter to center-to-center spacing is held at about 5.3. No. 8 aluminum wire spaced 0.65 inch may be used.

On u.h.f. TV channels, one wavelength (in inches) at the center of the channel can be derived from the formula:

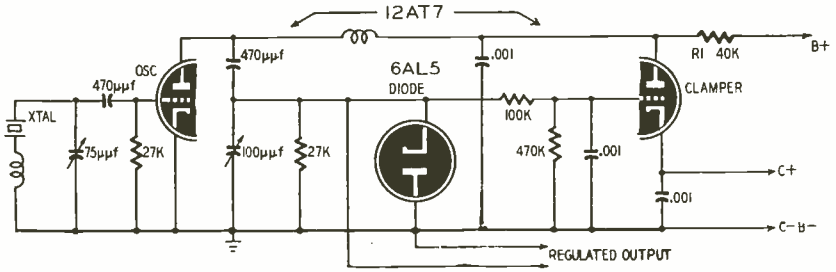
$$\lambda\,(\text{inches}) = \frac{(6 \times \text{u.h.f. channel No.}) + 389}{11{,}800}$$

CONSTANT-OUTPUT OSCILLATOR

The output level of variable-frequency oscillators in transmitter exciters, signal generators, and high-quality communications receivers should be stabilized against changes caused by variations in operating voltages and circuit constants. Various types of automatic voltage control have proved unsatisfactory for class-C oscillators because of their self-biasing feature. Clippers can be used to limit the amplitude but

this distorts the waveform and produces undesirable harmonics.

A constant-amplitude oscillator, developed by N. C. Hekimian of the National Bureau of Standards, and described in *Summary Technical Report 1710*, provides an r.f. voltage that remains reasonably stable regardless of changes in tube parameters, operating voltages, or load impedance. The device shown in the diagram consists of a conventional oscillator with a diode connected across its output terminals. Output stability is provided by a biased clamper tube sharing the same plate-dropping resistor (R1) with the oscillator.



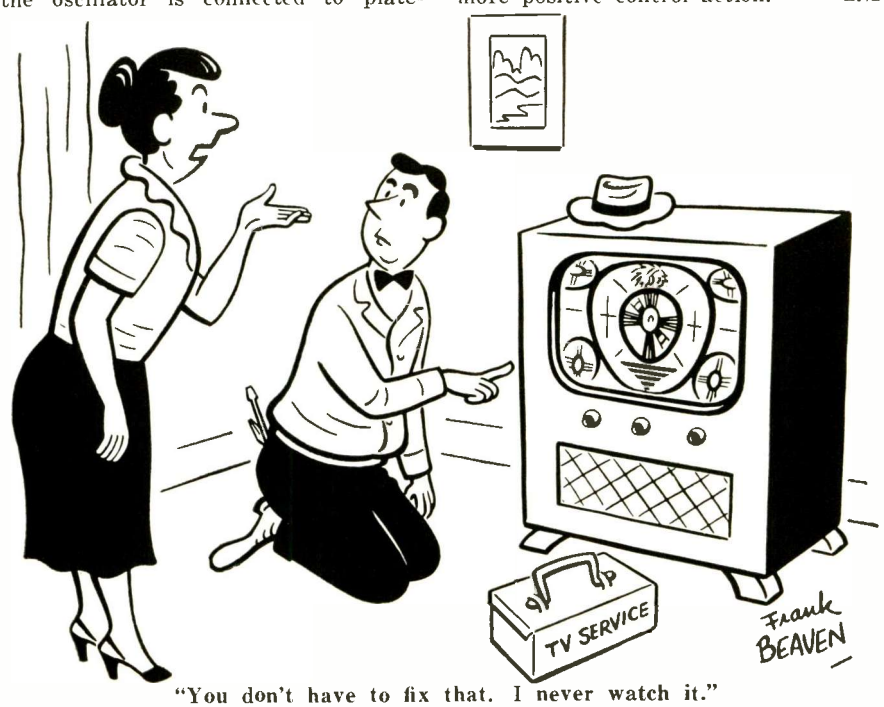
The oscillator was originally designed as a fixed-frequency local oscillator in a gain-stable receiver. It utilizes a 12AT7 as the oscillator and clamper tube and a 6AL5 diode detector. The grid tank circuit is composed of a fifth overtone crystal (30 mc), a frequency-shifting trimmer, and a crystal-peaking coil. A coil in the plate circuit of the oscillator section resonates at the crystal frequency.

The clamper tube is initially biased in the region of cut-off. The oscillator output—after rectification by the diode—is applied as a positive voltage to the grid of the clamper tube. When the oscillator output voltage reaches a sufficiently high level, the clamper begins to draw plate current and causes a reduction of plate voltage. Because the oscillator is connected to plate-dropping resistor R1, its plate voltage drops too. Thus, as the oscillator output voltage increases, the clamper tends to maintain the final output voltage at a relatively fixed level.

An experimental investigation of the effect of different values of R1 on the oscillator output voltage shows that a resistance of 10,000 ohms permits a 12-volt variation for a change in plate supply from 200 to 350 volts. A plate-load resistance of 40,000 ohms, however, restricts the output variation to 1.5 volts with the same change in plate supply. In both of these instances the bias supply voltage was held at 18 volts.

The bias for the clamper tube is usually obtained from a low-impedance constant-voltage source. In the test model the bias voltage was obtained from batteries with internal resistances of about 5 ohms. A bias of 25 volts permits the output to vary between 12 and 17 volts for a change in supply from 200 to 350 volts; whereas a bias voltage of 18 volts results in a change of only 1 volt in the output for the same change in supply.

Improved clamping may be obtained by employing a voltage-multiplier type of rectifier to drive the clamper tube. Thus a greater ratio of d.c. control bias to r.f. output is obtained and results in better regulation. Also, if a power amplifier replaced the clamper portion of the 12AT7, its greater plate-current capabilities would result in more positive control action. END



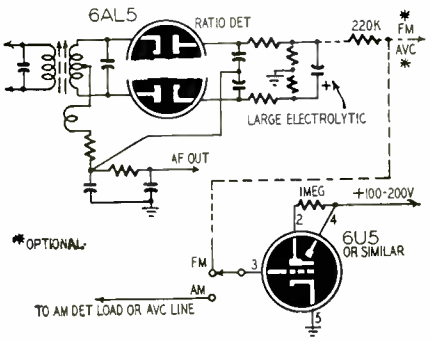
"You don't have to fix that. I never watch it."

Suggested by Jeanne De Good, Kansas City

TUNING INDICATOR CIRCUIT

? *I would like to add a tuning indicator to my AM-FM tuner. The AM circuit is conventional; the FM circuit uses a ratio detector.—M. G. S., Vicksburg, Miss.*

A. The diagram shows how a 6U5 or similar tuning indicator tube can be added to the circuit of a typical AM-FM tuner or receiver which uses a ratio detector. A suitable control voltage for the indicator can usually be



tapped off to the negative terminal of the electrolytic capacitor which is a part of the ratio detector circuit. The 220,000-ohm resistor may be added to improve the performance of the circuit.

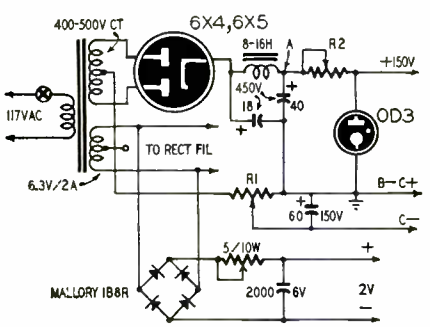
For AM tuning, the grid of the tuning indicator can be connected directly to the a.v.c. line or it may be connected to a point on the detector load resistor. The switch may be separate or it may be added as a part of the AM-FM switch.

POWER SUPPLY

? *How do I go about designing a power supply delivering 150 volts regulated B plus, 20 volts bias for grids, and 2 volts d.c. at 1 ampere for the filaments of the English battery set which I am converting.—I. I., Montreal, Canada*

A. The first step in designing any power supply is to set down the voltage and current requirements of each circuit to be supplied. You did not specify the current drain on the 150-volt line.

The basic diagram of a simple power supply of the type that you want is shown in the diagram. The values of



R1 and R2 are not given because these depend on the current through the 150-volt circuit. A single 0D3 can be used to stabilize the voltage at 150 if the current does not exceed 40 ma. If the total drain on the regulated source exceeds 40 ma, you may be able to split the load into several branches which

do not exceed 40 ma. Each branch can then be regulated by a separate 0D3 and series-dropping resistor. Vacuum-tube voltage-regulator circuits should be used if the load exceeds 40 ma and cannot be split into two or more branch circuits carrying not more than 40 ma each. See "Voltage Regulation" in the August, 1952, issue.

The value of R2 can be found from the formula

$$R = \frac{E_s - 150}{40}$$

where E_s is the supply voltage as measured at point A and 40 (ma) is the maximum operating current of the 0D3.

The value of R1 is found by dividing the required bias voltage (20) by the total current drawn from the 150-volt line.

Filament voltage is obtained by rectifying the voltage across a 6.3-volt filament winding on the transformer. The simple filter circuit shown will work for some sets. In others, it may be necessary to add a low-inductance, 1-amp filter choke and an additional 2,000-μf filter capacitor to reduce hum caused by ripple on the filament line.

High-voltage loss

? *In a Fada receiver having an RCA 630-type chassis, I have intermittent loss of high voltage. Replacement of the 1B3-GT and 6BG6-G cured the trouble for about two months but it has developed again. During the absence of the high-voltage I measured the plate voltage at the 6BG6-G and the 1B3-GT and have obtained two different readings. At one time the voltage measured 100 volts negative and at another time, 220 volts positive. The flyback transformer has been checked for continuity and the resistance conforms to that in the schematic. Capacitors C188 and C186 have been checked and found normal. E. F. A., Santa Ana, Calif.*

A. The fact that you get a variation in readings at the plate of the 6BG6-G indicates that an intermittent condition in this circuit is causing your trouble. The reading of minus 100 volts at one time, and the high positive voltage at another would give intermittent high voltage because loss of B-plus on the 6BG6-G would also remove the flyback pulse.

Your trouble might be in the damper circuit, which generates the voltage *boost* for the 6BG6-G. Try a new damper tube and also check all parts in that circuit. You should secure a steady 430 volts at C188 feeding the bottom of the horizontal output transformer.

Using a v.t.v.m. at the plate of the 6BG6-G is dangerous, for the v.t.v.m. can be damaged. When high voltage is present pulses in excess of 6,000 volts are present here besides the regular low-voltage B-plus. Better confine your voltage checks to the voltage boost system, screen of 6BG6-G, etc., and use *continuity* checks (with receiver off) for the coil sections.

S-38-C NOISE LIMITER

? *An early version of the S-38 receiver included an automatic noise limiter. My S-38-C does not have this feature. How can I add one to my set?— J. O., Olive View, Calif.*

A. A set such as this may not have enough gain for proper operation of an automatic noise limiter but we are showing two circuits you can try. Fig.

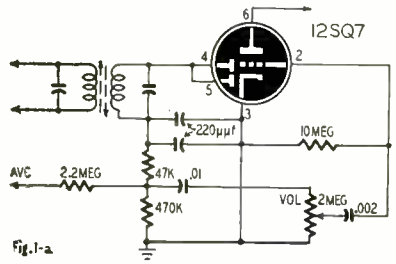


Fig. 1-a

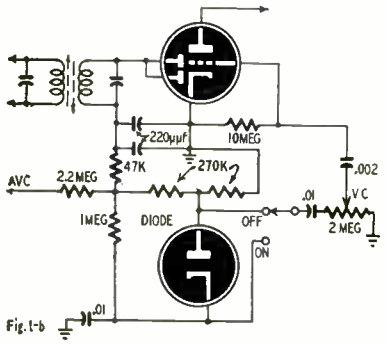


Fig. 1-b

1-a is the original circuit of the detector and first a.f. amplifier. Fig. 1-b shows how a diode noise limiter may be added to the circuit. You can substitute a 12S8-GT triple-diode-triode for the 12SQ7 or you can try a germanium diode. The diode noise limiter circuit is extremely sensitive, and great care should be exercised in the mounting of the switch. Because it readily picks up hum and introduces feedback, it should be mounted close to the tube.

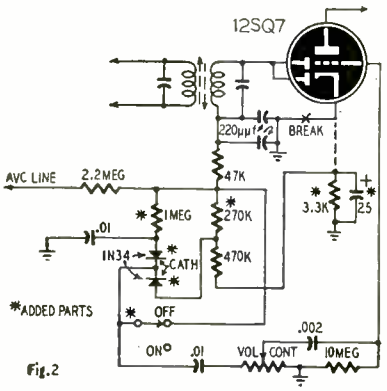


Fig. 2

Fig. 2 is a modification for using a pair of 1N34 diodes in a series-shunt noise limiter circuit. Components marked with an asterisk are added to the original circuit. Compare Fig. 2 with Fig. 1-a.

TRANSMITTER CONVERSION

? *I am planning to build the low-power transmitter described in the December, 1952, issue. However, I am a novice and cannot use a v.f.o., so I will need details on adding crystal*

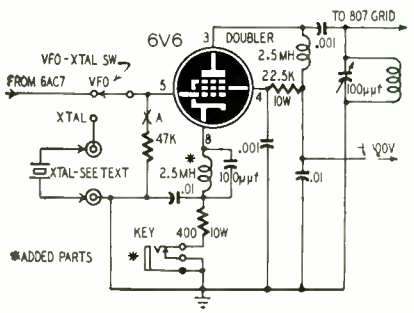
SERVICE TECHNICIANS

What was your most unusual service case? Not necessarily the most difficult one, but the one you will remember longest, either because of the problem itself or because of other conditions surrounding the job. If the experience was interesting to you, it probably will be to other readers of RADIO-ELECTRONICS. We will pay $10 for each "My Most Unusual Service Job" item we consider outstanding enough to publish in this magazine. If the item is striking enough or carries sufficient technical information to be worth more than $10 in our opinion, it will be paid for at our regular space rates. Address your stories to

Unusual Service Job
RADIO-ELECTRONICS
25 WEST BROADWAY NEW YORK 7, N. Y.

control. Will this rig work on 11 and 15 meters with crystal control? Please show me how to add crystal control to this rig.—H. M., Lake Worth, Fla.

A. The diagram shows how the 6V6 doubler can be converted to a crystal oscillator for use on the novice bands. A 2.5-mh r.f. choke, a 100-μμf capacitor, and a key jack are added to the 6V6 cathode circuit and a crystal socket across the grid leak as shown. You can construct the rig as a 3-tube crystal-controlled circuit or you can add the buffer and v.f.o. as described in the original article and use a switch in the 6V6 grid circuit to change over from crystal to v.f.o. control.



The 6V6 can be operated as a fundamental oscillator or as a frequency multiplier. The 807 can be used straight-through or as a doubler. You can operate on 15 meters by tripling in the oscillator from a 7-mc crystal or by using a 10.5-mc crystal and doubling in the oscillator or final. To reach 11 meters, you can use a 6.75-mc crystal and quadruple in the oscillator, or double in the oscillator and in the final, or you can use a suitable 14-mc crystal and double in the oscillator or in the final.

Try to avoid using harmonic and overtone type crystals because these often require special oscillator circuits for best performance. If the keying is sluggish, try connecting a 2.5-mh r.f. choke in series with the oscillator grid leak at point A.

You can use commercial plug-in coils in the oscillator and 807 plate circuits or you can wind your own from data which you will find in the various amateur radio handbooks. If care is taken, there is little to choose between commercial and home made coils.

HEATHKIT PREAMP MODIFICATION

? *I plan to use a G-E record compensator ahead of the Heathkit WA-P1 preamplifier so I would like to modify the latter to provide flat response. How can I do this?—E. E. S., Bronx, N. Y.*

A. According to information supplied by the Heath Company, all you have to do is to remove the turnover switch, the 100,000-ohm resistor, and the two .022-μf capacitors in the feedback network between the triode halves of the 12AY7 or 12AX7. Leave the 2,200-ohm cathode resistor intact. The response of the preamplifier-equalizer will now be flat when the tone controls are in the nine o'clock position. END

PEOPLE

Jack Hughes, former vice-president in charge of sales for Littelfuse, Inc., Des Plaines, Ill., was named vice-president and operations general manager of the company. In his new position, Mr. Hughes will continue to handle sales, with additional responsibilities in purchasing, production, production control, and time control.


J. Hughes

Harry H. Kline was named to the newly created position of general sales and merchandise manager of Ward Products, Division of Gabriel Co., Cleveland. He had been sales engineer, and more recently supervisor of inventory control for Ward.


H. H. Kline

W. Ward Willett joined LaPointe Electronics, Rockville, Conn., as advertising manager. He was formerly with the Plax Corporation. **Lincoln N. Kinnicutt**, who was the former director of advertising and public relations of LaPointe Electronics, has now been promoted to assistant to **Webster E. Barth**, the general sales manager of the company.


W. W. Willett

A. L. Champigny was promoted to advertising and sales promotion manager for the General Electric Tube Department, Schenectady, N. Y. He was previously manager of replacement sales promotion for the Tube Department. In his new position, he succeeds **G. A. Bradford** who was recently appointed manager of advertising and sales promotion for the General Electric Radio and Television Department in Syracuse, N. Y.


A. L. Champigny


G. M. Ehlers

G. Milton Ehlers has recently joined Aerovox Corp., New Bedford, Massachusetts, as chief research engineer. He was formerly president of the Herlec Corp., a subsidiary of Sprague Electric.

Paul G. Mathes joined the staff of Trio Manufacturing Co., Griggsville, Ill., as advertising manager. He was formerly with International Harvester.

Obituary

Julius G. Aceves, a pioneer inventor in the field of radio, died in New York City at the age of 65. He was a partner

Personnel Notes

. . . **Dr. Ivan Getting**, vice-president and director of engineering of Raytheon Manufacturing Co., Newton, Mass.; **Harold Bugbee**, president of Walter B. Snow, Boston advertising agency; and **Dr. Jerome B. Wiesner**, director of research of electronics at Massachusetts Institute of Technology, were chosen as judges for the $10,000 Transistor Contest sponsored by the Raytheon Receiving Tube Division.

. . . **Alfred E. Bourassa** joined CBS-Hytron, Danvers, Mass., as assistant to the advertising manager. He was formerly with Carter's Ink Co.

. . . **Harold Blumenthal** was named sales manager of Manufacturers Division of Shure Brothers, Chicago. He was formerly a sales engineer with the company.

. . . **Sheldon Rutter**, one of the country's top designers, was retained by Channel Master Corp., Ellenville, N. Y., to do all product design and to be packaging and art consultant.

. . . **Stanley Niciejewski**, former distributor sales manager of Sarkes Tarzian Rectifier Division, Bloomington, Ind., was promoted to sales manager, according to an announcement by **George Eannarino**, director of the Rectifier Division. **Alfred D'Urso**, former sales engineer, was promoted to assistant sales manager on distributor sales, and **Fred Lucas**, previously with Federal Telephone and Radio, joined the Sarkes Tarzian Rectifier Division as assistant sales manager of industrial sales.

. . . **Robert C. Sprague**, Chairman of the Board of Sprague Electric Co., North Adams, Mass., was selected as a member of the Business and Industry Advisory Committee of the New England Colleges Fund.

. . . **Donald S. Burge** joined Jensen Manufacturing Co., Chicago, to handle production control. He was formerly with Milled Screw Products.

. . . **Dr. William L. Everitt**, radio authority and dean of the College of Engineering of the University of Illinois, will receive the IRE Medal of Honor for 1954. The award will be made during the association's annual banquet in New York next March.

. . . **Clarence Rohwedder** joined Littelfuse, Inc., Des Plaines, Ill., as a process engineer. He held a similar position with A. O. Smith Corp. prior to his appointment. **David H. Shean** joined Littelfuse as purchasing agent. He was formerly with Redmond Co.

. . . **Clarence M. Clark**, former manager of Accounting at the Westinghouse Electronic Tube Division plant at Elmira, N. Y., was appointed manager of

the company's Tube plant in Bath, N. Y.

. . . **Christian J. Reimuller** joined Javex, Redlands, Calif., as head of the newly created Publicity and Public Relations Department. He previously was co-owner of a hydraulic machine-tool manufacturing concern.

. . . **Harry A. Ehle**, International Resistance Co., was elected president of the Radio Parts and Electronic Equipment Shows, Inc., sponsors of the Electronic Parts Show. Others elected were: **H. M. Carpenter**, Thurow Distributors, vice-president; **Francis F. Florsheim**, Columbia Wire & Supply, secretary; **Bernard L. Cahn**, Insuline Corp. of America, treasurer.

. . . **W. O. Spink** was appointed assistant equipment sales manager of the Sylvania Electronics Product Sales Department, with headquarters in New York City. He has been a member of the Sylvania sales staff since 1947.

. . . **J. C. Van Arsdell**, former manager of Sales Engineering for the Electronics Division of Erie Resistor Corp., Erie, Pa., was promoted to assistant general manager of the division. **William Klevans**, former field sales engineer, was advanced to Van Arsdell's previous position.

. . . **Joseph H. Morin** joined Howard W. Sams & Co., Indianapolis, as sales promotion manager. He had been distributor sales manager of Shure Brothers.

. . . **Martin W. Krenske** was named assistant sales manager of Edwin I. Guthman Co., Chicago. He was previously with Standard Transformer Corp.

. . . **Dr. W. R. G. Baker**, General Electric, was reappointed chairman of the RETMA Television Committee. **Max F. Balcom**, Sylvania, was reappointed chairman of the Educational Television Committee, and **Glenn McDaniel**, general counsel of the RETMA, was reappointed chairman of the Legal Committee. **Paul V. Galvin**, Motorola, and **H. A. Pope**, National Union, were reappointed chairmen of the Committee to Survey Subscription Television and of the Credit Committee, respectively. **William L. Dunn**, Raytheon, was appointed chairman of the Sales Managers Committee of the Set Division of RETMA.

. . . **Bruce R. Carlson**, an investment analyst, joined Sprague Electric, North Adams, Mass., as statistical assistant to the president.

. . . **Joseph F. Whitaker**, formerly with International Resistance Co., joined Weller Electric Corp., Easton, Pa., as sales manager.

. . . **Nat Welch** joined Orradio, Opelika, Ala., as sales manager. He was formerly a manufacturers' representative in the electrical industry.

END

COMMUNICATIONS

LOUDNESS CONTROLS

Dear Editor:

The article entitled "Loudness Controls" by M. G. O'Leary, published in the August, 1953, issue of RADIO-ELECTRONICS seemed to me a well thought out analysis of the subject. However, O'Leary posed the question, "If the loudness control compensates properly for the loud passages, does it also compensate properly for the softer ones?" Also, the closing paragraph of the article said, "Perhaps some genius will design a dynamic loudness control which will automatically vary the loudness compensation according to the type of musical passage being played." The answer to the question quoted above appears to be yes. Therefore a special dynamic loudness control is not needed.

The basic premise in Fletcher-Munson compensation is that the relative loudness of a group of tones shall remain the same regardless of the playback level. Thus, a 100-cycle bass tone of 80 db loudness and a 1,000-cycle middle tone also of 80 db loudness heard at the orchestra conductor's ear must both sound like 50 db when either is reproduced at only a 50 db loudness level. Similarly, if the 100-cycle bass tone is later played by the orchestra at 60 db but the 1,000-cycle tone remains at 80 db, then when the 1,000-cycle tone is reproduced at a 50-db level the 100-cycle tone must be reproduced at a 30-db level. These two instances are the conditions of O'Leary's question. If it can be demonstrated that the compensation is substantially the same for the 100-cycle tone in each instance, then the yes answer is proved. Calculation of the compensation is outlined below:

Original 100 cps tone	
Sensation level	Acoustic level
80 db	83 db
60 db	72 db

Reproduced 100 cps tone			
Acoustic level without comp.	Desired sensation level	Corres. acoustic level	Comp. required
53 db	50 db	67 db	14 db
42 db	30 db	57 db	15 db

If the bass tone had been 50 cycles but all other conditions remained the same, the compensations work out to 19 and 20 db.

JOHN R. SCHJELDERUP
Washington, D. C.

COMMUNITY ANTENNA SYSTEMS

Dear Editor:

In answer to the points raised in Mr. Shapp's letter (RADIO-ELECTRONICS, October, 1953), I believe that the fundamental consideration is simple. Where a community TV system is designed for distribution of not more than three channels, there are probably some advantages as to cost in the use of strip-type amplifiers, which

amplify each channel individually. Where more than three channels are to be distributed, now or in the future, I feel there are definite advantages in both cost and flexibility in specifying broadband amplifiers.

All the more recent community TV installations with which I am familiar are using strip-type amplifiers or preamplifiers with associated a.g.c. at the antenna site, and then broadband amplifiers for most of the remaining system. This has been done either because the operators are now distributing four or more channels, or because they plan ultimately to distribute several channels to their subscribers as new TV stations go on the air. Many are considering the addition of a channel for subscription TV, in addition to programs taken off the air; and in at least one case, it is planned to distribute FM radio programs as well as several TV channels.

The use of strip-type amplifiers at the headend or antenna site and broadband amplifiers in the remainder of the system is now in operation with equipment manufactured by Jerrold as well as that by Entron, SKL, and Telemeter.

Manufacturers of broad-band amplifiers have definitely considered the problem of matching amplifier gain to cable attenuation characteristics. Both SKL and Telemeter do this successfully, with equalizers designed to compensate for variations in cable attenuation with frequency. Entron accomplishes the same thing by "tilting" its broad-band amplifiers—that is, providing less gain at channel 2 than at channel 6 to match the cable attenuation curve.

Since manufacturers of broad-band amplifiers are making available designs with a gain of about 40 db, as well as models with lower gain for shorter cable runs, it is possible to use approximately the same number of broad-band amplifiers in a typical community installation as would be required if strip-type amplifiers were specified. This is particularly true because none of the strip-type amplifiers can be operated to full rated output if more than one channel is to be distributed, because of troublesome cross-modulation. If four or more channels are to be distributed, it is less expensive to use broad-band amplifiers.

In regard to maintenance, the failure of a tube in a chain-type amplifier reduces gain about 1.5 db and does not result in snow or cross-modulation. The difference with one tube out can't be detected by looking at the picture. Contrary to Mr. Shapp's belief, less than 1% of amplifier tube failures have been interelement shorts, according to the records of broad-band amplifier manufacturers and the operators of community TV systems. Where the number of channels exceeds three, more tubes are required in a strip-amplifier system than in a broad-band system, hence it is likely that maintenance costs would be higher in the former.

—E. D. LUCAS, JR.
Los Angeles, Calif.

ELECTRONIC LITERATURE

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. All literature offers void after six months.

RECEIVING TUBE DATA

G-E's new 134-page electronic tube handbook, *Essential Characteristics—Receiving Types* (ETR-15E) gives the characteristics, ratings, and basing diagrams of tubes of all manufacturers.

Included in this edition are metal, glass, miniature, subminiature, and television picture tubes, and germanium diodes. To aid in evaluating the information presented, there is a section entitled "Interpretation of Ratings and Technical Data." In addition, there are 10 pages of schematics of typical receivers, amplifiers, a preamplifier, a cascode television booster, and a regulated power supply. All schematics contain component values.

Available for 50¢ from General Electric Tube Dept., Schenectady, N. Y., or from G-E distributors.

NEW TRANSFORMERS

Stancor's Bulletin 467 describes 6 new transformers recently added to the company's line. Complete electrical and physical specifications are listed for three power transformers, P-6348, PC8422, PM8422; two audio output transformers, A-3337 and A-3839; and a heavy-duty plate transformer, P-8044, for ham use.

Available without charge from the Chicago Standard Transformer Corp., Standard Division, Addison and Elston, Chicago 18, Ill.

REPLACEMENT MANUAL

Ram's 1954 replacement manual is a 34-page booklet listing components for sweep replacement. Among the new products are 12 types of vertical scanning output transformers and five vertical blocking oscillator transformers. Seven pages are devoted to typical circuit applications.

Copies cost $1 and may be had from Ram Electronic Sales Co., Irvington-on-Hudson, N. Y., or from local distributors.

ALLIED CATALOG

Allied Radio has released its 268-page 1954 catalog, listing over 20,000 items. Included are hi-fi systems; TV chassis; boosters, rotators, and u.h.f. converters; table and portable radios; professional and home-recording equipment; P.A. amplifiers and systems; amateur receivers and transmitters; industrial v.h.f. radio and radio-telephone equipment. The back cover describes RCA's new *TV Eye*.

Request Catalog No. 135, available free, from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

TUBE CATALOG

Amperex has issued a new 20-page catalog which lists data and characteristics on their electronic tubes for communication, industrial, rectification, radiation detection, electro-medical, amateur, and special purposes.

Gratis from Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

COAXIAL CABLES

Federal's *Coaxial Cables and TV Lead-Ins* is a 24-page well-illustrated booklet which features some excellent tables. Among these are selection charts for choosing cables, copper wire specifications, temperature conversion charts, and coaxial cable impedance nomographs.

Available on request from the Selenium-Intelin Department, Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

RADIART AND C-D BOOKLETS

Recently issued by Radiart are a brochure on the TR-2, TR-11, and TR-12 antenna rotors, and TV accessory items including boosters and automatic clocks; a catalog on u.h.f. and v.h.f. indoor and outdoor antennas; and the 1953 supplement to the company's *Vibrator Replacement Guide.*

Gratis on request from the Radiart Corp., 3455 Vega Ave., Cleveland 13, Ohio and Cornell-Dublier Electric Corp., 333 Hamilton Blvd., South Plainfield, N. J.

REPLACEMENT CATALOG

Sprague's 20-page booklet, C-609, lists capacitors, resistors, interference filters, and test equipment for TV and radio.

Paper, ceramic, electrolytic, mica, and Bulplate printed-circuit capacitors are listed. Various ceramic capacitors are included, covering more than 375 ratings in voltages from 300 to 20,000 d.c.

Free on request from Sprague Products Co., Marshall St., North Adams, Mass.

VIBRATOR GUIDE

Mallory's 50-page 1953 *Vibrator Guide* shows specifications and base diagrams; installation notes and circuit diagrams; buffer capacitor reference circuits, auto battery ground chart, and auto radio service notes.

The booklet has reference sectio... prepared according to the Mallory replacement number, original equipment number, vibrator type, application, and manufacturer's replacement number.

Available for 15¢ from P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind.

TV HARDWARE

Telco's new 32-page well-illustrated catalog lists standoffs, mounts of all types, turnbuckles, antennas, tuner detents and numerous other accessories.

Ask for Catalog T-54 from Television Hardware Mfg. Co. (Division of General Cement Mfg. Co.), 919 Taylor Ave., Rockford, Ill. END

TELEVISION FUNDAMENTALS, by Kenneth Fowler and Harold B. Lippert. Published by McGraw-Hill Book Co., 330 West 42 St., New York, N. Y. 6 x 9 inches, 524 pages. Price $7.00

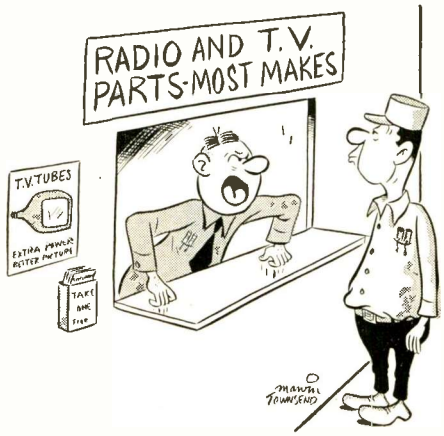
This volume deals with TV fundamentals but assumes a previous knowledge of radio principles. It is outstanding for its exceptionally detailed explanations and numerous diagrams and picture patterns. The book is intended to train service technicians by showing them the how and why of TV circuits.

Separate chapters treat the basic circuits of a receiver. Considerable space is devoted to important topics like deflection, synchronization, sweep generators, and a.f.c. Antennas and their installation also receive much attention. Chapters on test equipment and servicing contain much practical information on alignment, trouble-shooting, and measurements. The last chapter illustrates various defective patterns and specifies their causes.—*IQ*

RADIO AMATEUR MOBILE HANDBOOK, By William I. Orr, W6SAI. Published by Cowan Publishing Corp., 67 West 44th Street, New York 36, N. Y. 6½ x 9½ inches, 187 pages. Price $2.00

Mobile ham stations are no longer a novelty. Many hams have found that the joys of radio operating are greatly enhanced by working from an automobile. This book is devoted solely to them.

A mobile ham shack has problems that differ from those of a home station. Power supply, antenna, and noise limiter are some of the subjects that need such specialized treatment as is given in this handbook. The first chapters cover ignition systems, battery care, and mobile power supplies. Then how-to-build-and-operate data is provided on modern single-tube and more elaborate converters and receivers, crystal and v.f.o. rigs, multiband transmitters, and modulators. All bands from 80 meters down to 10 are included. Photos of actual tried-and-tested equipment are a great help here. In mobile work, compactness is an important item and it is a good idea to study the original assembly before proceeding.—*IQ*



"So you want a C174B-horizontal locking range, a CR1N82 crystal mixer, a T114-horizontal oscillator frequency adjuster, but you can't remember the name of the set you want it for?"

AUDIO AMPLIFIERS AND ASSOCIATED EQUIPMENT, Volume 4 (AA-4). Published by Howard W. Sams & Co., Indianapolis 5, Ind. 8½ x 11 inches. Pages not numbered. Price $3.95.

This new volume—the fourth in the Photofact Audio Library—in addition to covering the latest PA amplifiers, presents detailed descriptions of a number of the newer high-fidelity amplifiers and tuners and should be particularly useful to audio fans and experimenters who wish to compare circuits of competitive equipment. For example, there are the Radio Craftsmen model 500 and the Leak (British) RC/PA/U versions of the Williamson amplifiers. For other all-triode fans there are the Bogen H010 and the Bell 2145. Those interested in such features as automatic volume expansion and noise suppression will find them in the Amplifier Corporation of America's model ACA-100DC and the Scott 210-B. There are preamplifiers using almost every imaginable type of equalization and tone-correcting circuit.

The material on each piece of equipment includes large easy-to-read schematics, photographs with all parts labeled, voltage and resistance tables for trouble-shooting, and complete parts lists. In all, there are approximately 44 different preamplifiers and amplifiers and about 20 AM, FM, and AM-FM tuners made by leading audio equipment manufacturers. Also included is a 3-page index listing all the the amplifiers and tuners covered in the four volumes of the book.

As this writer sees it, there is but one thing that can be done to make the book even more valuable to the reader. That is to present response curves and distortion figures on equipment in the high-fidelity class. Such information would be of value to both the potential user of the equipment and the service technician who may be called upon to service it.—*RFS*

TELEVISION ENGINEERING, Volume 1, by S. W. Amos and D. C. Birkinshaw. Published by Iliffe & Sons, Ltd., London, England, and distributed in the U.S. by the British Book Center, 420 W. 45th St., New York, N. Y. 5½ x 8½ inches. 302 pages. Price $6.75.

Like other books in this series, this one is authentic and comprehensive. It is written especially to instruct the BBC staff, and will be found of particular interest by TV camera engineers and technicians.

The first part deals with fundamental topics: interlacing, scanning, blanking and sync pulses. Part 2 compares and describes various types of camera tubes, and discusses construction and applications. Part 3 deals with optics and the basic principles of light, mirrors, lenses and view finders. The last chapter covers electron optics, including electrostatic and magnetic lenses.

Several appendices treat more advanced and specialized subjects relating to electrons and light. Algebraic equations appear where helpful in both text and appendix.—*IQ*

END

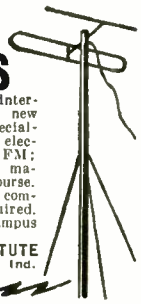
ADVERTISING INDEX

RADIO SCHOOL DIRECTORY
(Page 155)

Radio-Electronics does not assume responsibility for any errors appearing in above index.

RADIO SCHOOL DIRECTORY

GET INTO ELECTRONICS



You can enter this uncrowded, interesting field. Defense expansion, new developments demand trained specialists. Study all phases radio & electronics theory and practice: TV; FM; broadcasting; servicing; aviation, marine, police radio. 18-month course. Graduates in demand by major companies. H.S. or equivalent required. Begin Jan., March, June, Sept. Campus life. *Write for catalog.*

VALPARAISO TECHNICAL INSTITUTE
Dept. C Valparaiso, Ind.

TV REPAIRMEN MAKE TOP MONEY!

In just 39 weeks, you can get complete TV service training! Streamlined course gives you all essentials for a good job as service technician. Graduates in great demand; jobs are plentiful in this growing field. Other courses in electronics, radio operation and maintenance. Day or evening classes; modern equipment. Opportunity for employment in local industry.

Write for Catalog 111 Today

INDIANAPOLIS ELECTRONIC SCHOOL
312 E. Washington, Indianapolis 4, Ind.

RCA INSTITUTES, INC.

A service of Radio Corporation of America
350 West 4th St., New York 14, N. Y.

OFFERS COURSES IN ALL TECHNICAL PHASES OF RADIO, TELEVISION, ELECTRONICS

Approved for Veterans
Write Dept. RC-53 for Catalog

MAKE $600 EXTRA EACH MONTH!

F.C.C. LICENSE REQUIRED

Service 2-way mobile radio systems. Our free booklet tells of opportunities, explains the different types and classes of F.C.C. licenses required, and tells how you can get your license QUICKLY. 2nd class in 5 weeks. 1st class in 3 additional weeks. Both correspondence and residence training available. Write today for free booklet.

GRANTHAM SCHOOL OF ELECTRONICS, DEPT. 101
6064 Hollywood Blvd., Hollywood 28, Calif.

CODE SENDING RECEIVING SPEED

Be a "key" man. Learn how to send and receive messages in code by telegraph and radio. Commerce needs thousands of men for jobs. Good pay, adventure, interesting work. Learn at home quickly through famous Candler System. Qualify for Amateur or Commercial License. Write for FREE BOOK.

CANDLER SYSTEM CO.
Dept.3-M,Box 928,Denver 1,Colo.,U.S.A.

CORRECTION

The 500-ma meter in the diagram of the "Tube-Filament Checker" which appeared in the July, 1953 issue is correct, rather than the 5-ma meter as specified in the text. The article appeared on page 91, and not page 90 as stated last month.

Unlimited Opportunities in RADIO ENGINEERING

DEGREE IN 27 MONTHS

Complete Radio Engineering course including Telev., U. H. F. and F. M. Bachelor of Science Degree also in Mech., Civil, Elect., Chem., and Aero. Eng.; Bus. Adm., Acct. Extensive campus, modern buildings, well equipped labs. Low cost. Prep courses. Personalized, practical instruction. Founded 1884. Placement service. Growing shortage of engineers. Prepare now. Approved for Korean vets. *Enter January, March, June, September. Write for catalog.*

TRI-STATE COLLEGE
24113 College Ave. ANGOLA, IND.

RADIO ENGINEERING DEGREE IN 27 MONTHS

Intensive, specialized course including strong bases in mathematics and electrical engineering, advanced radio theory and design, television. Modern lab. Low tuition. Self-help opportunities. Also B.S. degree in 27 months in Aeronautical, Chemical, Civil, Electrical, and Mechanical Engineering. G.I. Gov't approved. Enter December, March, June, September. Catalog.

INDIANA TECHNICAL COLLEGE
1511 E. Washington Blvd., Fort Wayne 2, Indiana

EARN MORE MONEY— BE A PROFESSIONAL TELEVISION SERVICE TECHNICIAN

STEP INTO THE TOP PAY $5,000—$10,000 A YEAR CLASS. 7 MONTHS' SHOP TRAINING QUALIFIES YOU.

If you want to reach your goal as a Successful Service Technician you will need plenty of "KNOW HOW" to qualify for the better servicing jobs or profitable shop ownership.

SEND FOR FREE BOOK TODAY!

WESTERN TV offers real experience on live equipment in our BIG SHOPS AND LABORATORIES in the shortest practical time under expert instructors. Graduates are in big demand because they have the "field experience" necessary for immediate "bench" or supervisory positions. You learn every phase of Radio and TV servicing (AM, FM, VHF, UHF). WTI men win fast promotion . . . can demand better pay . . . develop highly profitable businesses of their own with the latest and most PRACTICAL PERSONALIZED TRAINING BEHIND THEM. You concentrate all your time on being a PROFESSIONAL TV SERVICE TECHNICIAN — non-essential math and engineering theory omitted. YOU CAN EARN WHILE YOU LEARN. Special Finance Plan.

APPROVED FOR VETERANS. Find out how you can get into the TOP PAY GROUP — Send for this fact-packed book NOW!

WESTERN TELEVISION INSTITUTE
America's Leading Television Servicing School

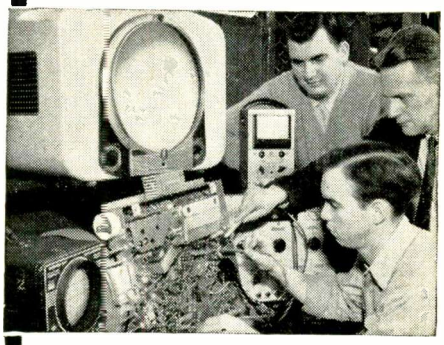
Western Television Institute Dept. E-113
341 W. 18th St., Los Angeles 15, Calif.
Without obligation, please send FREE fully illustrated booklet. (No salesman will call.)

NAME_____ AGE____

ADDRESS_____

CITY_____ ZONE___ STATE_____

BECOME AN ELECTRICAL ENGINEER



Bachelor of Science Degree in 36 months.

Major in Electronics or Power. Now, prepare for a career in these rapidly expanding fields.

This school will prepare you to become an engineer, technician or service man. Previous military, academic or practical training may be evaluated for advanced credit.

Enter Both Radio and Television

In 12 months you can attain the *Radio-Technician's* certificate. An added 6 months course qualifies you for the *Radio-TV Technician's* certificate and the Degree of "Associate in Applied Science." The Technician's course is the first third of the program leading to a Bachelor of Science Degree in Electrical Engineering with a major in Electronics.

Also offered: 12-month Radio-TV service course; 12-month Electronics or Electro Technician Courses; 6-month Electrical Service Course and 3-month refresher and general preparatory classes

Terms Open January, March, June, October

Famous for its Concentric Curriculum. Faculty of specialists. 50,000 former students. Annual enrolment from 48 states and 23 overseas countries. *Non-profit. 50th year.* Courses approved for Veterans. Residence courses only.

MILWAUKEE SCHOOL OF ENGINEERING

MILWAUKEE SCHOOL OF ENGINEERING
Dept. RE-1153, 1025 N. Milwaukee
Milwaukee 1, Wisconsin

Send: ☐ Free 45-page "Your Career" booklet describing Electrical Engineering Courses; ☐ Booklet on Careers in Radio-TV.

I am interested in_____
name of course

Name_____ Age_____

Address_____

City_____ Zone____ State_____

If veteran, indicate date of discharge_____

"TABS" NEW TRANSFORMER STOCK

2.5VCT/10A 12.5KVINS Kenyon $6.98
778VCT/200MA, 5V/3A, 6.3VCT/5A $5.98
800VCT/150MA Stancor $5.98; 3 for $16;
850VCT/148MA 5V/3A, 6.3V/5A, 6.3V/3A $6.49
2500VDC/200MA KIT, Transformers power & bridge filaments & 4/866 rectifiers. Special $23.00
WRITE FOR QUANTITY PRICES

FILAMENT TRANS.

2.5V/2A @ 79¢; 2 for $1.49; 10 for $6.49
6.3V/2AMP @ $1.08; 2 for 1.98
2.5VCT/10A 5KVINS 3.59
5VCT/10A/12KV INSUL G.E. 8.25
7.5VCT/12A CSD KENYON 15 KVINS 10.95
24V/1.25A CSD @ $1.98. Two for .. 3.49
2X12V/2A or 24V/2A @ $3.89. Two for 6.98

TRANSFORMERS

All 115 V 60 Cyc Input TV, & CR pwr Xmfr up to 20" tubes. Hi VOLTS to 20 KV (w/quadrupler ckt.) ALL tubes. & FIL wndgs 300 VDC/275 Ma Full-Wave; 6.4/10.3A, 5.4V/8A, 2.5V/3A Hypersil Core. Oil Impreg. $6.49; Two for .. $12.49
1000VCT/45MA, 795VCT/80MA, 360VCT/55MA, 3X5V/3A, 6.3VCT/1A, 6.3VCT/3A CSD HVINS CAN BE USED 2X RATING RAYTHEON HYPERSIL CORE ..... $ 4.98
950VCT/100 MA, 5V/2.5A, 5V/5A, 45V/1A, 10V/1.5A WESTERN ELECT ..... $ 5.49
900V/35MA, 2X5V/2A, XCLENT 1800V DBLER TWO 2X2 FIL WNDGS ... $ 2.25
840VCT/110MA, & 530VCT/21MA, 2X5V/3A,6.3VCT/1A, 6.3VCT/3A ..... $ 3.45
780VCT/250MA, 5V/6A, 12.6V/5.5A $ 7.95
770VCT/200MA, 5V/6A, 12.6V/3.5A $ 6.95
770V/2.5MA, 2.5V/3A, HVINS HMSLD includes FILTER PARTS 4/scope ... $ 3.69
700VCT/120MA, 2X6.3V/3A, 6.3V/1A Price ..... $ 7.25
700VCT/100MA, 2X6.3V/1.5A, 5V/2A, Isolation Winding 120MA ..... $ 3.49
680VCT/200MA, 5V/3.5A, 6.3V/4A, 78V/1A ..... $4.39; 3 for $12
420VCT/90MA, 6.3V/1.9A, W/INPUTS 6, 12, 24, 115VDC & 115 & 230 VAC @ $ 1.49

FILTER CHOKES

12Hy/80ma/H'Sld/3KVins 2.25
10Hy/125ma/UTC/Csd/H'Sld/1Kvins 1.49
50Hy/125ma/Csd/H'Sld ... 2.89
20 Hy/300ma or 15Hy/400ma/12KVins 8.95
13.5Hy 1 amp 17 Kvins Raytheon .. 39.95
6 Hy/175ma, 250 ohm ... 1.49; 2 for 2.49
12 Hy/300ma, Hmsld 5KVins 4.95
10 Hy/85ma 550 ohm ... 95¢; 2 for 1.69
3 Hy/40ma UTC HI "Q" .95¢; 2 for $1.39

"TAB" THAT'S A BUY

RHEOSTAT SALE

2 ohm 50W Model J ..2.25; 5 for 10.00
6 ohm 25W Model LH ..1.49; 2 for 2.49
20 ohm 50W Model J ...1.98; 2 for 3.50
60 ohm 50W w/knob ....2.25; 2 for 3.98
100 ohm 50W Model K ...1.98; 2 for 3.50
200 ohm 25W Model D ...1.49; 2 for 2.49
250 ohm 25W ..... ea. 1.19; 3 for 2.98
300 ohm 225W Model P ...2.98; 2 for 5.00
350, 500, 5000 ohm Slotted shaft, 25 watt ..... 79¢; 3 for 2.00

POWERSTAT SPECIALS

Type 20/O-135V/3 Amp/N ..... $ 10.98
Type 116U/O-135V/7.5 Amp/N 16.98
Type 116/as above, except cased N 20.49
Type 1126/O-135V/15 Amp/LN 41.98
Type 1226/O-270V/9 Amp/LN .. 41.98
3000 BU/O-135V/30 Amp/4KV/N 48.00
3020 BU/O-270V/15 Amp/4.5KV/N 48.00
GR50A/O-135V/45 Amp/5KV/LN. 100.00
GR50B/O-270V/31 Amp/7KV/LN. 100.00

SPEEDWAY ELEC. DRILLS

115VAC JACOBS CHUCK, Hi-Torque UL Approved, 200J/¼" RPM 1500 & 9 Drills CSD $14.75
200JK/Kit/Drill & Accessories/55 Pcs. ... 19.25
79J/⅜" RPM600 & 9 Drills CSD 20.95
400J/1½" RPM 425 & 9 Drills CSD 29.95
1000 Speed Saw ¼ HP/up to 45°/1¼" Depth 22.35

OIL CONDENSERS WAREHOUSE CLEARANCE SALE

RECTANGULAR CASE

.5MFD 1500VDC ..... 95¢; 2 for $1.50
.5MFD 600VDC ..... 1.98; 2 for 3.00
10MFD 600VDC ..... 1.98; 2 for 3.50
3MFD 330VAC 1000VDC .49¢; 3 for 1.20
2x2MFD 600VDC ..... 89¢; 2 for 1.59

BATHTUB SIDE TERMINALS

1MFD 600VDC ..... 39¢; 3 for 1.00
4MFD 50VDC ..... 50¢; 5 for 2.00
.1MFD 2000VDC ..... 1.05; 5 for 4.50

DC POWER SUPPLY

0 to 12 VDC/2 Amp. Variable DC supply, uncased and completely built—Impt. 115v/60 cy. Usable LAB supply, filament D. C. plating, battery charging, model railroad, includes voltage & speed control and center off reversing sw. Ideal for two "HO" locomotives ..... $10.95 2 for $20.00

FEDERAL "ITT" SELENIUM BATTERY CHARGER RECTIFIER

10-0-10V (CT) 100 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL. ... $11.98

SELENIUM RECTIFIERS

½ WAVE FOR RADIO & TV

Current (Cont.)	List Price	"TAB" Price	Qty 12 For
65MA @ 130V	$1.50	$0.59	$6.48
75MA @ 130V	1.85	.69	7.58
100MA @ 130V	2.05	.79	8.68
150MA @ 130V	2.25	.99	10.78
200MA @ 130V	3.15	1.39	14.98
300MA @ 130V	3.30	1.49	15.98
400MA @ 130V	4.25	1.89	20.38
500MA @ 130V	4.40	1.98	21.28
230MA @ 18V	1.40	.59	5.98
230MA @ 36V	2.25	.89	8.38
250MA @ 300V	6.95	1.39	14.98

ANY 12, LESS 10¢ FROM "TAB" PRICE

RECTIFIER XFMRS

Primary 115V 60 Cyc
Secondary 6-12-18-24-36V
4 Amp ..... $ 8.75
12 Amp $16.75
24 Amp $35.75
30-32-34-36V/48 Amp .. $59.75

SELENIUM RECTIFIERS

We specialize in Rectifiers, Power supplies to specifications. Immediate delivery.

Current (Cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	2.15	3.70	7.50
2AMP	2.20	3.60	5.40	10.50
3AMP	4.25	7.95	12.95	25.25
4AMP	4.75	9.00	13.50	33.00
10AMP	6.75	12.75	20.00	40.00
12AMP	8.50	16.25	25.50	45.00
20AMP	13.25	25.50	39.00	79.50
24AMP	18.25	32.50	45.00	90.00

Full-Wave Selen Rect & Trans. in Kit Form. All 115V/60 cy inputs
up to 14VDC at 12 amps. $23.98
up to 28VDC at 12 amps. 31.98
up to 28VDC at 48 amps. 129.00

TELEVISION ANTENNA

VEE CONICAL Broad response, all channel, powerful for fringe areas. $8.95
FOLDED DIPOLE Hi & low antennas, all channel, sturdy const. $4.95
TV CONICAL ANTENNA All Channel, Sturdy Incls 8 elements & 100 ft. Twinex. $5.25
DOUBLE-V Ant. All Channel, Sturdy Cons. w Mtg Clamps & 100 ft. Twinex $4.49
WINDOW CONICAL ANT. All Channel, Hvy Const. Mounts outside window $3.95
5 FOOT Interlocking Mast Sections, Hvy Duty, rustproof ..... 2 for $1.49; 10 for $7

TV & COAX CABLE

300 Ohm Twinex, Heavy duty 65 mil all copper TV lead in, per ft. 2¢; 100 feet $1.39
1000 foot reel $11.95
RG59U 73 ohm TV Coax Cable MFGRD to rigid UHF specs. per ft. 5¢; 100 feet $4.50, SPECIAL 500 feet $22.00

CRYSTAL DIODES

IN23B Sylvania $1.89
Lots of 10
Smaller Quantity, Unit Price $2.25
1N21 ..... .85¢; 6 for $ 4.00
1N21A ..... $1.55; 5 for $ 7.00
1N21B ..... $2.89; 4 for $10.00
1N27 ..... $1.55; 5 for $ 7.00
1N46 ..... 69¢; 5 for $ 3.25

"LAST MINUTE SPECIALS"

HELIPOT 50K OHM 10 Turn 0.5% $ 8.95
DUAL ATTENUATOR 7470 & 1003 ohm 12 step ±KS0458 ..... 3.49
DAVEN ATTENUATOR T33G dual 600 ohm, 20 step 1½DB per /step 10.98
VECTOR TURRET SOCKET 8N9T & Base Shld ..... 2 for .98
LACING CORD ±6 Waxed for cabling 1.39
LACING CORD ±12 Waxed, Linen 1.89
CARBIDE DRILLS for TV Antenna Installation ¼", ⅜", ½" ..... 3 for 3.89

TUBE SPECIALS

YOU PICK THEM **39¢** lots of 10

Cracked base or broken key electrically perfect
TESTED & 90 DAY GUARANTEED
ORDER NOW, WHILE THEY LAST
5U4G — 6SN7 — 25L6GT — 35Z5
5Y3GT — 6K6GT — 12SA7GT — 6H6
6V6GT — 6BQ6 — 6W4GT — 12SG7

TUBES

*From This Special List We Ship $10.00 and Up Tube Orders At Our Expense (Post-paid) Within Continental Limits of U.S.A.
90 Day Gtd. When ordering mention 10RE

0A2	.95	6AV5GT	1.29	6L6	2.09	12AX7	.79	5CK676	1.29
0A3/VR75	1.04	6AV6	.49	6L6GA	1.35	12AY7	2.79	CK5678	1.89
0B2	1.37	6AW6	1.89	6L6GAY	1.35	12AZ7	1.49	5687	5.49
0B3/VR90	1.09	6B4G	1.23	6L6GB	2.29	12BA6	.59	CK5702	3.49
0C3/VR105	1.15	6BA6	.63	6S4T	.63	12BA7	.79	CK5703	1.29
0D3/VR150	.90	6BA7	1.27	6S7T	.90	12BD6	1.23	Xtal Diodes	
1B3/5Q1G	.81	6BC5	.63	6SD7GT	.80	12BE6	.59	1N21A	1.55
1X2A	1.29	6BC7	1.23	6SF5	.77	12BH7	1.29	1N21B	2.89
2K2	.49	6BD5GT	1.65	6SF7	.73	12BY7	1.35	1N21C	21.50
2X2A	1.53	6BD6	.69	6SQ7	.72	12BZ7	1.25	1N22	1.55
5R4GY	1.55	6BE6	.59	6SN7	.61	12SA7GT	.69	1N23	1.35
5R4GYW	1.75	6BF5	.98	6SJ7	.70	12SC7	.80	1N23A	2.20
5U4G	.69	6BF6	.65	6SL7GT	.69	12SF5GT	.72	1N23B	2.25
5Y3GT	.43	6BF7	2.15	6SN7GT	.70	12SF7GT	.49	1N25	4.98
6AG5	.79	6BG6G	1.39	6SQ7GT	.63	12SG7	.83	1N26	9.75
6AG7	1.39	6BG7	1.98	6SR7	.65	12SH7	.63	1N27	1.55
6AH5Q	1.49	6BH6	.63	6SS7	.75	12SJ7GT	.59	1N34	.64
6AH6	1.22	6BJ6	.69	6ST7	.98	12SK7	.72	1N34A	.90
6AJ5	1.40	6BK7	2.15	6V6	1.39	12SL7GT	.95	1N38	1.65
6AK5	.74	6BL7GT	1.45	6V6GT	.57	12SN7GT	.75	1N38A	1.43
6AK6	1.05	6BN6	1.79	6W4GT	.57	12SQ7GT	.63	1N41	1.29
6AL5	.54	6BN7	1.69	6X4	.59	19T8	1.09	1N42	8.95
6AL7GT	1.79	6BQ6GT	1.20	12AH7GT	1.45	19V8	1.62	1N45	16.95
6AN5	2.90	6BQ7	1.65	12AK5	1.98	25BQ6GT	1.19	1N46	.69
6AQ5	.85	6C4	.50	12AL5	.77	25L6GT	.69	1N47	4.00
6AQ6	.81	6C86	.69	12AT6	.89	25Z5	.79	1N48	.55
6AQ7GT	1.29	6CD6G	1.69	12AT7	.81	25Z6GT	.99	1N51	.89
6AR6	2.98	6D4	2.70	12AU6	.72	28D7	1.95	1N52	1.39
6AS5	.79	6H6	.60	12AU7	.63	35Z5GT	.59	1N54	.89
6AS6	2.43	6J4	6.66	12AV6	.49	50L6GT	.69	1N54A	1.15
6AS7G	4.65	6J5GT	.47	12AV7	.98	80	.69	1N57	.99
6AT6	.63	6J6	.63	12AW6	1.79	81	1.69	1N58	1.19
6AU5GT	1.10	6K4A	6.45	12AX4GT	1.20	82	1.19	1N58A	1.15
6AU6	.59	6K6GT	.59					1N60	.60
								1N61	2.07
								1N63/K63	2.49
								1N64	.69
								1N69	.98
								1N86	1.15
								1N87	1.15

RELAY SALE

SPST mini size 115VAC 3A cts. ..... 98¢; 3 for $2.75
SPDT min. size 115VAC 3A cts ..... $1.39; 3 for $3.75
SPNO 115 V AC, 15A Cts S'Dunn .. $1.98; 2 for $3.50
DPDT & SPNO 12 V DC, 10 A CTS $2.95; 2 for $3.75
DPDT Clare SK 5010, Octal Base 18-28V 2 Amp Cts, Nitrogen Sld. New Stock SPECIAL $2.98

STORAGE BATTERIES

36 Volt WILLARD Mini-BRAND NEW: 5 oz Designed Portable Equipt Models. 98¢; 4 for $3
(4) 36V Batteries w/acid* $3.35
2V/20AH Willard PLUS 2V. Vibrator. 2.98
2V/20AH w/vib & acid* 3.59
6V/6AH Willd NT6/BB214U 2.98
6V/6AH Battery w/acid* 3.25
6V/40AH Battery 6.98
6V/40AH Battery w/acid* 9.25
*We ship acid in bottles, R exp only

AUDIO AMPLIFIERS READY TO GO

Model 305MP 5 Watt Ampl, as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Ctrls. Latest Compensated Tone Cntrl Design. Complete with Tubes $14.98
Model 302PA 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph. .. $4.98
TAB300 Hi-Fi Pre Amp & Pwr Supply $45.00
TAB312 Hi-Fi 12W Pwr Amp & Supp 45.00
GARRARD-RC 80 & GE RPX-050 .. 47.00
WRITE FOR DETAILS & PRICES

AUDIO COMPONENTS

GE RPX041 Phono Cart. ... $4.49
GE RPX050 Triple Play Cart. 6.98
Electrovoice Triple Play .. 6.98
Pickup Arm & Xtal Hi-Outpt 2.39
PM 12" Hi-Fi British Speaker 4.98
PM 12" **GE S1201A Speaker** $18.69
GE RPJ010 Dual, 001" & .0007 Sapphire 2.95
GE RPJ005 Single .001" Sapphire .. 1.75
GE RPJ001 Single .003" Sapphire .. 1.75
GE RPJ004 Single .001" Diamond .. 13.75
GE RPJ013 Dual Diamond & Sapphire. 14.75
PM 5" Speaker Gud Tone 1.98

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max. Amp	Each
U5W	SPRG FA104	150	5.98
U10	GE FT114	100	7.25
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
VA	SYLV. 4330	200	9.98
22ST	FT 110	200	9.98
V4X4	X400	200	10.98
DX	SPRGFA100	150	9.00

CONDENSER SPECIAL

2 MFD 1000 VDC 330 VAC "CD" MFGR **25¢** Lots of 10
..Smaller Quantities, each..49¢; 3 for $1.25
2MFD 600VDC Porcelain Insulators with Adjustable Mounting Clamp...3 for $1.50

YOU PICK THEM **59¢** WHILE THEY LAST
LOTS OF 10
Your selection of 10 at 59¢ each or smaller quantity at indicated prices.

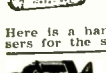
ELECTROLYTIC CONDENSERS

2X 20MFD/450VDC.. 69¢; 3 for $1.95
3X 15MFD/450VDC.. 98¢; 3 for 2.50
3X 20MFD/400VDC.. 79¢; 2 for 1.29
80MFD/450VDC .... 79¢; 2 for 1.29
25MFD/450VDC .... 69¢; 3 for 1.95
45MFD/450VDC .... 79¢; 2 for 1.29
20MF/450V&20MF/25V .. 3 for 1.95
50 mf/350vdc FP ..... 5 for 1.00
30-15-10 mf/250vdc ..... 6 for 1.00
40-20mf/250-25vdc ..... 6 for 1.00
30-2x20mf/450-25vdc .... 3 for 1.00

ELECTROLYTIC CONDENSER KIT

POPULAR VALUES **25¢ ea.** lots of 15
Here is a handy assortment of 15 condensers for the serviceman. Only $3.75

TACHOMETER GENERATOR



MARK V STUD MTG
GENERAL ELECTRIC Part ±2CM5-AAK-20 **$4.98 ea.**
Write for quantity price

OIL CONDENSER SPECIAL

10 MFD 600 VDC $1.75 ea lots of 3
Case dimensions, not including insulators 4½H x 3¾W x 1¼"D
Smaller Quantities, special $1.98

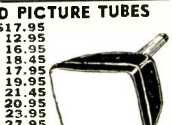
HI-FI POWER SUPPLY

SOLA constant voltage power transformer, mounted on chassis with (2) octal rectifier sockets.
NEW MFGRD BY DUMONT
Furnishes 400VDC/250MA to filter system, 2X6.3V/6A or 12.6VCT/6A and 6.3V/12A or 12.6VCT/6A ..... Special $13.98
With filter condensers, choke and rectifier tubes $18.98

INFRARED SNOOPERSCOPE

SEE-IN-DARK TUBE
Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—data & tube, ER ..... $4.98; 2 for $9.49
SNOOPERSCOPE PWR SUPPLY
.800VDC/35MA, Using Doubler Ckt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram ..... 5¢

866A KIT and XFORMER



2 Tubes, Sckts, xmfr, 115v60cyc Inpt, outpt 2.5vct/10A/ Hivins $4.98
DIODE PROBE TUBE Unexcelled for **No-Loss** VHF testing. Ultra-sensitive subminiature-envelope. **New.** w/data VR92 ..... 25c; 5 for $1.

CIRCULAR SLIDE RULE

Equiv to 12"—Only 2⅛" Radius. LAMINATED—Print Stays On! Mult. Div. Sqs. Cubes & Roots, Log. Decimal Equiv. 98¢

ONE YEAR GTD PICTURE TUBES

7JP4 ..... $17.95
10BP4 ..... 12.95
12" Glass 16.95
12" Metal 18.45
14" Rectangular .. 17.95
16" Glass 19.95
16" Metal 21.45
17" Rectangular .. 20.95
19" Round 23.95
20" Rectangular .. 27.95
21" Rectangular .. 28.95
24" Hytron 74.95
27" Hytron 89.95

SELSYNS

AY1 & AY5 28V/400 Cy or 22V/60 Cy. Each .. **$3.49**
AY20 Brand New 12.98
2J1H1 GE Selsyns .... Each 8.98
2J1F3 GE Brand New 9.75
C78248 Sync. Transmitter 115V 60 cy. .$30.00; 2 for $55.00
C78249 Sync. Diff 115V/60 cy 12.95
Sync. Repeater 115/60 cy Type 11-4 49.50

SOCKET ASSEMBLIES

½" JEWEL BAYONET SOCKET **29¢ ea** Lots of 5
Ordered in smaller quantity, Ea. 39c
1" JEWEL Candelabra (screw) base.... 55c
PANEL LAMPS ±40-41-44-46-47 10 for 79c

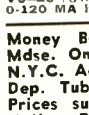
PALMER CLAW HAMMERS

85¢ Lots of 3
REGULAR $2.95
STD 16 OZ BRAND NEW
SMALLER QUANTITIES, EACH 98c
Stillson Wrench 1st Quality 8" 98c
Stillson Wrench as above 10" .$1.25
Vernier Caliper 5" capacity. Precision Vernier action $1.10

100 WATT SEC PHOTOFLASH KIT

Includes DX Flash Lamp Rated 150 Watt Sec. Flash Lamp Holder & 8" Reflector & Cable, Power Transformer & CD Flash Capacitors. Rated 100 Watt Sec. Resistors, Capacitors, Rectifiers & Sockets $29.98
"CEBE" I Photoflash. Lite & Compact, completely built. W/Case & Battery $49.98
AC PACK for "Cebe" I 10.95
WRITE FOR DETAILS & SPECIAL PRICES

METER SPECIALS



0-30 VDC "AN" 1.98; 2 for 3.25
0-60 AUC "AN" type Less Shunt .. 2.95; 2 for 5.00
0-150 VAC WSTGHS/2½/RND 60 cyc. 3.49
0-150 VAC/25-125cy/3½"Sq/RA35 . 5.98
0-1 MADC WSTGHS/3½"SQ/RA35 . 6.49
0-5a Microamps Weston 301 3½" Sq. 13.98
V1-20 +3WESTON/301/3"Sq/L.P.841 14.98
0-120 MA RF 3½" RND Weston 301 12.98

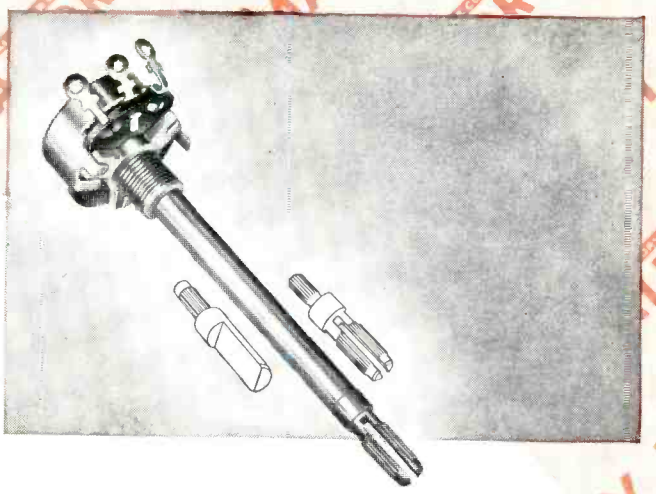
"TAB" THAT'S A BUY

Dept. 10RE — 111 LIBERTY STREET, NEW YORK 6, N. Y., U.S.A. — THAT'S A BUY

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges or 25% Dep. Tubes Gtd. via R-Exp. only. Prices subject to Change Without Notice. Phone Rector 2-6245.

PRINTED IN THE U. S. A. BY THE CUNEO PRESS, INC.

Depend on Mallory
for
Approved Precision Quality



"WE'LL HAVE IT BACK TOMORROW"

Mallory Dual Control Kits

Three kits of controls and switches, selected to meet varying requirements in different parts of the country, will serve 50 different models of radio and television sets. You pay only for the controls and switches; attractive 3-drawer metal cabinet is free of extra cost. Get details from your Mallory Distributor.

Fast turnover . . . more jobs done per day . . . that's the answer to greater profits for any service shop. Every minute saved is time available for turning out more work.

That's why Mallory Midgetrols® were designed for fast, easy installation in any set . . . TV or radio.

Round tubular shafts **can be cut accurately and quickly . . . fit split-knurl or flatted-type knobs.**

AC switches **can be attached instantly without disassembling the control.**

Unique design **simplifies inventory problems . . . makes them quickly available from your distributor.**

Midgetrols are engineered to match the electrical characteristics of the original equipment of any TV or radio set. They will give equal, and often better, performance and life than the original control.

For all your service work, use Mallory Midgetrols. They are the answer to fast installation . . . precision quality on every job.

This will save you time, too. Ask your Mallory Distributor for a copy of the Mallory Control Guide. It is a complete cross reference between set manufacturers' part numbers and the equivalent Mallory control.

P. R. MALLORY & Co. Inc.

MALLORY

CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES

APPROVED PRECISION PRODUCTS

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

A serviceman's *"best friend"* is an RCA Tube

An RCA Tube starts working for you from the instant the customer first sees the familiar red, black, and white carton. You have her confidence from the start, because she knows and respects the RCA trademark.

But the big payoff to you begins when the tube goes to work. For, experience has proven that the superior quality of RCA Receiving Tubes and Kinescopes is your best measure of protection against premature tube failures. With RCA Tubes, you can be sure the job is well done.

Helping you to safeguard your reputation is a vital, everyday service of RCA Tubes. And that protection is yours at no extra cost.

UNLOCK THE DOOR TO BIGGER PROFITS

Here's *your* key to better business... RCA's dynamic Dealer Identification Program. Ask your **RCA Tube Distributor** for your copy of the colorful, 16-page booklet "A Magic Pass-Key to Customer Confidence." It tells you how you can become a Registered Dealer . . . and get *extra* sales benefits.

RCA®

RADIO CORPORATION of AMERICA

ELECTRON TUBES

HARRISON, N. J.