You will remember the fabulous lamp—and how it served its master, Aladdin. Serving you, today, is a real "magic lamp"... the electron tube.

You are familiar with these tubes in your radio, Victrola radio-phonograph or television set... but that is only a small part of the work they do. Using radio tubes, RCA Laboratories have helped to develop many new servants for man.

A partial list includes: all-electronic television, FM radio, portable radios, the electron microscope, radio-heat, radar, Shoran, Teleran, and countless special "tools" for science, communications and commerce.

The electron microscope, helping in the fight against disease, magnifies bacteria more than 100,000 diameters; radar sees through fog and darkness; all-electronic television shows events taking place at a distance, radio-heat "glues" wood or plastics; Shoran locates points on the earth's surface with unbelievable accuracy; Teleran adds to the safety of air travel.

Constant advances in radio-electronics are a major objective at RCA Laboratories. Fully developed, these progressive developments are part of the instruments bearing the name RCA, or RCA Victor.

When in Radio City, New York, be sure to see the radio, television and electronic wonders on display at RCA Exhibition Hall, 36 West 49th Street. Admission is always free. Radio Corporation of America, RCA Building, Radio City, New York City 20, N.Y.
I BROKE INTO RADIO
BY PRACTICING IN SPARE TIME
WITH THE BIG KITS FROM N.R.I.

HOBERT HEAD

In the course you build this Tester with parts N.R.I. sends, you learn how to build neighborhood Radios and earn EXTRA money in spare time.

You get parts to build Radio Circuits; then test them: see how they work, learn how to build special circuits, how to locate and repair circuit defects.

LEARN RADIO
by Practicing in Spare Time

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to Be a Success in RADIO—Television, Electronics." See how N.R.I. gives you practical Radio experience at home—building, testing, repairing Radios with BIG KITS OF PARTS I send!

Many Beginners Soon Make Good Extra Money in Spare Time While Learning

The day you enroll, I start sending EXTRA MONEY manuals. You LEARN Radio principles from my easy-to-grasp, illustrated lessons—PRACTICE what you learn with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own full-time Radio Shop or a good Radio job!

Veterans
You can get this training right in your own home under G. I. Bill. Mail coupon for full details.

N.R.I. sends you Soldering Equipment and Radio parts; shows you how to do Radio soldering, how to mount and connect Radio parts; gives you practical experience.

You get parts to build this Vacuum Tube Power Pack, easy to change which gives you experience with parts of many kinds; learn to correct power pack troubles.

You get parts to build this AM Signal Generator gives you morevaluable experience. It provides amplitude-modulated signals for many tests and experiments.

LEARN RADIO
by Practicing in Spare Time

Future for Trained Men Is Bright in Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before because the Radio Repair Business is booming. Trained Radio Technicians also find profitable opportunities in Police, Aviation, Marine Radio, Broadcasting, Radio Manufacturing, Public Address Work. Think of even greater opportunities as public demand for Television, FM and Electronic series continues to grow! Send for free book now!

Our 34th Year of Training Men for Success in Radio

Mail Coupon for Rumble Learn and my 64-page book, "How to Be a Success in RADIO—Television, Electronics." I will supply 64 pages free, unobligated. Mail Coupon NOW in an envelope or paste it on a penny postal. J. E. SMITH, President, Dept. SEX, National Radio Institute, Pioneer Home Study Radio School, Washington 6, D.C.

Good for Both—FREE

See how to avoid military obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal.

NAME ________________________________ AGE ____________

ADDRESS ________________________________ CITY ____________ STATE ____________

Mail coupon to: J. E. SMITH, President, Dept. SEX
National Radio Institute, Washington 6, D.C.
War Surplus Bargains Sold As Used Unless Otherwise Specified!

(HRU) DC POWER SUPPLY
24-28 V, all 70-75 amp., 2000 watts. gasoline engine generator with electric starter. Power supply which can be used to operate 24-28 V equipment, start airplane engine, charge batteries, as a welding machine, lighting system, or for amateur radio station. 2½", 4½" x 2½", Wgt., 115 lbs. Includes 20 ft. plug-in cable. SPECIAL PRICE $72.00

INTERPHONE AMPLIFIER RL-7
Convert to high fidelity phone Amp. Complete with tube and connecting leads. 24 V. DC operation. Used but in good condition. PRICE $1.95

NEW WILLARD RECHARGEABLE STORAGE BATTERY
New 6 volt battery in spill-proof clear plastic case, housed in metal case for easy mounting. Applicable for a wide range of uses where battery power is needed. Shipped dry. Uses standard battery electrolyte available everywhere.

Price, each: $6.90 In lots of ten, each $5.35 Without metal case, each $3.35 In lots of ten, each $2.85

OXYGEN TANKS
These oxygen tanks, furnished from surplus aircraft, have a capacity of 500 lbs. pressure. Tanks 82. Complete with all necessary assembly. Size of tank 2½" x 6½" Wgt. 2 lbs.

PRICE $5.95

R-5 ARN-7 RECEIVER
Three bands, 200 to 1750 KC. Complete with 17 tubes required. This set is ideal for conversion to home broadcast Receiver addition to ham shack, etc. Reported sold for many times the price when brand new. A Receiver that would be hard to pick up at this price. ONLY $24.75

TERMS: CASH with ORDER

BARGAINS

BRAND NEW SCR-625 MINE DETECTORS
ATTENTION, PROSPECTORS, MINES, OIL COMPANIES, PLUMBERS, ETC.
Used by the Army to detect buried metallic mines. Its primary use suggests the location of underground or underwater pipes, cables and ore-bearing rock, the location of metallic fragments in scrap material, logs, etc., and the screening of personnel in plants for carrying of metallic objects. New, complete in original overseas packing container. Originally sold by War Assets for $16.00. The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products. $79.50

SCR-274N COMMAND SET
SCC-274N Transmitter and Receiver Assembly consists of 13 pieces which are: 4 Transmitters, 1 modulator, 1 remote control box, 2 Transmitters, 1 receiver and one antenna relay unit and it has its own individual dynamotor. Each receiver employs 12 W tubes. Each transmitter contains four 12 W tubes and has a voice frequency and crystal calibrated master oscillator, driven by two 1025 fluid oscillator tubes. 55-watt footout, with built-in silver plated variable induction antenna, including device. Dynamotor and final stage have simultaneous tuning and the idler is directly calibrated in MC. Transmitters have plugged-in capacity tanks, built-in high voltage and antenna switches. Transmitter furnishes plate supply for transmitters and is equipped with a dynamotor for high voltage. Also supplied is one antenna relay with built-in antenna meter. Transmitters make ideal VFO driver unit, easily converted to 500 W drive. Price approximately 500 lbs.

PRICE $24.75

TERMS: CASH with ORDER

AMERICAN SURPLUS PRODUCTS CO.
537 N. CAPITOL AVE. INDIANAPOLIS, IND.

RADIO ALTIMETER APN 1
A complete 460 ml. radio receiver and transmitter which can be reconditioned for home or commercial use. Tubes used and included: 4-12N1, 12L17, 2-6K6, 1-VR135, 2-725, 2-0084. Other components such as relay, 24 V. dynamotor, transformer, etc. The SCR-625 Mine Detector is said to make this a bay on which you can not go wrong. Commodities are shown in aluminum case. 18 x 27½".

PRICE $8.95

NAVY CRV-46151 AIRCRAFT RADIO RECEIVER
INCLUDING CASE $19.50

Four bands, including broadcast band (KCI). Giraffe is five stage super heterodyne with mechanical band switch or remote operated mechanical band change. Remote band changes and tuning controls included, making this set readily adaptable to mobile ham side. Powered from self-contained 24 V. DC dynamotor. The sets are complete with tubes, mounting rack and remote controls. No tubes or plugs.

SPECIAL BARGAINS

BRAND NEW NAVY SURPLUS HOSPITAL TENTS
New fire resistant, heavy canvas, 16' wide, 50' long. 12' apex, 4' side walls. Complete except poles. $150.00

ANTENNA RELAY UNITS
Switching Relay—Current Indicator BC-442-A. Consists of 50 mmfd vacuum condenser, 19.5 millivolt movement, current transformer and thermos couple (use with any rig).

PRICE $1.95

MODULATOR UNITS OUT OF SCR 274-N COMMAND SETS
Complete with 4 tubes and dynamotor. Good condition.

PRICE $295

TERMS: CASH with ORDER

AMERICAN SURPLUS PRODUCTS CO.
537 N. CAPITOL AVE. INDIANAPOLIS, IND.

RADIO-CRAFT for MAY, 1944
If you are already employed in the great Radio Industry, you know how great the demand is for trained, experienced technicians. You know how fast the field is growing and how important it is to keep up with new developments in F.M., Television and Electronics. The Radio Industry is alive with opportunities for the highly trained technician whose knowledge is up-to-the-minute. You can be an F.M. and Television Technician and get into the lucrative Radio Service Field, own a business of your own, if you prefer. National Schools of Los Angeles, for over 25 years a practical resident and home study trade school, has just been expanded to start its 1948 Training Program. This program, adapted to National's Master Shop Method Home Study Course, can qualify you to enter the exciting field of Radio and Television. For details of this Program fill out and mail the coupon below.

SHADE METHOD HOME TRAINING from a Technical Trade Resident School

National Schools bring its exclusive Shop Method of training right into your own home. You can learn the most up-to-date approved practical training projects, systems and circuits from the very beginning! In your spare time, here is trained-in-person instruction—experienced instructors working with students right in the show, NEW Television and Broadcast Studies and Experimental Laboratories of NATIONAL SCHOOLS—one of the very best educational centers in the world.

Take Advantage of these outstanding Features of National Schools' 1948 Training Program

1. New National's '48 Course is planned to prepare you for real success in Radio, Television, and Electronics.
2. Experimental equipment supplied with the Course has been completely revised to give you the most up-to-date practical experience with new circuits, new units, right in your own home.
3. New Television Lessons have been expanded to give you training in the latest developments in this important field.
4. The '48 Course includes a Professional Multitester (shown above) and is adapted for your use in spare or full-time radio work.
5. National Schools give you advanced training—the best to the better position in Radio, Television, Television.
6. You receive standard Experimental Equipment, including tubes and accessories, for building a fully modern, state-of-the-art radio, including Portable Receiver. All equipment becomes your personal property.
7. National Schools' 45 years of experience in Technical Training for modern stores and laboratories. All equipment used in the School is furnished you time-tested Training Equipment for a brighter future.

G.I. APPROVED

MAIL OPPORTUNITY COUPON FOR CONCOUNCIL

MAIL OPPORTUNITY COUPON FOR CONCOUNCIL

NAME: ____________________________ AGE: ____________

ADDRESS: ____________________________ CITY: ____________________________ STATE: ____________________________
What Does it Take to Wake YOU Up?

The tremendous growth of radio-electronics is so rapid and spreading in so many directions that the demand for technically qualified radiomen has created a condition wherein there are many more good jobs than there are capable men to fill them.

By the end of 1948 the total number of broadcasting stations (AM, FM and Television) will triple those since shortly before the war. Airlines and airports are rapidly installing new radio communications and radar equipment. Major railroads have adopted radio communications, as have large trucking and taxi cab companies. Manufacturing is at an all-time high as millions of home receivers, broadcasting equipment, etc., are being produced. Television receivers are in mass production.

All of this means that OPPORTUNITY IS HERE . . . Now!

Every page in this magazine could be filled with similar astounding facts concerning career opportunities available to trained radiomen. The point is, what are you going to do about it? Just figure out for yourself how many good jobs are waiting to be filled. You can't say, "I don't need more training." Every radioman needs to increase his technical knowledge if he wants to keep ahead of the competition that is bound to come . . . if he wants to go after—and get—the better jobs that offer good money and personal security.

If you have a commonplace job. If you have the ambition to hold a position of greater responsibility with higher pay . . . then a CREI spare time program for self-improvement will help you accomplish your ambition at this opportune time. It costs you nothing to read the interesting facts. Write today for the outline of CREI courses and the free booklet, "CREI Training for Your Better Job in Radio-Electronics."

If you have had professional or amateur radio experience and want to make more money, let us prove to you we have the training you need to qualify for a better radio job. To help us intelligently answer your inquiry—PLEASE STATE BRIEFLY YOUR BACKGROUND OF EXPERIENCE, EDUCATION AND PRESENT POSITION.

VETERANS: CREI TRAINING AVAILABLE UNDER THE "G. I." BILL.

CAPITOL RADIO ENGINEERING INSTITUTE

An Accredited Technical Institute

Dept. RC-5, 16th and Park Road, N. W., Washington 10, D. C.
To keep Ahead of the Game-

Keep up with PHOTOFAC'T Folders—
The Key to Profitable, Progressive Servicing!

Build the service data library that keeps you out ahead, abreast of all the newest radio developments. Have at your finger-tips the most accurate, uniform and practical servicing data—everything you need for easier, more profitable work. From the moment you get them, PHOTOFAC'T Folder Sets increase in value. They pile up increasing profit for you month after month, year after year. You can't afford to miss a single PHOTOFAC'T Set! Buy every issue regularly—it's the easy pay-as-you-use way to build the world's most practical service data library. Published 20 times per year. Price per Set, Only $1.50

Cumulative Index to All Post-War Receivers

New Cumulative Index to all PHOTOFAC'T Folders now available! Send for this invaluable guide to the most practical and useful data available on all post-war radio receivers. Locates in a jiffy the Folder Sets you need for quicker, more profitable work. Ask your parts jobber today for a FREE copy, or use coupon below.

THESE HOWARD W. SAMS BOOKS EARN MONEY FOR YOU EVERY SINGLE DAY

**RADIO RECEIVER TUBE PLACEMENT GUIDE**


**PHOTOFAC'T VOLUMES**


**1947 AUTOMATIC RECORD CHANGER MANUAL**

Nothing like it! Complete, accurate data on over 40 post-war models. Exclusive exploded views, photos from every angle. Gives full change cycle data, information on adjustments, service hints and kinks, complete parts lists. PLUS complete, accurate data on leading Wire, Ribbon, Tape and Paper Disc Recorders! 400 pages; hard cover; opens flat. Don't be without this manual. ONLY $4.95

Mail This Order Form to HOWARD W. SAMS & CO., INC.

3924 E. Washington St., Indianapolis 7, Indiana.

Name ____________________________

Address __________________________

City __________________ State ________

Send $18.39 each for VOL. 1, 2, 3.

SEND FOR THE FREE Cumulative Index to PHOTOFAC'T Folders covering all post-war receivers up to the present. You'll want this valuable reference guide.

Mail This Order Form

DIAL CORD STRINGING GUIDE

The book that shows you the one right easy way to string a dial cord. Here for the first time, in one handy pocket-sized book, are all available dial cord diagrams covering over 2300 receivers, 1938 through 1948. Makes dial cord restringing quick and simple. Pays for itself in time saved on a single dial cord repair job. A "must" for every service bench and tool kit. Order your copies now. ONLY $1.00

SEND $1.50 per set for...

- PHOTOFAC'T Sets Nos. 1 through 30.
- PHOTOFAC'T Sets Nos. 31 through 59.
- PHOTOFAC'T Sets Nos. 60 through 80.
- PHOTOFAC'T Sets Nos. 81 through 100.

- SAMS TUBE PLACEMENT GUIDE(S) at $1.25 per copy.

- SAMS' 1947 AUTOMATIC RECORD CHANGER MANUAL(S) at $1.95 each.

- SAMS' DIAL CORD STRINGING GUIDE(S) at $1.00 per copy.

Name ____________________________

Address __________________________

City __________________ State ________

Mail This Order Form

RADIO-CRAFT for MAY, 1948

Howard W. Sams & Co., Inc.
Indianapolis 7, Indiana

Photofact Service
"The Service that pays for itself over and over again"
MODEL 666-HH
VOLT-OhM-MILLIAMMETER

This new "hand-size" Triplett tester packs a laboratory of versatile service into a size that fits your hand and weighs only 1/2 lbs.

In a handsome, streamlined, molded case, Model 666-HH has greater scale readability, new banana-type jacks, an assurance of low contact resistance, greater stability evolved through special new type resistors—plus other features. Delivers better results than many larger, costlier testers. It's ideal for servicemen, amateurs, engineers and technicians.

RANGES
D.C. VOLTS: 0-10-50-750-1000-2500 at 1000 ohms/Volt.
A.C. VOLTS: 0-10-50-750-1000-2500 at 1000 ohms/Volt.
D.C. MILLIAMPERES: 0-10-100-500 at 250 millivolts.
OHMS: 0-2000-400,000.

U.S.A. Dealer Net $22.00

For descriptive Material write Dept. LS

Solve Your Service Problems Better—With TRIPLETT

Model 3432—Illuminated dial Test Oscillator.
U.S.A. Dealer Net $63.25

Model 3480—Combination Tube Tester Volt-Ohm-Mill-Ammeter.
U.S.A. Dealer Net $49.75

Model 625-NA — Wide Range Volt-Ohm-Mil-Ammeter.
U.S.A. Dealer Net $45.00

Model 3413—Tube Tester, with Speed Roll chart.
U.S.A. Dealer Net $60.75

TRIPLETT ELECTRICAL INSTRUMENT CO. • BLUFFTON, OHIO
In Canada, Triplett Instruments of Canada, Georgetown, Ontario.
RADIO

big, powerful

easy

tical way.

Radio

eate

Profitable Radio Service

11

bel pay lob

and

parts

Radia taro

perform

-CRAFT

interesting

...I

ting

vision."

I

big

EEp,

Radio

HOW

art

na

1E1

arto

build

1

step

send you.

It

big

art

rata

1948

to work

rata

for

their

asce

Television.

is

monthly

To Make Money

Sprayberry

I'll

can

go

a

professional

and

Television.

is

nothing

VETERANS.

and

Public Laws

IF YOU

WANT TO LEARN

RADIO!

I TRAIN YOU RIGHT BY SENDING YOU 8 BIG KITS OF

RADIO EQUIPMENT INCLUDING A POWERFUL 6 TUBE

SUPERHET RECEIVER AND 16 RANGE TEST METER!

Get these 2 big books FREE...

soon after you start I send you my famous BUSINESS
BUILDERS that help you earn EXTRA CASH
setting and doing neighborhood Radio Service jobs
while learning. You couldn't pick a better time to get
into Radio. The Radio Repair Business is booming!
Good Radio Service and Repair Shops are needed
everywhere as millions of new sets are in use. Trained
men are wanted for opportunities in Police, Aviation and
Marine Radio, F. M. and Standard Broadcasting and
Television. Manufacturers are looking for men who
know Radio as production reaches new peaks. Get
the facts about your future in radio mail the COUPON TODAY for my FREE BOOKS'...

By Working with your Hands!

Learn how to build-test-repair radios

Sprayberry Training costs surprisingly little! Easy
monthly payments, if desired. Everything you need
is furnished — nothing else to buy. With Sprayberry
Training to back you up, you will be able to step
into your own profitable Radio Business or
use your new training for a job. I have
trained thousands of successful Radio men — and
I can help you, too. Get the facts about Sprayberry
training — it's your first step to success, security
and a higher income in a field where you really
enjoy your work. Fill out and mail coupon TODAY.
I'll rush my two FREE books to you by return mail.

Veterans:

Sprayberry Academy of Radio

F. L. SPRAYBERRY, President

Room 205B, Sprayberry Bldg., Pueblo, Colorado

Rush coupon today!

Sprayberry Academy of Radio

F. L. SPRAYBERRY, President

Room 205B, Sprayberry Bldg., Pueblo, Colorado

Please rush my free copies of "How To Make Money In
Radio, Electronics and Television" and "How To Read Radio
Diagrams and Symbols." No salesman will call.

Name:____________________Age:______

Address __________________________

City and Zone ________________________State _____________

[ ] Check here if a veteran

(Mail in an Envelope or Paste on Penny Postcard)
HEADSETS
Dynamic micros and headband combination. A high
quality, efficient unit, used in B-19 tank. Grommets
and plastic complex, now...

TEST SET 159TPX
CATHODE RAY TUBES
56P1...$1.20
6PP7...$1.75
6PPL...$1.20
3JP2...$4.00

RADAR • AIRCRAFT
AMATEUR • INDUSTRIAL

24-Volt Filament
Transformers
No. 2217, Input 110 volt, 60 cycles. Output
24 volt @ 3 amp. Size 3 x 3½ x 3½ (not shown)
Price...

MICROWAVE TUBES
(Microwave)
Tube Price

Microphone Tube Price

Relays
BO 4105, DPDT, 18-28 volts, contains 10 amps...

Silver-Mica Button Capacitors
(Erie, Centralia) .50¢ per 100

Motor Drive Switch
Switch operates at 1800 rpm, using internal
DC motor, switch to DPDT, and was originally designed
for automatic switching of Yagi radar antennas...

COMMUNICATIONS EQUIPMENT CO.
131 C. Liberty St., New York City 7, N. Y.
Digby 9-4124

All merchandise guaranteed. Mall orders promptly filled. All prices, F.O.B. New York City.
Send Money Order or Check. Shipping charges sent C.O.D.
DeFOREST'S PROJECTOR

This have

to give you the experience and confidence needed for a responsible, Good-Pay Job, or to Start a Business of Your Own!

Here is a REAL opportunity field for YOU... when you are a trained Radio-Electronics man! Just think of the tremendously exciting future ahead of P.M. Radio, Aviation and Broadcast Radio, Sound Motion Picture Equipment, Servicing and Sales of Radio Equipment, etc. Put yourself in this picture... See how you can benefit from a PRACTICAL training in this fascinating work! Think, too, of the coming possibilities ahead of Radar, Fascimile and Television.

Send TODAY for the interesting, opportunity-revealing book, "Victory for You!" See how others probably no more talented or ambitious than you, have advanced in earning power after this training... how YOU can do it too! Mail the coupon NOW!

WITH THE HELP OF

A EIGHT Big Kits of Actual "Learn-by-Doing" Radio Parts and Assemblies with which you make 133 fascinating SHOP METHOD EXPERIMENTS in your own home! Imagine building 7 different Radio Receivers that operate!

B A 16 mm Home Movie Projector and Twelve Reels of "Learn-by-Seeing" Home Movie Films... for picture-clear, fast understanding of Radio Fundamentals!

C Modern, well-illustrated, Loose-leaf Lessons, prepared in clear, simple, understandable language... to guide you throughout your training!

THEN GET THE HELP OF OUR EFFECTIVE EMPLOYMENT SERVICE

NO PREVIOUS RADIO OR ELECTRICAL EXPERIENCE NECESSARY

DeForest's Training, Inc. provides every major home study aid to help you learn Radio-Electronics rapidly and thoroughly... to give you the experience and confidence needed for a responsible, Good-Pay Job, or to Start a Business of Your Own!

A REAL opportunity field for YOU... when you are a trained Radio-Electronics man! Just think of the tremendously exciting future ahead of P.M. Radio, Aviation and Broadcast Radio, Sound Motion Picture Equipment, Servicing and Sales of Radio Equipment, etc. Put yourself in this picture... See how you can benefit from a PRACTICAL training in this fascinating work! Think, too, of the coming possibilities ahead of Radar, Fascimile and Television.

Send TODAY for the interesting, opportunity-revealing book, "Victory for You!" See how others probably no more talented or ambitious than you, have advanced in earning power after this training... how YOU can do it too! Mail the coupon NOW!

E. B. DEVRY, President
DeFOREST'S TRAINING, INC.
2335-41 North Ashland Ave., Dept. RC-E5
Chicago 14, Illinois, U.S.A.

Send FREE "VICTORY FOR YOU" BOOK, showing how I may make my start in Radio Electronics.

Name: ____________________________ Age: _______
Address: ____________________________ Apt: _______
City: ____________________________ State: ____________________________

If under 16, check here. If a discharged Veteran of World War II, check here.
MAY • 1948

Editorials: Appliqued Radio Circuits ........................................ Hugo Gernsback 17
Radio-Electronics Monthly Review ........................................ 18, 19
Radio Thirty-Five Years Ago .................................................. 80

Radio and Electronics
Electret Construction .......................................................... Victor H. Laughter 20
Electronic Visibility Meter .................................................... S. R. Winters 22
12,000-Tube Electron Beam (Cover Feature) ......................... A. Pascale 28

Amateur Radio
Efficient 100-Watt .............................................................. E. F. Harris, W8JSJ 24
WWV Schedule Changes ..................................................... 71

Servicing
Radio Set & Service Review (Midget Television Preamplifier) .... 31
Servicing Wind Generators ................................................... Max Alth 33
Serviceshop Tests Serviceshops ............................................. Eric Leslie 66
Radiomaton on Wheels ........................................................ Richard Laurence 78

Test Instruments
Miniature 3-Use Fixed Oscillator ........................................... William Lyon McLoughlin 26
Laboratory-Type Oscillators .................................................. William B. Miller 27
Wobbulated Signal Generator ................................................. George W. Schultz 34
Push-Button Signal Generator ............................................... Alfred Hass 37

Sound
Noise Reduction in A.F. Circuits ............................................. I. Queen, WZOUX 23
Phase Inversion Circuits ..................................................... J. W. Straede 32
High-Fidelity Amplifiers ..................................................... R. F. Scott 36
Volume Expander .................................................................... 75

Construction
Light with a Memory ............................................................. M. Gordon Moses 30
Cheap and Effective Noise Limiter ......................................... Otto Wooley, WOSGG 80

Departments:
Transatlantic News .............................................................. Major Ralph W. Hallows 38
New Radio-Electronic Devices .............................................. 40
The Question Box .................................................................... 42
Radio-Electronic Circuits ....................................................... 44
Technotes ............................................................................... 47
Try This One ........................................................................... 50
New Radio-Electronic Patents ................................................. I. Queen 54
World-Wide Station List ....................................................... Elmer R. Fuller 63
Communications .................................................................. 83
Book Reviews ........................................................................ 87

ABC PAID CIRCULATION 6 MONTHS PERIOD TO DEC. 31, 1947—102,688.
PRINTED FOR MAY ISSUE—151,000.

RADCRAFT PUBLICATIONS, INC., Hugo Gernsback, President; M. Harvey Gernsback, Vice President; G. Aliquo, Secretary

Editorial: Copyright, 1948, by RADCraft Publications, Inc. Text and illustrations must not be reproduced without permission of Copyright owners.

In Our Next Issue
SPECIAL ARTICLES ON ALL PHASES OF FM—THEORETICAL AND PRACTICAL CONSTRUCTION AND SERVICING, FEATURE THE JUNE ISSUE.

On the Cover:
International Business Machines' 12,000-tube computer which does the work of more than 1,000 mathematicians.

Chromatone by Alex Schomburg from Harris & Ewing photo.

Wobbulated Laboratory Test Radioman Servicing WWV Efficient Electronic Visibility Meter Electret Construction, Radio

MAY WATCH FOREIGN AGENTS: the
When
Contents
RADCRAFT ABC PAID Communications World-Wide Try Radio-Electronics The Transatlantic Departments:
Light with Sound Push-44

Radio- Electronics
Edited by Hugo W. Watts

Radio- Electronics
The Cover:

HUGO GERNSBACK
Editor-in-Chief
FRED SHUNAMAN, Managing Editor
M. HARVEY GERNSBACK, Consulting Editor
ROBERT F. SCOTT, WPW6G, Technical Editor
ANGIE PASCALE, Production Manager
I. QUEEN, WZOUX, Editorial Associate
ELMER FULLER, Shortwave Editor
G. ALIQUO, Circulation Manager
JOHN J. LAMSON, Advertising Director
ALFRED STERN, Promotion Manager

In Our Next Issue
SPECIAL ARTICLES ON ALL PHASES OF FM—THEORETICAL AND PRACTICAL CONSTRUCTION AND SERVICING, FEATURE THE JUNE ISSUE.

On the Cover:
International Business Machines' 12,000-tube computer which does the work of more than 1,000 mathematicians.

Chromatone by Alex Schomburg from Harris & Ewing photo.
NOW! FAMOUS $500 TELEVISION COURSE YOURS WITH PHOTOFACT FOLDERS!

Get Ready to Make Big Money in Television Servicing with This Practical, Successfully Proven Instruction!

NOW! AT NO EXTRA COST TO YOU—you can have the nationally-famous $500 Saunders’ Television Course! It’s the world’s finest training—practical down-to-earth training that actually prepares you for Television and keeps you way out ahead of the game. Here’s the first real help in Television for Servicemen—brought to you exclusively by PHOTOFACT and PHOTOFACT alone! If you want to stay in Radio Servicing, you can’t afford to miss a single installment of this amazing Television Course! Read every word of this announcement and then ACT!

Not Just a Book — A Complete Training Course in Television!

You get the actual $500 Television Course, exactly as taught in the nationally-famous Saunders Radio & Electronics School at Newton, Mass. We literally bring this course to you in print—transcribed word for word from the original lectures, supplemented by graphic training aids, exclusive PHOTOFACT “exploded!” views and hundreds of visual illustrations, prepared under Mr. Saunders’ personal supervision. This is the same course attended by hundreds of established service technicians and by service personnel of leading set manufacturers—the same $500 course!

First Installation Appears in PHOTOFACT Set No. 38!

The Television Course will appear in regular installments in each PHOTOFACT Folder Set, beginning with Set No. 38. Each installment will include the right amount of material so that you will be able to digest it easily and completely between issues. Instruction will be kept up-to-date and will include the latest information promptly as it is available on the subject. There’s no need to wait now for books that will never cover the ground adequately, or to buy books that are obsolete already. Be sure to order PHOTOFACT Set No. 38 now—and begin to qualify yourself for Television!

Get Television Training Worth $500—Plus Incomparable Photofact Service Data at the Cost of PHOTOFACT Alone!

Here’s the chance of a lifetime that really fits you for a profitable, successful career in Television servicing. Just think of it—you get the world’s finest radio service data in PHOTOFACT—at only $1.50 per set—and at the same time you train practically and successfully for Television with the finest course available in the country—a course worth $500.00 that costs you nothing extra!

$500 TELEVISION COURSE BEGINS IN SET NO. 38. ORDER TODAY!

Mail This Order Form to your local Paris Distributor, or to Howard W. Sams & Co., Inc., 2924 E. Washington St., Indianapolis 7, Ind.

My (check) (money order) for $1.50 enclosed.

☐ Send PHOTOFACT Folder Set No. 38, including the first installment of the famous $500 Saunders Television Course.

Name ______________________________
Address ______________________________
City __________ State __________

RADIO-CRAFT for MAY, 1948
**WE GUARANTEE SATISFACTION**

**RADIF CONTROLLED BOMB-FIN**

$9.85

This unit was originally used to control a guided bomb; it contains a 24-volt Willard rechargeable battery pack, which operates a gyroscope and low geared reversible motor. The unit also contains a precision built 5-tube RF Receiver complete with dynamotor. Shipped express charge collect.

**RCA ANTENNA REEL**

MODEL M-120411

$1.49

A hand operated antenna reel, for reeling in and out trailing antennas. Mfrd. by Continental Radio & Television Corp. under RCA license. Add 20c to cover postage & handling.

**PHANTOM ANTENNA 85F**

A transmitting antenna, for use on approximately 450 MC. Complete with standard coax connector. A weatherproof unit. Add 25c to cover handling and postage.

**COMMAND RECEIVER**

BC454 $3.95

BC455

Your choice of either of these two famous Command Set Receivers. BC454 has range 3 to 6 MC or the BC455 6 to 9.1 MC. These sets are used, but in good condition. They are complete with tubes. Price—3.95 each. (Shipped express, charges collect)

**ANTENNA LOOP 21-A**

LP-21-A

$5.95

Only

Used primarily on aircraft & Marine ADP Systems. Loop LP-21-A contains an electric motor and selvage. These loops have been removed from salvage aircraft, but are guaranteed to be in excellent working condition. Shipped Express Collect.

**RADIO COMPASS 433G**

$17.25 each

RS433G or 433G, either of these Radio Compass Receivers complete with tubes. Ideal for conversion for home reception. Used but good. A real buy at only $17.25. (Shipped express, collect)

**500' Telephone Wire**

Wire now only

$2.25

8 conductor insulated copper and steel telephone wire. It is of copper for conductivity and steel for strength. Worth at least 3c per foot, yet due to an exceptional buy we can now offer it at less than 1c per foot. (Shipped express charges collect)

**1300' Rubber Covered Wire**

Only $18.00


**MT53B ANTENNA UNIT**

ONLY $1.95

This unit contains a single pole double-throw vacuum switch, which is capable of handling RF potentials as high as 20 KV. When used in DC circuits, the switch will handle over 1 ampere at 5 KV. (These are Manufacturers Spots.)

The case is ideal for a portable mobile receiver or a small transmitter, as your control panel can be mounted behind the hinged door for protection. The case also has a built-in high voltage insulated antenna post. Dimensions are 6 1/2" x 7". Worth many times the price. Add 40c to cover postage and handling.

**M. SILVERSTINE CO.**

6532 East McNichols Road Detroit 12, Michigan

"Seven Acres of Surplus"

N. SILVERSTINE CO.

6532 EAST McNICHOLS ROAD DETROIT 12, MICHIGAN

[Radio-Craft] for MAY, 1948

12
Mr. Radio Dealer—

You're in the Driver's Seat!

Steer Your Customers STRAIGHT... with the

FM

Pilotuner

Where's FM headed, Mr. Radio Dealer? YOU decide.

WANT TO MAKE A FIASCO OF FM? ...Then—go ahead ... SELL second-rate, "almost-good-enough" FM equipment. But—be prepared for customer squawks, dissatisfaction ... a bad name for FM ... migraine headaches for yourself!

WANT TO "GO TO TOWN" WITH FM? Then—use the sensational FM PILOTUNER, as your standard of comparison, in testing all FM equipment. The Pilotuner has the last-detail quality ... the thorough integrity ... that do credit to FMI

The PILOTUNER was a tremendous hit in '47 ... With new FM stations opening at the rate of fifty a month, it's headed for an even greater '48! Stock it—feature it—get YOUR share of the big new business, new traffic! Send coupon for details.

PILOT RADIO CORP., 37-06 36th St., Long Island City, N.Y.

Send me full information concerning the FM PILOTUNER.

NAME

ADDRESS

CITY .. ZONE NO. .. STATE

PILOT RADO CORPORATION

37-06 36th ST., LONG ISLAND CITY, N.Y.

Makers of PILOTONE RECORDS • PIONEERS IN FM & TELEVISION

RADIO-CRAFT for MAY, 1948
**METERS — Brand new and all checked for accuracy**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-500 MA DC 3/4&quot; round NX35 Westinghouse</td>
<td>$3.00</td>
</tr>
<tr>
<td>0-5 Amps RF 3/4&quot; round NT33 Westinghouse Internal TC</td>
<td>$4.50</td>
</tr>
<tr>
<td>0-3 Amps RF 2 1/2&quot; round NT33 Westinghouse, loss TC</td>
<td>$3.50</td>
</tr>
<tr>
<td>0-10 &amp; 0-250 MA DC combination round NX33 Westinghouse</td>
<td>$2.50</td>
</tr>
<tr>
<td>0-10 &amp; 0-250 MA DC combination round DW41 G.E.</td>
<td>$2.50</td>
</tr>
<tr>
<td>0-2 volts full scale 2000 volts/volt Volume Level meter, Westinghouse, round 2 1/2&quot;</td>
<td>$3.00</td>
</tr>
<tr>
<td>0-100 MA DC 2 1/2&quot; round MD22901 McClinckox</td>
<td>$2.50</td>
</tr>
<tr>
<td>0-3 MA DC 3 1/2&quot; square 327A Triplott</td>
<td>$4.50</td>
</tr>
<tr>
<td>0-500 Volts AC 3 1/2&quot; square 327A Triplott</td>
<td>$6.00</td>
</tr>
<tr>
<td>0-2 Volts AC rectifier type 10,000 volts/volt 327A Triplott 3 1/2&quot; square</td>
<td>$15.00</td>
</tr>
<tr>
<td>0-50 MA AC 327A Triplott 3 1/2&quot; square</td>
<td>$7.50</td>
</tr>
<tr>
<td>0-30 amps AC 3 1/2&quot; round case, 311JP Triplott</td>
<td>$6.00</td>
</tr>
</tbody>
</table>

**RELEYS — All Brand New**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>110-60 cycle Plunger type for door lock</td>
<td>$0.50</td>
</tr>
<tr>
<td>R8M DPDT 110 x 60 cycle, make before break</td>
<td>$0.75</td>
</tr>
<tr>
<td>Relay, 6 MA 5000 Ohm DC resistance, SPDT</td>
<td>$0.65</td>
</tr>
<tr>
<td>Leach type 1127-A 110 volts 60 cycle DPST</td>
<td>$1.50</td>
</tr>
<tr>
<td>Automatic Electric Co. DPDT 24 v. DC</td>
<td>$6.00</td>
</tr>
<tr>
<td>4 amp silver tungsten Contacts</td>
<td>$4.00</td>
</tr>
<tr>
<td>Automatic Electric Co. Delay relay, 20 amp, silver tungsten contacts</td>
<td>$4.00</td>
</tr>
<tr>
<td>Starter relay, 20 volt operated, heavy duty construction</td>
<td>$0.50</td>
</tr>
<tr>
<td>Switch, pushbutton type DPST or on/off type, to fit standard switch box, 10 amps at 250 volts</td>
<td>$0.25</td>
</tr>
<tr>
<td>Switch, toggle type, handle DPDT, heavy duty contacts</td>
<td>$0.35</td>
</tr>
<tr>
<td>Leaf type switch, 4 poles, single throw, single hole mounting</td>
<td>$0.25</td>
</tr>
</tbody>
</table>

**TRANSFORMERS**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Transformer, 110 volts 60 cycle input; output being two secondary, each giving 14 volts @ 11 amperes, which can be used alone, in parallel, or in series for various voltage and current combinations. Size about 3 1/2&quot; x 3 1/2&quot; x 1/2&quot;, high efficiency, used for beam antenna rotation, 7 lbs. Manufactured for &quot;Eico Radio&quot; Corporation</td>
<td>$5.95</td>
</tr>
</tbody>
</table>

**CONDENSERS**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornell-Dubilier—240 F@ 1000 V DC, 1&quot; Diameter</td>
<td>$1.35</td>
</tr>
<tr>
<td>General—490 F@ 500 V DC, 1&quot; Diameter</td>
<td>$1.95</td>
</tr>
<tr>
<td>Electrolytic 40 F@ 400 V DC, 1 1/2&quot; Diameter</td>
<td>$1.00</td>
</tr>
<tr>
<td>Electrolytic 40 F@ 400 V DC, 1 1/2&quot; Diameter, alumi-num can</td>
<td>$1.00</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
<tr>
<td>Electrolytic, 20 F@ 500 V DC, 1/2&quot; Diameter, alu- minum can</td>
<td>$1.50</td>
</tr>
</tbody>
</table>

*Do not fail to closely examine this list of bargains. We believe that every item listed below is a sensational value that soon can never be repeated. All equipment advertised herein is unconditionally guaranteed to the customer's satisfaction to this extent: Return any item advertised within five days after delivery for full refund except transportation charges (both ways).*
RADIO MODULATOR

BC-424, made by Westinghouse, 110 volt 60 cycle AC operated. Size 9" x 14" x 9" high, weight about 30 lbs. packed. Has National Velvet Vernier Dial, Thordarson power transformer and choke, tubes used and included are 68I, 6J7, 6J7, 5W4 and 955. Frequency about 190 megacycles. Comes with heavy steel case............$22.50

Microswitch, completely weather-proofed metal-cast or cased, rated 15 amps at 115 volts, normally open type, plunger has override feature............NEW $0.35

Battery type BA-38, 103.5 volts, used in Handie-Talkie, Mine detectors, or for any purpose where low current drain is required. Size 1" x 1 3/4" x 11 1/2" long. Outdated, but tests O.K.............NEW $3.00

Tube socket, RCA, for 866 or similar type tube bases............NEW $0.35

Tube socket, wafer octal type, excellent mica insulation............NEW $0.10

Tube socket for 813 type tube, Johnson type 237............NEW $0.60

Tube socket for Acorn type tubes, made by Millen Co.............NEW $0.20

Tube socket, porcelain octal type, less mounting ring............NEW $0.10

First IF transformer for BC348 type receiver, 915 Kilocycles............NEW $0.00

Ohmite tap switch, model 111, 9 taps, non-shorting, will handle 10 amps at 115 volts............NEW $0.35

Kit of potentiometers, twenty-five assorted sizes carbon and wire-wound............NEW $2.25

Resistor, voltmeter multiplier type, rated at 2 megohms 2 kilovolts insulation, 1 MA maximum current, about 1" diameter x 5 1/2" long, mounts in clips............NEW $0.75

Resistor, 100 watt type, 5 sections having 7500, 3000, 23, 23 and 750 ohms (total of 11,269 ohms) resistance. 1/2" diameter by 8 1/2" long............NEW $0.35

Cord CD-132, has PL-55 type plug and 9" cord, with spade type lug tips............$0.35

Sylvania type 1N26 crystal............NEW $0.35

Resistor 20 watt, one-half ohm............NEW $0.10

Fuse holder for type 3AG fuses............NEW $0.10

Amphenol co-axial chassis connector, new type 83-1R............$0.40

Amphenol co-axial junction connector, new type 83-1J............$0.40

Amphenol co-axial angle plug adapter, used type 83-1AP............$0.40

Connector, bakelite insulation, male and female sections, 6 pin polarized, Price............$0.50

Canvas bag, moisture & fungus proofed, with carrying strap, leather re-enforced corners, weight 3 lbs, size 9" x 14" x 12" high. Ideal for tool case, for sportsmen, etc............NEW $1.00

HAND SET 5-5-10-G—Sound powered telephone. No batteries required for operation: connect to any two wires, wire fence and ground, etc., by convenient clips included. Price............NEW $9.50 each

ARGON BULBS—2 watt ideal for transmitter tuning, night light, etc. Price 35c each. $3.00 per carton of ten.

BC-406-A Receiver—Brand new. Manufactured by Western Electric, 165 to 205 mc operation. IF frequency 19.5 mc, IF band width .7 mc. Easily converted for operation on other ultra-high frequencies. Operate from 110 V., 60 cycle, A.C. Worth many times this amount for tubes and parts. Tubes—one 574, two 6817, four 65K7, one 6N7, five 954's, one 955, one 6F7, one 6N7. Also contains small 110 V. operated motor............$34.50

Interphone Amplifier, size 7" x 9" x 6" high, weight about 12 lbs. packed. Contains 65J7 and 6V6 tubes, 24 volt dynamotor. Use for phono or intercom amplifier............$37.50

Antenna Tuning Unit BC-729-C, size about 9" x 9" x 19" overall, weight 24 lbs. packed. Contains 0-15 amphere RF ammeter 3 1/2" square case, Tuning Inductance, having 60 turns heavy wire on 3/5" dia., coil form, completely variable, also split stator coil with swinging link, vernier dial and revolution counter, will easily handle 500 watts of RF power. Will match up any length antenna to any common frequency for amateur transmitters............$95.00

ESSE Radio Co

130 W. New York St.
Indianapolis 4, Ind.

ESSE Radio Co

Radio Craft for May, 1948
Traffic is heavy under the street, too

Surely the busiest thoroughfare in the world is a telephone cable. But it is more than "telephone"; for these thousand or more wires, carrying sound and pictures at lightning speed, are highways for many different services.

Each one of these presents its own problems to Bell Laboratories scientists and engineers: for the telephone differs from television, and television differs from a radio program. And yet they have an essential unity: they involve transmission of alternating currents, with frequencies from zero up to several million cycles. Each calls for new thinking, new ideas, new goals of accomplishment.

The diversity of the cable's many services speaks for the unity of Bell Laboratories' purpose. That is, to know the theory of communication so thoroughly, to practice the art so skilfully, that any transmission of sight or sound can reach its destination clearly, quickly, economically.

**TELEPHONE**  
**TELEVISION**

**RADIO PROGRAMS**  
**AIR TRAFFIC CONTROL**

**TELETYPE**  
**TELEMETER**

**PHOTOGRAPHS**  
**WIRED MUSIC**

**FACSIMILE**  
**ALARM SYSTEMS**
APPLIQUÉD RADIO CIRCUITS

The next great radio advance is now in the making...

By HUGO GERNBSACK

There remains little doubt that the next few years will see a complete revolution in the building of our radio receivers, be they AM, FM or television.

It is certain that the wired radio receiver with its hundreds of wires and soldered connections will soon be completely outmoded.

The reason for this is elementary—from an economic standpoint wired and soldered radios are already dated, due to the tremendous labor costs. Then, too, receivers tend to become more complex as time goes on and the vast multiplicity of soldered connections no longer are workable. Servicing such sets is becoming more and more of a nightmare for that reason. Tracing circuits during trouble shooting is often a hopeless procedure and as the art progresses it becomes more hopeless both physically and economically.

At the present time top radio receiver manufacturers are racing toward the day when the wired component receiver will be replaced by something much simpler, which is cheap to assemble, and which will make servicing in the future a picnic—compared to our present receivers.

As reported in these pages repeatedly, the future receiver will either use a printed circuit in which the connecting wires are printed on a solid sheet of insulating material, or applied by some similar means. There are—and we mention only a few—the following:

Instead of printing the circuit it can be electroplated; it can be applied by the so-called silk screen process; or it can be done by spraying molten metal onto the surface.

Such new circuits also include the various resistors which are no longer solid blocks, but instead lines printed, sprayed, or applied to the surface by other means. An entire new art is springing up along these lines.

So far no “printed” radio sets have been produced for public consumption in the United States, but during the war there was great activity in this new art.

Dr. Cledo Brunetti, of the Bureau of Standards, outstanding exponent of printed circuits, produced many war radio sets where small size and guarantee of absolute performance were the prime considerations. These, however, were mostly along the miniature radio receiver lines. Standard receivers for home use, however, have so far not been produced.

In England one or two manufacturers have produced such radios, particularly those of the sprayed-circuit variety.*

Up to now there has not been an all-embracing term in the English language which would do justice to this new and very important art. Not all circuits are printed, nor are they plated, nor sprayed. Yet they all come under the same general classification.

We therefore advance the term “appliqué” (from the French)—rhymes with bouquet. The English dictionary defines the term as follows: “Appliqué—decora-

*See RADIO-CRAFT, September, 1947, issue.

RADIO-CRAFT for MAY, 1948 17
COORDINATION of the efforts of radio technicians' associations is being undertaken under the leadership of the Federation of Radio Servicemen's Associations of Pennsylvania, the country's largest organization of radio technicians. Originating at a meeting held at Harrisburg in the early spring, the plan proposes to coordinate the objectives of member associations, to solicit the cooperation of all servicemen's associations with whom the Federation is in correspondence, and finally to invite participation in the organization's efforts to improve radio receiver servicing by servicemen and servicemen's associations wherever situated. The secretary of the Federation, Mr. John Rader of 704 Walnut St., Pittsburgh, Penna., was appointed secretary of the coordinating committee. Any interested individuals or organizations are requested to contact him.

The move toward coordination by the FRAS was prompted by a review of the opinions the radio technicians representing more than 16 states at the Philadelphia convention last January.

MICROWAVE GENERATION with conventional tubes was demonstrated by DeMornay Budd Inc. at the recent Institute of Radio Engineers Convention. Development is expected to expand vastly the use of microwave equipment, which has been hampered by the necessity of designing it around the scarce and expensive klystrons and magnetrons.

Previously, ordinary tubes, available for other purposes, have been considered unsuitable for microwave generation because of excessive transit time and grid conductance. This development overcomes these two problems by making the transit time between cathode and plate correspond to some multiple of 360 degrees phase shift. An alternate development achieves similar results by making the transit time correspond to any odd number of half periods of oscillation.

RADIO-ELECTRONICS

The potentialities for this development are considered to be an "open sesame" to the very roomy microwave region for amateur, citizens and mobile bands, relay and communication and navigation functions.

METALLIC TECHNETIUM, chemical element number 43, has been isolated by Dr. Sherman Fried of the chemistry division of the Argonne National Laboratory, it was announced last month.

One of the last four of the 96 elements to be named, technetium is revealed to be a silvery substance similar to the other rare metals, rhenium, osmium and ruthenium, which are located near it in the periodic table of elements.

Two tiny quantities of the metal were prepared from compounds manufactured in the atomic furnaces at Oak Ridge and made available by Dr. G. W. Parker of the Clinton Laboratories. Dr. Fried reported the isolation of the new metal in a report to the Journal of the American Chemical Society.

PUBLIC REACTION indicates that radio is doing a good job, according to a survey made by the University of Chicago's National Opinion Research Center. The report released last month reveals that 70% of the people interviewed approved of the job being done by radio in their communities. Only 59% were as satisfied with their schools, 63% approved of their newspapers, and 42% were as pleased with their local governments.

A further study of the figures showed that 67% of the people were against government control of radio news, 76% opposed regulation of radio advertising, and 65% were opposed to government control of the programming of controversial issues.

TELEVISION COMPETITION is cutting into the movies and regular radio programs, Ed James stated in the American Magazine last month.

A survey of television set owners in New York by CBS disclosed that nearly half had attended movies less frequently since obtaining the set, and more than half reported there was no radio program they preferred to television. "Television," said one set owner, "is more entertaining than radio and more convenient than movies."

SIGNAL CORPS SCIENTISTS are preparing to explore the surface of the moon with radar in an attempt to map its mountains, valleys, and craters. They will use electronic improvements developed since January, 1946, when the Signal Corps first made contact with the moon from the Evans Signal Laboratory, Belmar, N. J.

The scientists said that the difficult part of the first experiment was in building a receiver sensitive enough to pick up the radar echo. Since then they have greatly increased the sensitivity of the receiver which will be used in the new experiments at Evans laboratory.

PRIVATE OPERATION of radio broadcasting in Canada is receiving strong public support, it was reported at the fifth annual meeting of the Canadian Association of Broadcasters last month.

A Dominion-wide poll completed last December showed that 60% of Canadians polled favored private operation of radio against 22% in favor of a government-operated system. Canada has at present both a government broadcasting company and privately-owned stations.

RADIO FURNISHED TIME to people in California during the power shortage last March. The lack of power forced the Pacific Gas and Electric Company to reduce its frequency, causing all electric clocks to run six or more minutes slow per day. As soon as the situation became known, the principal radio stations began giving time signals on each station break, enabling listeners to keep their clocks adjusted.

ACCURATE RADAR SPOTTING of planes is prevented by this wartime development in which the plane itself in effect, becomes a non-reflector of radar signals. U. S. patent No. 2,490,578, issued last month to Arthur Korn of Hoboken and Joseph Hess and Simon L. Ruskin of New York, covers this invention.

The plane is coated with a substance that is a poor or "scattery" reflector of radar waves. Three such substances are cuprous oxide and the elements selenium and tellurium. Various methods of applying the coatings, all involving rolling or pressure at fairly high temperatures have been devised.

Equipment for generating power on microwaves with tubes now used at broadcast frequencies.
**MONTHLY REVIEW**

**ATOMIC ENERGY** will be used to power radio and television receivers in the future, David Sarnoff, President of the Radio Corporation of America predicted at Boston University Founders' Day ceremonies.

"A miniature power supply in capsule form may make possible radio receivers no larger than a wrist watch, and television sets that may be carried in the pocket like a camera," declared General Sarnoff. "When that day comes people may carry pocket-size radiophones that will enable them to communicate with home or office, no matter where they are."

These fascinating possibilities are not "just around the corner" General Sarnoff pointed out, but we shall see these promises fulfilled if the world is at peace and science is unfettered. Beyond today's horizon, he said, automobiles, tractors, airplanes, locomotives and ships may be powered also by small capsules of nuclear energy.

More optimistic on the subject of atomic energy is Dr. Edward U. Condon, who at the recent meeting of the Institute of Electrical Engineers in New York City predicted atomic power plants "within a year or two" and ships running on electric energy "within a decade." Atomic power plants are now under way at Oak Ridge, Tennessee, Chicago, Illinois, and Schenectady, New York. Dr. Condon told the assembled engineers, and it should be possible to realize experimental production of power within the next year or two. However, he believed that atomic power plants are likely to be too heavy for cars, planes or even railroad locomotives, though it is reasonable to believe that within a decade ships may derive their power from atomic piles.

**A MICROWAVE RADIO** relay system instead of the usual telephone lines is planned for the Rural Radio Network whose headquarters is in Ithaca, N. Y. The network expects to go on the air with three of its six FM stations early in May.

The new FM network, to be cooperatively supported by farmer organizations, will concentrate on the farm audiences in the agricultural areas of upstate New York.

**THREE-YEAR LICENSES** for FM stations will be issued beginning May 1, the FCC announced last month. This announcement complies with requests made by the Frequency Modulation Association. The Commission pointed out that it "recognized the rapid development of FM as meriting the statutory maximum license period."

First renewals will be for one, two, and three years to work into a staggered schedule of renewals by frequencies. Thereafter, all renewals will be for the three-year period, according to the FCC.

**THE INSTITUTE of Radio Engineers held its 1948 convention March 22-25 at the Hotel Commodore and the Grand Central Palace, New York City. The meeting was the largest on record, with an attendance of 16,000, as compared to the 5,000 engineers who appeared at last year's convention.**

Dr. B. E. Shackleford, 1948 IRE president.

It was necessary to subdivide the subjects discussed and hold meetings simultaneously in five auditoriums to accommodate the more than 130 papers read. A symposium on nuclear science which consisted of five talks and occupied a full morning session indicated the Institute's interest in this very important new branch of science.

**THE RADIO PARTS SHOW** will be held again at Chicago May 11, 12, 13, and 14. At this show, which is sponsored by the Association of Electronic Parts and Equipment Manufacturers, the National Electronics Distributors Association, the EMA, and the Sales Managers Club, all the leading manufacturers of radio and electronic components will exhibit their new products for the coming season.

It is believed that this year will see the industry's largest parts exhibition, and dealers, distributors and manufacturers expect to see a number of new developments, inventions and features which have been kept "under wraps" for release at the show.

**TAPE RECORDINGS** instead of discs will be used beginning April 25 for rebroadcasting of network programs by affiliates of the American Broadcasting Company during daylight saving time. This method will permit rebroadcasts as needed with improved quality at lower costs.

Only regularly scheduled programs will be rebroadcast; outstanding special events will be aired live and when they occur.

"SNOWSTORM," a type of television interference that produces streaking on the television screen and is commonly produced by ignition interference has been found to be caused by the sun, it was reported last month.

Engineers of the British Broadcasting Corporation suspected the sun while they were tracing the cause of a brief but particularly violent snowstorm. A check with records of solar noises confirmed their suspicions.

**TELEVISION RECEIVER** production in February reached a new high level, the Radio Manufacturers' Association disclosed last month.

The manufacture of 35,889 sets in February brought the total number produced since the war to 250,937. The February television set output, 5,888 more than the January production, represented a 141% increase over the average 1947 monthly output.

**TELEVISION WEATHER** broadcasts are now being made on a daily basis. The ten-minute program, beginning at 6:06 pm, is carried over the Dumont stations in New York City and Washington, D. C.

**EUROPEAN LISTENERS** total between 150,000,000 and 175,000,000, according to a last month's State Department estimate. Over 100,000 of these are believed to have shortwave listening facilities.

**THE MOTION PICTURE** industry is planning to enter the television field actively, Frank Mullen, executive vice-president of the National Broadcasting Company, revealed at a press conference last month.
ELECTRET CONSTRUCTION

The author describes in detail the material, method and equipment for making electrets.

A

A

positive charge. When first removed from the cooker, the electret usually shows a positive charge on the side that was next to the negative polarizing plate and a minus charge next to the plus plate. This relationship is expected and is according to the law "unlike poles attract and like poles repel." Later a reversal of poles occurs; the positive side becoming negative, and the negative side positive. Once made, this reversal is permanent. The result is that the polarity on the electret is the same as that of the charging voltage. The positive charge thus formed holds. This is contrary to usual action. Normally a positively charged surface attracts free negative electrons, building up a negative

clude a condenser mike with no polarizing voltage and no danger of breakdown, phone pickup, plate-repulsion-type oscillator, an interior element of a vacuum tube in which the electret provides the necessary electrostatic voltage. Gemant has used electrets as plates of an electrometer, also as a microphote.

Equipment

The equipment shown in Figs. 1 and 2 was used by the writer in making electrets. High voltage is supplied by a neon-sign-type transformer delivering 5,000 to 10,000 volts at not more than 10 ma. The rectifier tube is a WL-579-B. Equivalents such as the 72, 73, RX-705-A, and 8013 may be used. The filament transformer must have good high-voltage insulation between its windings and should handle the rectifier tube used.

The current through the mixture decreases as the mixture cools, and the supply voltage rises to its peak value causing breakdown between the plate P and the cup. The dropping resistor R1 is included to prevent this breakdown. It consists of a number of small resistors connected in series and has a total value of about 50 megohms. One or more resistors may be shorted to adjust the voltage. The filter condensers C1 and C2 have a total capacitance of about 500 ufd and may be either air or mica types. The amount of capacitance is not critical.

Details of one type of cooker unit are shown in Fig. 3. Its base is made from 1/4- or 3/8-inch sheet aluminum. An electric-iron heater element is mounted on the underside of the base and held in place with another sheet of aluminum.

Bushings support a mycalex strip which holds the plate. The strip is drilled and tapped at center for 8-32 threads. One end of a brass rod is threaded for an 8-32 nut. The other end is turned down and threaded for a 2-56 nut. The plate P is an aluminum disc about 1/4 inches in diameter and 1/16-inch thick, drilled and tapped at center for 2-56 screw. The cup is an aluminum drinking cup 2 inches in diameter and

Fig. 1—Experimental set-up of one type of equipment used in the construction of electrets.

Fig. 2—A suitable high-voltage power supply.

Fig. 3—The materials are melted in the cup.

By VICTOR H. LAUGHTER

RADIO-CRAFT for MAY, 1948
cut down to ½-inch height. Spring clips hold the cup firmly to the base. The cooker unit is simply a method for providing heat to a container holding the wax and a variable means for contacting the mixture, so you can change its construction any way you desire. The various electrical units should have separate switches so any desired operation can be selected. The writer has made several hundred electrets using sand pack, oil bath, gas heat and infrared, but prefers the type of heater shown here.

Materials for electret-making
The minimum material for making electrets consists of 1 pound of carnauba wax, 1 pound of resin, 1 pound of aluminum foil about .001-inch thick, a small can of silica gel or other dehydrant, and a quart can in which to keep completed electrets. Cut off a piece of foil and force down into and around the inside of the cup. Work smooth to remove wrinkles. Also wrap foil around the plate that is to contact the wax. The foil keeps the mixture from adhering to cup and plate, allowing easy removal. It can be stripped off later. Shave off a teaspoonful of carnauba wax and resin. Place cup in position, run plate up out of way, and turn on only the heater.

Drop small quantities of the wax into the cup and stir the mixture with a rod as it melts. The depth of the wax should be about 3/16-inch for trial. Run the plate down until it contacts the melted wax. Connect the plate to the positive side of the high-voltage supply and the base to the negative side. The wax will wet the foil on the plate and allow backing up so that our final contact is about as shown in Fig. 4. Turn off the heater when the wax is thoroughly melted. Let the filament heat 15 to 30 seconds before applying plate voltage. The mixture should jump perceptibly when the high voltage goes on. If sparks break across from cup to plate, more resistance should be added to R1. Allow wax to cool to room temperature with voltage on. This should take 45 minutes to 1 hour. If for any reason you are dissatisfied with the product, remelt and remake. If the edges of cup are bent slightly, the cooled electret will break free and can be removed. Unscrew plate from rod and pry the electret off the plate with a knife blade. Strip off adhering foil and wrap in new foil. Place in the can—in which ½-inch of silica has been poured—until ready to test.

Testing electrets
The electrometer, a laboratory instrument, is the proper meter for testing electrets. Such meters are not generally available so other methods must be considered. The discharge test, as described here, can be made without cost and will reveal whether an electret is good or bad. To make this test, cut a disc of brass about .010-inch thick and slightly larger in diameter than the electret. See Fig. 5. Place the electret on a metal sheet (shown in Fig. 5 as COLLECTOR) resting on a block of insulating material. Hold the collector about 2 inches above the electret so that, when dropped, it will hit flat with the triangular part overlapping the electret coming in contact with the metal plate. What happens is that the collector, when dropped, travels through the electrostatic field, collects a charge which builds up, and is discharged when the triangle point contacts the metal plate.

Note that the collector has been cut with the triangular piece slightly longer than the thickness of the electret and bent down at an angle. The triangle section should be bent in or out for best spark action. This test must be made in the dark. Test both sides of the electret; one side will no doubt give a much heavier spark than the other. This is normal. Generally the heavier spark occurs on the negative side. The spark method is perfectly satisfactory as it indicates good or bad and, by the strength of spark, the comparative difference between electrets. A vacuum-tube voltmeter with an impedance of at least 1,000 megohms can be used and is of value for indicating positive and negative sides of an electret. This is a special type of instrument, however, and cannot be described in this article.

The wax mixture used by the writer is composed of equal parts of carnauba wax and Halowax. Halowax can be secured from the Halowax Products Division, Union Carbide and Carbon Corp. The addition of the Halowax gives an ivory-white finish, with good shrinking properties, allowing easy removal from cup. The electret should have a high melting point to be of more general use. It is advisable to experiment with various kinds of plastics and waxes that have a high melting range. Glass has been suggested as a medium and preliminary tests show some conductivity. The actual arrangement of the furnace, electrodes, and leads is a serious problem for the experimenter. It may be that actual conductivity is not important as the electrical stress will no doubt give the proper orientation. So far tests indicate that the electret must have a fairly hard and brittle finish. Likewise some carnauba wax, even though in minute quantity, must be included in the mixture. Some component of carnauba wax forms under the electrical stress the permanent characteristic of an electret, but just what this element is is not known. Electrets made without carnauba wax show only a temporary charge. It has been suggested that the carnauba shrinks when cooled, developing high internal stress resulting in a piezoelectric effect. This theory (if correct) indicates that certain kinds of glass should become electrets under proper treatment.

(Continued on page 82)
Electronic Visibility Meter

This device measures the air's clearness

By S. R. WINTERS

INDICATING the approach of fog six hours before the human eye sees it, this device designed by the National Bureau of Standards is a promising safety device for airports. It also can give reliable indication of the lifting of fog long before the naked eye can detect such clearance. The device can likewise control glaring approach lights and fog-dispersal apparatus at airfields and may have many other uses.

The Bureau of Standards calls this equipment a transmissometer. It is a four-in-one piece of apparatus—a light transmitter, a phototube receiver, an amplifier, and an indicator. This electronic gadget operates on the principle that the amount of light reaching the receiver from the transmitter is determined by the thickness of the fog or other obscuring atmospheric condition. The distance between the transmitter and receiver may be varied, but in practical tests good results have been achieved at ranges varying from 400 to 4,000 feet.

The transmitting unit has a 6-volt, sealed-reflector lamp, with a candle-power of 350,000, which differs from a sealed-beam headlight only in its cover and filament. The brilliancy of the light is controlled precisely by a voltage-regulating transformer. Adjustments are made by a series rheostat.

The receiver includes a lens, a diaphragm, a photo-pulse unit, and an amplifier. Light from the transmitter, focused by the lens on a pinhole in the diaphragm, falls on the phototube. The receiver develops voltage pulses at a frequency directly proportional to the intensity of the light falling on it. These pulses are amplified and sent over a signal line to the indicating unit. Frequency of these pulses ranges from 60 per second in fair weather to one every 20 minutes in thick fog.

The indicator consists of a two-stage amplifier, a frequency-measuring unit, and a calibrator. Since the latter operates from a standard power line, the calibration frequency is 60 cycles per second. The two-stage amplifier boosts and sharpens the incoming pulses, as well as cutting down noise picked up by the transmission line. The frequency meter also is variable, thereby giving a reading directly proportional to the pulse frequency which is proportional to the transmission of the atmosphere between the light source and the receiving unit.

The indicator unit affords both dial readings and a record on a revolving drum, and can operate as far as 10 miles from the receiver. This flexibility permits installing the indicator in the airport control tower and also the use of more than one transmissometer to "finger" across various sectors of the airport, while having the various indications converge at a single point for central observation. Experimental units of the transmissometer are in operation in studies on fog-dispersal measures, glaring approach lights, visibility, and airport lighting equipment. Five are functioning at the Joint Landing Aids Experiment Station at Arcata, California. Others are in use at the Civil Aeronautics Administration's Experimental Station, at Indianapolis, Indiana, and at the Naval Air Test Center of the Bureau of Aeronautics, for visibility and airport lighting equipment tests; and at the Tiffany Foundation, at Long Island, N. Y., under guidance of the National Defense Research Council.

The Bureau of Standards lists six main uses for its electronic brain-child in aviation: (1) for controlling high-intensity apparatus; (2) as a supplement to routine visual observations by a continuous record of atmospheric conditions; (3) as replacement for visual observations where trained observers or satisfactory lights are not present; (4) as a means of giving accurate indication of visual ranges over a limited area remote from the observer, especially in an approach zone; (5) as a method of registering variations and rate of change conditions of visual range; and (6) to afford precise indications of the visual ranges when visibility is poor.

The receiver. Phototube and lens is at left. Telescope is for sighting.

Transmitter consists of an auto-type lamp and means of regulating it.
Noise Reduction In A. F. Circuits

By I. Queen, W2OUX

Modern phonograph pickups, amplifiers and reproducers have excellent fidelity throughout the audio range. Unfortunately, hiss, scratch, hum and other background noises usually accompany the desirable records to spoil what is otherwise life-like reproduction.

Various circuits have been designed that can eliminate noise completely without affecting speech and music. It is possible to eliminate certain types of noise greatly with negligible effect on the signal. Two types of noise reducers are now used in high-fidelity phonograph reproduction and broadcasting. Each is capable of causing as much as 20 db drop in background noise.

Possibly the best known type of noise control is the Dynamic Noise Suppressor. It is a development of Hermon Hosmer Scott, and is already in commercial use on a number of high-class audio amplifiers and radio-phonograph combinations. It is an electronic control that automatically adjusts the band width of an amplifier in accordance with the frequency of the incoming signal.

With no signal, two electronic gates limit the amplifier pass-band to about 250-1500 cycles. One of these limits highs, the other lows. Since hiss and scratch are high-frequency components and rumble and hum are very low-frequency noise, the amplifier will be quiet in this condition.

The high-frequency gate operates only on high frequency signals. This extends the upper limit of the amplifier pass-band to about 20,000 cycles. Between musical notes or words the band-width narrows again.

Dynamic suppressors are available in several models. They range from complicated 15-tube circuits for broadcasting to simple 3-tube affairs which give excellent noise reduction with good response for home phonograph reproduction. Fig. 1 is the schematic of the latter model.

The first tube is a 6SQ7 voltage amplifier whose diode plates are used to provide control voltages for the two 6SJ7 electronic gates. For convenience the diode plates are shown as independent rectifiers, D1 and D2. The triangular component of each rectifier is in each case the 6SQ7 cathode.

The first 6SJ7 is a capacitive-reactance tube. Condensers connected between its plate and control grid, and the high resistance between grid and cathode, cause the plate voltage to lag the plate current by 90 degrees.

Operation of the gates

The a-c component of the 6SQ7 plate current flows through the control filter and high-frequency control circuit and is rectified by one of the diode plates (shown as the rectifying element D1). Fundamentals of desired high-frequency components are filtered out and applied as varying bias to the control grid of the first 6SJ7. The filter allows only a narrow band of frequencies near 3000 cycles to control the high-frequency gate. This band was selected because it was found to contain the fundamentals of most of the high-frequency harmonics whose inclusion is desirable for good reproduction. If higher frequencies were permitted to operate the gate, the high-frequency noise itself would be able to open the gate. This of course would nullify the action of the circuit.

The parallel-tuned circuit L1-C6, the inductance L2 and the capacitive reactance of the first 6SJ7 comprise a low-pass filter. The varying grid bias causes a change in the tube reactance which changes the upper cut-off frequency. When this frequency is high enough, the fundamentals and harmonics of high-frequency speech and music are transmitted through the amplifier. The other 6SJ7 is connected as an inductive-reactance tube. This reactance— together with condenser C8 and the circuit capacitance—forms a high-pass filter with variable cutoff frequency, depending upon the instantaneous grid bias. The bias voltage is derived from D5, the second diode plate of the 6SQ7. After filtering, it contains only harmonics of low-frequency speech or music. Low-frequency noise such as rumble and hum do not operate the gate because these have negligible harmonics.

Several refinements are included in this suppressor. When S1 is opened, suppressor action is removed. S2 limits the amplifier frequency range for reproduction of very noisy records. S3 is a ganged push-button switch, added to demonstrate the effectiveness of the suppressor. When switched to B the circuit becomes a low-pass filter. High-frequency noise along with high-frequency sound components are attenuated.

Octave band transmission

Another noise reducer, associated with Harry F. Olson, of the RCA Laboratories, is simpler than the dynamic suppressor in principle and operation, and requires no tubes. However, special band-filters are needed.

Output from a pickup, microphone or other source passes through two rectifiers (Continued on page 62)
Efficient 100-Watter

A transmitter which uses few tubes and components to achieve good results

By E. F. Harris, W8SJB

Here is a 100-watt transmitter that has much to offer. It is simple and straightforward in circuit design and the almost miniature mechanical layout and the care taken to insure good looks has resulted in a unit which rivals professional models. The input power runs between 100 and 120 watts. If higher power is desired, this little unit is capable of pushing any final amplifier up to the allowable power limit on any band, from 80 to 10 meters. Because of this last feature, no modulator was included as an integral part of the transmitter.

To be compact, the transmitter had to be built around a physically small tube which could handle the required power input safely. An HK-24 was chosen for the job because it meets the requirements of size and power and is also very efficient at high frequencies. The other tubes are: 6L6 crystal oscillator, 5Z3 low-voltage rectifier, and two 816 rectifiers for the high-voltage power supply. A block diagram of the transmitter appears in Fig. 1.

The 6L6 in a harmonic oscillator circuit (Fig. 2) gives adequate output to drive the final amplifier on the fundamental, second, and fourth harmonics of the crystal. Feedback is obtained from the divider circuit formed by C1 and C2. Initially, C1 should be adjusted to give maximum output when the oscillator is used as a harmonic generator, and all that is necessary afterward is to choose the appropriate crystals and coils for the desired band and tune the plate tank to either the fundamental or desired harmonic of the crystal. The 60-ma pilot lamp in series with the crystal serves as a fuse to prevent crystal burn-out. It should glow dimly when the oscillator is operating straight-through and should barely light or not light at all during harmonic operation.

Keying is in the oscillator cathode return to ground. The note is clean and free from clicks and chirps, even on harmonics. The .01 cathode condenser bypasses the r.f. to ground when the key is plugged into the jack. Omitting it will cause an appreciable loss of output, but, if c.w. operation is not desired, it may be omitted.

The oscillator is capacitance-coupled to the HK-24 final and provides sufficient drive on all bands. This type of coupling eliminates one tuned circuit, and is convenient to use.

The tank circuit of the final amplifier uses a 2,500-volt blocking condenser, which removes much of the danger of arcing in the split-stator tuning condenser. The neutralizing condenser is very small. It is actually one of the early disc-type neutralizing condensers designed for use with 6L6's. The disc plates are the size of a quarter, and proper neutralization takes place with the plates set from ¼ to ½ inch apart.

To avoid using fixed bias, a resistor is inserted in the filament return of the final amplifier. It provides sufficient cathode bias to limit the plate current to a safe value. This method is more convenient than battery bias, and the actual loss in plate voltage to the tube is less than 50.

A multitap modulation transformer is mounted on the chassis between the oscillator and final amplifier power supplies. The transformer taps were selected to match the final amplifier's impedance (between 9,000 and 10,000 ohms) to a 500-ohm line. The 500-ohm line terminals are brought out to a 6-prong female connector at the rear of the chassis. With this arrangement any audio amplifier which can deliver about 30 watts and has a 500-ohm output connection may be employed.

In case a separate modulator is desired, the transformer may be used to match the impedance of the modulator tubes to the final amplifier. The transformer may be left mounted on the transmitter chassis and the modulator plate leads run to it through the 6-prong connector at the rear of the transmitter chassis.

The oscillator power supply delivers 350 volts to the oscillator under a load of about 60 ma. The bleeder resistor across the output also acts as a voltage divider to supply 250 volts to the screen of the 6L6.

The final power supply uses a pair of 816's in a full-wave rectifier circuit. The plate transformer's rating is 1,800 v.a.t. at 250 ma and the filter choke is also rated at 250 ma. Since the current drain is 100 ma under full load, the voltage at the plate of the final amplifier is slightly over 1,000 v (measured). The filter condensers are 8 µf, 600 working-volts each, and as the pairs are series-parallel connected they can easily handle the output of the rectifiers. A bleeder resistor is included to insure condenser discharge.

The metering and control circuits provide flexibility of operation, and the maximum utilization of the one panel meter. S1 is the a.c. line and filament switch. A 2- to 3-ampere fuse will, in the main line, give adequate protection. Switch S2 closes the center tap return of the high-voltage winding to ground.

Compactness of the equipment is shown here.

Radio-Craft for May, 1948
in the oscillator power supply. It allows operation of the oscillator only when initially tuned up and also allows checking the frequency of the transmitter when listening to the receiver. Switch S3 is used in the initial tuning of the final amplifier. When it is on, a resistor is inserted in the primary lead of the high-voltage plate transformer to reduce the voltage on the HK-24 for tuning. It also energizes the relays Ry 1 and Ry 2. Throwing S3 to the off position after tuning has been completed shorts out the resistor and permits normal operation.

Switch S4 is the master send-receive switch. In the on position, high voltage is applied to the oscillator and power amplifier. It also connects the antenna to the transmitter (through Ry 2) and silences the receiver (through Ry 1). This system can readily be adapted to break-in operation.

S5 is a 2-pole, 3-position switch which connects a 160-ma meter across 50-ohm resistors inserted in the oscillator plate and final grid and plate circuits. The different currents may be read by merely rotating the switch to the desired position. The resistors do not affect the operation of the circuits in any way.

To neutralize the transmitter, turn it on and tune the oscillator to resonance. With the final plate voltage off, rotate the final plate tank condenser. If the HK-24 is not neutralized, the grid current will vary. Adjust the neutralizing condenser and again rotate the tank condenser while watching the grid meter. The amplifier is neutralized when turning the condenser causes no change in grid current.

Table 1

<table>
<thead>
<tr>
<th>Band</th>
<th>Turns</th>
<th>Diameter</th>
<th>Length</th>
<th>Inductance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>25</td>
<td>1/8</td>
<td>1/8</td>
<td>1.4</td>
</tr>
<tr>
<td>7</td>
<td>14</td>
<td>3/8</td>
<td>1/8</td>
<td>1.6</td>
</tr>
<tr>
<td>14</td>
<td>8</td>
<td>3/16</td>
<td>1/8</td>
<td>1.5</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>1/16</td>
<td>1/8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Or 8 & W JCL series

The HK-24 tank coil is designed to work properly into a low-impedance line. A double antenna fed with coaxial cable or a folded dipole fed by 300-ohm twin lead will give good results. In any case, the output of the transmitter may be link-coupled to a universal antenna tuner and used with any antenna. Coil data for the transmitter is given in tables I and II.

Table 2

<table>
<thead>
<tr>
<th>Band</th>
<th>Turns</th>
<th>Diameter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>24, No. 14</td>
<td>3/16</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>20, No. 14</td>
<td>3/16</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>10, No. 14</td>
<td>1/16</td>
<td>4</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>1/16</td>
<td>4</td>
</tr>
</tbody>
</table>

"1/16-inch copper tubing or 8 & W JCL series

Table 1

<table>
<thead>
<tr>
<th>Band</th>
<th>Turns</th>
<th>Diameter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>24, No. 14</td>
<td>3/16</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>20, No. 14</td>
<td>3/16</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>10, No. 14</td>
<td>1/16</td>
<td>4</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>1/16</td>
<td>4</td>
</tr>
</tbody>
</table>

"1/16-inch copper tubing or 8 & W JCL series

Load the transmitter till the final's plate current reads 100 ma. The input is about 100 watts with this amount of current. The oscillator plate current should be about 50 ma and the HK-24 grid current between 20 and 30 ma.

RADIO-CRAFT for MAY, 1948

Amplifier Uses 6AD7 Inverter

This is the circuit of a good-quality phonograph amplifier with a total of 4 tubes. The amplifier uses a 6SJ7, a 6AD7, and a 6F6. The pentode section of the 6AD7 is driven directly by the 6SJ7 preamplifier. The triode section acts as a phase inverter and amplifier for a small portion of the signal from the 6SJ7 which it applies to the grid of the 6F6. Push-pull operation is thus obtained with a minimum of parts.

A low plate load resistor in the 6SJ7 stage provides a slight low-frequency boost as its increasing reactance increases the effective load resistance for these frequencies. Separate attenuators are included for adjusting the low- and high-frequency response. The .005-
f condensers from the output plates to cathode are for absorbing sharp peaks. A small amount of inverse feedback is provided by the 3-meg-ohm resistors from the plates of the output tubes to the driving plates to correct any distortion in the output and to improve speaker damping.

A 6-inch and a 12-inch PM speaker are used for full-range reproduction. The small speaker operates on the higher frequencies where the reactance of the 4-µf coupling condenser in series with its voice coil becomes negligible.

The output transformer has a plate-to-plate impedance of 10,000 ohms to match the impedance of the output tubes.

The tuner used with this amplifier is a conventional superheterodyne.

A d.p.d.t. switch is mounted on the amplifier chassis to switch the amplifier from the tuner to the phonograph pick-up as well as cut off the B-plus supply to the tuner.

Careful layout is important. The transformers are placed for minimum hum pickup, and filament leads are twisted and run in the angles of the chassis. All the ground leads from each stage are returned to a single point. To prevent feed-back the grid and plate leads are short and well separated.
**Miniature 3-Use Fixed Oscillator**

*By WILLIAM LYON McLAUGHLIN*

WITH so many monitors and signal generators on the market, this three-purpose oscillator makes its bid for fame only through its ultra-midget size.

As a simple signal generator, or as a monitor with phones in the circuit, it radiates a signal with terrific sock on any plate supply above seven and one-half volts. Its possibilities for c.w. with a key in the circuit are very interesting with B supply as high as 180 volts. The midget can also be used to calibrate crystals. The job has been tested on fundamentals and harmonics to 30 mc, so will obviously go much higher.

The circuit is the well proven Pierce oscillator, similar to the "CGQ" used by the U. S. Navy during the war.

The Raytheon CK-507-AX was chosen because of its small size as well as its output possibilities. The Burgess K20 B-battery was used because of space requirements. The little ceramic condensers were used for the same reason.

Requirement number one is a transparent, plastic, standard-brand cigarette case. Upon completion of the unit the case is not completely closed. The cover is permitted to overlap the body by a little over one-eighth of an inch. The two parts are held firmly together by drilling three small holes in the case and cover and fastening them with the smallest possible brass wood screws. No screw is used on the end where the B-battery is placed.

At one end of the cover, immediately above the B-battery, a plastic-bodied crystal holder adapter has been placed. Its contact pins have been cut down to about 5/16-inch in length. Three holes are drilled in the cover: two for the pins and one in the center for engagement. This last requires a matching hole to be drilled and threaded in the crystal holder. The author used a 6-32 screw which is screwed up from inside the cover.

The smallest possible r.f. choke is then mounted inside the opposite end of the cigarette case cover, as close to the top as possible. It is well to solder the 10-µuf. condenser and the leads to the choke before mounting it in the cover.

On one side of the cover, free from either the choke or the B-battery, a binding post is located. This supports the antenna, which is made from a piece of heavy wire shaped like an L, so that when not in use it can be dropped down alongside the case.

A Wirt sliding contact double-pole double-throw switch is mounted at one end, bottom, of the case, opposite the B-battery. The ears of the switch are bent ninety degrees to the body and drawn through slots cut through the end of the case as close to the side walls as possible. The ears are then bent around to hold the switch firmly against the case. Even though only one side of this switch is used it was chosen because it was the smallest available. It is well to remove the lugs on the unused side and then cut the remaining lugs down to a size that will permit soldering on the leads. To allow for the movement of the switch button an oblong hole one-half inch long and one-quarter inch wide must be cut.

Two 3/32-inch holes are drilled 3/16 inch above the switch for the Fahnestock clips. The boss running up the end of the case will allow ample separation. As the width of the boss is about .08 inch the actual linear distance against current creepage is better than 1/8 inch.

The jumper can be made from a piece of hookup wire, twisted and soldered at one end to provide easy manipulation. This also permits attaching it to some point on the case to avoid mislaying it.

The tube pins are cut down to less than one-quarter of an inch. Pins P and G2 are soldered together. When assembly is completed the tube will be upside down next to the penlight cell and midway between the switch and B-battery. Care must be taken when closing the case to see that tube pins are kept about 1/32-inch from the lug of the choke.

---

**Schematic follows that of the Navy's "CGQ."**

All parts are referred to in the two views.

---

26 R**ADIO:** **CRAFT** for MAY, 1948
Laboratory Type Oscillators

By WILLIAM B. MILLER

SOME oscillators for use in the laboratory are very elaborate, using 10 or more tubes, crystal control and regulated power supplies. A few are extremely simple, like the Hummer used to supply tone for an a.c. bridge. This is a tuning fork kept in operation so that the tank circuit may produce current passing through the primary of a transformer, while contacts on the fork make and break the circuit.

A laboratory oscillator is required to have better than ordinary stability, freedom from unwanted harmonics, and as pure a sine-wave output as possible (unless special types of wave forms are needed for specific purposes).

An often overlooked cause of frequency shift is the relative phase of the grid-cathode and plate-cathode voltages. This relative phase shift—brought about by changes in tube electrode voltages—shifts the oscillator slightly off resonance. If the phase shift is great enough, the oscillator will be shifted to the point where the output voltage is zero. Thus, the oscillator may be varied by changing the control-grid potential. By keeping the amplitude low, the harmonic content of the output wave can be kept small.

Transitron oscillator

Another type of negative-resistance oscillator, the transitron (Fig. 2), is an improved dynatron. The main difference is the use of the suppressor-grid.

Crystal oscillators

When a crystal is placed between two metal plates with a difference of potential applied to them, mechanical strains are set up in the crystal which cause it to produce an alternating voltage, of a frequency determined by the physical dimensions of the crystal itself. The bias resistor R in Fig. 3 controls the amplitude of the voltage through the crystal and prevents it from vibrating too violently. The Q of a crystal circuit is at least 100 times that obtainable with commonplace capacitors and inductors. It therefore has a very sharp resonance curve, and it oscillates over only an extremely narrow range of frequencies. When its temperature is controlled with an oven, frequency variation can be kept within about two parts in ten million. Of course crystal-controlled oscillators can only be used for fixed frequencies.

A feedback oscillator is one that supplies its own input voltage of correct amplitude and phase. The Hartley (Fig. 4) is much used in the laboratory as it is easily adjusted, has excellent wave form, and oscillates over a wide range of frequencies. It is used particularly for audio and low radio frequencies. The tube, usually a triode, is operated as a class-A amplifier with self-bias.

Fig. 1-Dynatron—early laboratory oscillator.

Fig. 2—An improvement over the dynatron.

Fig. 3—Crystal oscillators are stable.

Fig. 4—The old familiar sheet-fed Hartley.

Fig. 5—Wien bridge; ideal for audio work.

R in this circuit is the resistance stabilization adjustment; it improves the frequency stability and wave form considerably at the cost of some reduction in efficiency. Since a change in the plate resistance of the tube causes a change in frequency, resistor R (usually from two to five times the value of the plate resistance) is high enough so that variations of plate resistance are of comparatively little consequence. Varying R controls the amplitude of oscillation.

(Continued on page 72)
WOULD you like to compute the position of the moon involving the equations shown below in seven minutes?

EQUATIONS USED FOR COMPUTING THE POSITION OF THE MOON ON THE IBM SELECTION SCIENCE ELECTRONIC CALCULATOR

\[
\frac{1000 \times \sin \left( \frac{1}{2} \pi \right) - 1000 \times \sin \left( \frac{1}{2} \pi \right)}{1000 \times \sin \left( \frac{1}{2} \pi \right)}
\]

\[
\frac{1000 \times \sin \left( \frac{1}{2} \pi \right) - 1000 \times \sin \left( \frac{1}{2} \pi \right)}{1000 \times \sin \left( \frac{1}{2} \pi \right)}
\]

\[
\frac{1000 \times \sin \left( \frac{1}{2} \pi \right) - 1000 \times \sin \left( \frac{1}{2} \pi \right)}{1000 \times \sin \left( \frac{1}{2} \pi \right)}
\]

\[
\frac{1000 \times \sin \left( \frac{1}{2} \pi \right) - 1000 \times \sin \left( \frac{1}{2} \pi \right)}{1000 \times \sin \left( \frac{1}{2} \pi \right)}
\]

The entire machine is made up of card reading tubes, sequence tubes, sequence relays, table look-up (for consulting reference tables), relay memory, counters, control relays, power distribution, tape memory, arithmetic unit, sequence interlocks, electronic memory, printers, card punchers, and card readers, in addition to the control desk and pulse generator shown on our front cover. These are all housed in a specially-designed room, 40.6 feet wide x 86.6 feet long x 14 feet high, the walls of which are completely lined with panels of vacuum tubes and relays. These walls—with a number of pieces of floor apparatus, such as printers and control consoles—actually are the machine.

The calculating element of the machine adds, subtracts, multiplies and divides the numbers it receives. The machine can make 3,500 additions or subtractions of 19-digit numbers in a second; 50 multiplications of 14-digit numbers in a second, and 30 divisions of 14-digit numbers in a second. It has a storage capacity of 400,000 digits in tubes, relays and punched tapes. When punched cards are used for storage the capacity of operation becomes virtually unlimited.

**Operation of the machine**

Instructions are given to the machine by the scientist on punched cards or continuous card-stock tapes. The tapes are prepared in one of two ways—either by the machine itself or with an auxiliary tape punch which transcribes data from punched cards. When the instructions are given on punched cards the numerical data is converted electronically from the original decimal form to the binary-decimal form in which each digit is represented by a combination of the binary numbers, 8, 4, 2, 1, used by all the new giant electronic calculating machines.

As soon as the numbers are converted to the binary system, masses of neon lights carry on a fire-fly flickering at stupendous speed, while very intricate calculations are being made within the machine. The innocent onlooker is virtually overwhelmed by this display.

The machine follows the instructions on the cards or tapes and stores each intermediate result in a memory unit for later use in the course of the calculation. There are three means of storing numbers: electronic tubes (trigger circuits using 125YF tubes), relays and tapes. The relay and tape memory units are provided for general storage when large capacity is the dominant requirement. Electronic memory units are used in connection with the arithmetic unit where the need for speed predominates. But though the electronic system is more rapid, it cannot be used to the exclusion of tape and relay systems. If the present storage capacity of the machine, which is over 400,000 digits, were to be stored in electronic circuits it would be impracticable to house the machine in one building.

Not only does this machine add, subtract, divide and multiply, but it will also look up logarithm, trigonometric and other tables. If a table has to be referred to in the course of the calculation, the machine starts the tape of the desired table spinning. When the reference is reached, an electronic impulse stops it. The number then is stored in the memory section for future use.

The data for all computations and results obtained must flow to and from the arithmetic unit through any one of hundreds of channels throughout the machine, such as the reading and recording units and the great reservoir of stored results. Eight separate channels, each capable of transmitting simultaneously 10 decimal digits and an algebraic
sign, lead to and from the arithmetical unit. Traffic is directed along these channels to and from the other units by IBM electromagnetic relays. One of these relays, which is slightly larger than a conventional vacuum tube, can change twelve independent circuits in a few thousandths of a second. For some special problems, it may even be desirable to change the whole mode of operation of the machine. This can be done in a few minutes by means of automatic control panels. About 40,000 pluggable connections on these control panels can be changed in units in a remarkably short time.

Problem results may be recorded either in punched card or in printed record form, or if desired, in both forms. Since the machine is being utilized primarily for research purposes and because calculation proceeds at such a high speed, it is necessary that the scientists know at all times what results are being obtained, so that modifying instructions may be injected whenever necessary. Provision was made, therefore, for the continuous printing of results throughout the calculation.

The console, or operation indicator and control desk (shown on the front cover) is used for keeping a check on the operation of the machine. Have you stopped to consider what an immense servicing problem it must be to locate a burned-out filament in this maze of vacuum tubes? The control desk is useful for trouble shooting. If a tube burns out, or anything else goes wrong mechanically, neon lights in the panel on the control desk assist the operator in finding and diagnosing the trouble. A check is then made in the faulty section, the trouble repaired, and the machine goes on with its work. Of course, the trouble will be discovered only when the machine has to make use of that particular panel in the course of the calculation.

The machine requires 180 kilowatts of electrical energy. All the alternating current it uses is rectified by a large battery of rectifier tubes housed in cabinets in a room beneath the calculator. A large air-conditioning system is provided. It has a cooling capacity approximately equal to that required to air-condition completely a building containing 250,000 cubic feet of space. The system is capable of dissipating 200 kilowatts of heat.

The calculator is divided into three fire zones, each equipped with automatic temperature-detecting devices. Control of fire after detection can be either manual or automatic. Full release of the fire-extinguishing apparatus would discharge 32 tanks of CO₂ into the calculator units. The air conditioning and power supply would shut off automatically if gas were discharged. The instrument was built at a cost of $750,000.

Many branches of industry will be greatly aided by this machine. In certain commercial statistical fields calculations have to be made where complicated sequences of operations must be handled one at a time. The operations can be so speeded up as to perform calculations which now are considered impractical due to the amount of time that would be involved.

The scientist will be the one most aided by it. What once took scientists years upon years to work out, now can be done in a few hours, freeing him for further research.

Greatest of all may be the effect of this new computer on the progress of atomic research. By performing the complex and laborious calculations required in the study of the atom, it will be a dominant factor both in keeping this country well ahead of all competitors in the military development of the atom and in speeding the day when atomic power will be available to peaceful arts and industry.

But, it cannot, and never will, replace the human scientist as its purpose is only to follow his commands. If the incorrect instructions are given to it, it will follow them. The scientist is supreme over the great electronic calculator, which is his child to assist him in exploring the ever-profound depths of science.

As President Thomas J. Watson of IBM said: "This machine will assist the scientist in institutions of learning, in government, and in industry, to explore the consequences of man's thought to the outermost reaches of time, space and physical conditions."
Light with a Memory

This remote radio control has several practical applications

By M. GORDON MOSES

It has always been everyone's secret desire to press a button at one point and cause something to happen at another point. With the advent of radio control, this old dream became a reality. For example, model airplane construction has been combined with radio to produce remote-controlled planes which glide and turn in the sky—all at the whim of the operator on the ground.

An unusual application of radio control is the "light with a memory." The effect is startling even to those well versed in radio. Briefly, the stage setting is this: A small wooden panel, with push-button, flashlight lamp, and batteries mounted on top, is shown. The batteries, push-button, and lamp are wired in series so that when the push-button is pressed the lamp lights. Pushing the button several times, say five, the "magician" waves his hand over the panel. Lo and behold! The light mysteriously blinks the same number of times as the miracle-worker pressed the button. Spectators are then allowed to press the button any number of times they desire, and the light—virtually a light with a memory—repeats the flashes!

The base of the panel is hollow and contains a complete radio control receiver. A compact transmitter in the operator's pocket is pulsed by means of a leaf switch concealed in a vest pocket. The lamp in the receiver flashes each time a pulse is picked up from the transmitter.

A photograph of the panel and base as the spectators see them is shown at the left in Fig. 1. The mechanical design was influenced by the special use to which the device was put. It was necessary that the unit be as flat and compact as possible, so that spectators would not suspect its existence. However, it is fundamentally a standard radio remote-controlled relay, and can be used in a variety of ways. The mechanical design can be modified to fit any particular application.

The push-button and miniature porcelain socket can be purchased in any electrical parts house, and the holder for the two penlight cells can be bought at a hobby supply store. The receiver with base removed is shown in Fig. 2, also at the left. Follow the placing of parts closely. The tuning coil consists of 14 turns of No. 14 tinned copper wire, wound to an inside diameter of ½ inch and spaced for an over-all coil length of approximately 1½ inches. Fig. 3 is the schematic of the miniature receiver.

The antenna lead of the receiver is a 2-foot length of No. 22 d.c.c. magnet wire. Care must be taken not to bring any part of this lead too close to the tank coil and not to coil the antenna lead too much. The best arrangement is to run the lead around the inside of the hollow panel and bring the free end to the miniature Raytheon RK-61 gas control triode.

Special attention is called to the unique rotary switch used to turn the receiver on and off. Shown in the upper right-hand corner of the panel, the switch consists of a ½-inch diameter disc of thin hardwood with two silvered brass segments glued on at spaced intervals. Four silvered brass wipers act as contact arms. A sketch of this switch is shown in Fig. 4. One of the wood screws used to hold the miniature porcelain socket on the panel is a dummy, and is actually used as a shaft to rotate the special two-circuit switch. One set of contacts goes to the filament circuit of the RK-61 tube, and the other set is in series with the contacts on the relay. Closing the rotary switch turns on the receiver and puts the relay contacts in parallel with the push-button switch mounted on top of the panel. More conventional switches are obtainable as band-change switches for short-wave receivers.

The antenna lead of the receiver is a 2-foot length of No. 22 d.c.c. magnet wire. Care must be taken not to bring any part of this lead too close to the tank coil and not to coil the antenna lead too much. The best arrangement is to run the lead around the inside of the hollow panel and bring the free end to the miniature Raytheon RK-61 gas control triode.

(Continued on page 81)
Radio Set and Service Review

Midget television preamplifier

The great popularity of postwar television has caused many sets to be installed in areas where signal levels are not high enough for clear, stable pictures. In some instances set owners are further handicapped by not being able to put up adequate antennas. Very often weak signals can be boosted to satisfactory levels by inserting a preamplifier between the antenna and the set's antenna terminals. Several television preamplifiers are being made by various manufacturers and a number of independent servicemen—all of whom treat their circuits as trade secrets. All these preamplifiers use one or more stages; some require tuning and others do not. Many of these boosters, like the one we are about to describe, were designed from material appearing in the article, "Cathode-Coupled Wide-Range Amplifiers," in the October 1945 issue of the Proceedings of the I.R.E.

Our booster, a 6J6 grounded-grid amplifier designed to operate on channels 1 through 6, amplifies the antenna signal two to four times while providing a substantial improvement in signal-to-noise ratio. It has several advantages. It does not require manual tuning; it is small enough to fit on the chassis or inside the cabinet of almost all television receivers and it does not require a special power supply.

The grounded-grid amplifier

The grounded-grid amplifier used in this circuit was developed to avoid neutralization when using high-frequency triode amplifiers. (See Radio-Craft, Nov., 1947, P. 32). The input signal is applied between cathode and grid, and the output voltage is developed across a load between plate and grid. The grid, either grounded directly or through a suitable bypass condenser, acts as a shield between the input and output circuits, thus forestalling oscillations until the input frequency is so high that the grid lead has appreciable impedance.

The grounded-grid amplifier has several advantages, which make it useful as an untuned r.f. amplifier between the antenna and television. These are: Lower tube noise, output capacitance less than one-half of that of a conventional neutralized amplifier, and low input capacitance—necessity for high transconductance. The low input and output capacitances result in greater band-width without manual tuning.

Construction

The circuit of the grounded-grid preamplifier is shown in Fig. 1. It is constructed on a chassis 2 ¼ inches square and 1 inch deep. The three terminal strips are for input, output and power connections. Filament and plate voltages are taken from the low-voltage supply of the set.

The tube is a 6J6 with its triodes connected in parallel. The cathode and plate coils are wound so that combinations of distributed and circuit capacitances tune them to cover the first six television channels. The antenna transformer is mounted on a bracket near the input terminals. The output transformer is fastened to the chassis with a machine screw threaded into one end of its form.

The primary of the antenna transformer is designed to match a 300-ohm balanced transmission line. It is an 8-turn winding tapped at the center. The cathode coil has five turns interwound with the primary. The output transformer has a 10-turn plate winding with a 2-turn output link interwound with the primary. The output transformer has a 10-turn plate winding with a 2-turn output link interwound at its lower end. Both transformers are wound with No. 34 enamel wire on 5/16-inch polystyrene tubing. All coils are close-wound. Use 300-ohm twin-lead between the preamplifier and the antenna terminals of the set.

The unit is so simple as to make it unnecessary—and almost impossible—to give any further construction details. An almost slavish adherence to original RCA development illustrated in the I.R.E. Proceedings, in regard to placement of parts, size of chassis and manner of making connections has been observed in more than one successful model. The constructor would therefore probably be well advised to follow the photograph closely—at least in his first model.

V.T.V.M. CALCULATIONS

This method of calculating the resistance values in a voltage divider may be useful to the serviceman who wishes to build his own vacuum-tube voltmeter.

As an example, assume that the desired ranges are: 3, 15, 150, 300, 600, and 1,200 volts; the total input resistance is 10 megohms; and 3 volts are required on the grid of the tube for full-scale deflection. For the 1,200-volt scale, divide 1,200 volts by 10 megohms to find the current through the resistor A:

$$\frac{1,200}{10 \text{ meg}} = 0.0012 \text{ amp}$$

Dividing the 3 volts (required for full deflection) by 0.0012 amp gives the resistance as 25,000 ohms. This is the value of resistor A.

For the 600-volt scale, the procedure is the same:

$$\frac{600}{10 \text{ meg}} = 0.0006 \text{ amp}$$

Three volts divided by 0.0006 amp shows the resistance to be 50,000 ohms, which is the value of B plus A. Subtracting the value of A from 50,000 gives B as 25,000 ohms. By repeating the same procedure the remaining resistors are: x. For the 600-volt scale, the procedure is the same:

<table>
<thead>
<tr>
<th>Scale (volts)</th>
<th>Resistor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>C</td>
<td>50,000 ohms</td>
</tr>
<tr>
<td>150</td>
<td>D</td>
<td>100,000 ohms</td>
</tr>
<tr>
<td>15</td>
<td>E</td>
<td>1.9 megohms</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>8 megohms</td>
</tr>
</tbody>
</table>

The total resistance is 10 megohms.

The preamp's dimensions are cigarette-size.

Under-chassis view, showing part placement.
Phase Inversion Circuits

Part I — The transformer type of inverter, with some variations on standard circuits

By J. W. STRAEDER

PHASE inverters are devices commonly used in amplifiers and large radios. Their purpose is to provide two equal but antiphase alternating phase voltages which are usually applied to the grids of push-pull output tubes. They are also used in electronic test equipment, including watt-meters, distortion meters and special types of oscilloscopes.

The signal voltage required by the following stage and the suitability of the system for use with negative feedback, are among the several factors that must be considered in the choice of a phase-inverter circuit. Power may also be required by the output tubes, as in class-AB2 operation, and, finally, the cost may override all other factors, no matter how desirable they might be.

Four criteria are classified according to the way the signal voltages are fed from one stage to another. Classifications are: (1) Inductively coupled, (2) Resistance-capacitance coupled, and (3) Direct coupled.

The oldest form of inductively coupled phase inverter is the transformer with a center-tapped secondary, or with two secondary windings — one for each grid. Other inductive systems use a center-tapped choke coil, and a transformer with no center tap but with the secondary voltage divided by a pair of equal resistors. These three circuits are shown in Figs. 1, 2, and 3.

Transformer coupling

Biggest drawbacks to the use of transformers are their cost, liability to hum pickup, and imperfect frequency response. Hum can be reduced by mounting them away from power transformers and chokes and by rotating them until a position of minimum hum is found. High-frequency peaks can be reduced by shunting the secondary with resistors (about ¼ megohm), while things can be improved generally by using negative feedback in the driver stage.

Fig. 1 — Standard transformer-coupled circuit.

Advantages of transformer coupling are the large signal voltages obtainable, the low d.c. resistance in the grid circuits of the output tubes and its adaptability for class-AB2 operation. In this case, the transformer usually has a step-down ratio to match the minimum grid input resistance of the next stage to the plate resistance of the driver. (Grid input resistance varies from values too large to bother about when the grid is negative to values as low as a few hundred ohms when the grid is very positive.)

Transformer with resistors

A transformer with resistors (Fig. 3) is often used as a makeshift, but is quite capable of good gain and frequency response if the output tubes require no driving power and if high-grid-circuit resistance is permissible. The two resistors must be as nearly equal as possible and must be large to prevent high-frequency loss in the transformer and to present a reasonably large load impedance to the driver tube. This impedance is given by $2R_g + nR_p$, where $n$ is the step-up ratio of the transformer. The gain to each grid is then $R_{\mu}R_g$.

If the driver is a low-impedance tube such as a 6C6 and the grid resistors are each 0.6 megohm, the gain is very nearly equal to $R_{\mu}$ at mid-frequencies. At low frequencies the gain is 3 db down when the reactance of the transformer primary is equal to the plate resistance of the driver.

Fig. 3 — How an untapped condenser is used.

A second article by Mr. Straede, in an early issue, will cover resistance-capacitance types of phase inverters.

PHONO PREAMPLIFIER

I have a small superheterodyne using a 6A8, 6F7, 6K6, and rectifier. I tried unsuccessfully to add a phono attachment by connecting it to the grid of the 6K6. The output of the pickup was too low for use without a preamplifier. I removed the 6K6 and wired in a 6AD7 as shown. The triode section is used as a preamplifier for the pickup without altering the performances of the set.

JOSEPH PRITCHARD,
Hamilton, Ont., Canada

RADIO-CRAFT for MAY, 1948
Servicing Wind Generators

By MAX ALTH

THERE is little chance that one of us will ever be called on to service the 1,000-kw giant wind generator atop Grandpa's Knob near Rutland, Vermont. But we will be called upon sooner or later to service one of the more than a million wind-driven power plants in use today.

Wind-generator servicing is not hard. After the tower has been climbed, there is really nothing to worry about. These generators are very similar to automotive generators. In fact the first units, some of which are still being used today, were auto generators.

If called upon to install a plant, select a spot as close to the load and as unobstructed as possible. The prop on a 6-volt machine should be mounted at least 15 feet higher than any obstruction within a radius of 500 feet. The larger, 32-volt job requires a clearance of at least 30 feet above anything within ¼ mile. Higher up the air is smoother and will develop more power. Raising the Wincharger Model 3227 from 65 feet to 105 feet has been found to increase the power output 30%.

Since the lines from generator to load carry high current at low voltage, they should be kept as short as possible from the point of view of both voltage drop and wire cost. A 32-volt line carrying 40 amps should be at least No. 6 wire if it runs 100 feet, and No. 4 if it runs 200.

The tower should be erected plumb so that the generator doesn't tend to fall off to one side. It should be well grounded as otherwise it would be a natural target for lightning.

After the unit has been erected, the prop should be checked for balance and track. On a windless day, remove the brushes or tie them back with a piece of string, and give the prop a quarter turn, then another. If the same blade comes to rest in the down position every time, the prop is unbalanced.

Correct unbalance by loosening the prop in its haft or holder, and wriggling. If there isn't enough play for correction, drive a wood screw into the lighter arm. First locate the balancing spot for the screw by temporarily fastening the screw to the prop with a piece of adhesive tape. If the screw has to be more than 2 feet from the center, it's best to locate a better-matched pair of prop blades. Some props are equipped with counter balancing weights. An out-of-balance prop will vibrate the plant and shorten its life considerably.

Check the track by measuring carefully from inner edges of each blade, from equidistant points from prop end back to a fixed point on the tower. Correct by again wriggling prop, or by slipping a shim between prop and haft. Out-of-track blades make whistling noises and reduce prop efficiency.

Be sure the unit is lubricated before placing in operation; some of these units are packed and shipped dry.

Now let her go and watch the voltmeter. If it reads backward, or if the relay chatters, disconnect before relay is injured. Your wires may be reversed. If the wiring checks O.K., the polarity of the unit may have been reversed at the factory. Run the generator as a motor for a few minutes by connecting the storage battery to it. In some cases closing the relay by hand will make this connection; in others it will have to be done with a jumper. Check the diagram furnished with each generator first. A typical 32-volt hookup is shown in Fig. 1 — the 6-volt jobs are even simpler.

Motoring the generator will not only correct the polarity of the generator but will also give you a general idea of the condition of the unit, whether or not the circuit is complete, etc.

Servicing established units

Complaints fall into 2 general categories: lack of immediate power, or insufficient power over a period of time. If there is no power, first check the controls for proper adjustment, then run an ordinary continuity check up the leads through the slip rings and slipping brushes to the generator proper. Check the position of the third brush, if the model has one. The brush may have slipped back. Check the other brushes for seating and tension. The commutator should have a dull-brown oxide sheen. If it is lightly scored, it may be repaired by holding sandpaper against the commutator and turning it. If the commutator is deeply scored, it will have to be turned down on a lathe. Light or deep scoring indicates hard spots on the brushes. They should be

(Continued on page 76)
Wobbled Signal Generator

A signal generator of this type is necessary for visual alignment of AM receivers

The versatility and true worth of an oscilloscope cannot be fully realized until you have actually had such a device on your bench for some time and used it for servicing or development. Perhaps the most important of these applications is visual alignment of receivers, requiring a frequency-modulated sweep generator or "frequency wobbler." The frequency-modulated signal generator described here (Fig. 1) for use in alignment of AM receivers was developed and constructed by the author.

The following specifications were set up:

1. A center frequency variable from approximately 450 to 840 kc, giving an easily adjusted carrier frequency covering the i.f.'s of practically all modern AM receivers.

2. Frequency deviation adjustable from 0 to 30 kc. Such a maximum deviation will project the response curves of the i.f. and r.f. transformers in all AM receivers (including the high-fidelity ones) to zero response both sides of maximum.

3. Unit must be compact. Such a characteristic becomes a virtue on the average service bench.

4. Cost must be kept to a minimum.

5. Unit must be adequately shielded (as all good r.f. signal generators should be) to avoid radiation of unwanted signals to other equipment.

A separate power supply, connected to the wave generator by a multiconductor cable, was considered desirable. First, magnetic shielding is simplified. Second, by making the unit a universal power supply, it becomes an extremely useful tool for other activities as well.

Theory of operation

Three operations are carried out in the frequency-modulated oscillator. A r.f. signal is generated; second, the frequency of the signal is varied by a change in the effective inductance in the oscillator tuned circuit; and third, the change in frequency is automatically controlled between fixed limits.

The triode section of V4 (Fig. 1) with the tank circuit L-C18 forms a simple Hartley r.f. oscillator. For a detailed account of the theory of operation of the reactance tube V3, the reader is referred to any of the standard texts.

We can simply say that varying the control grid voltage of the reactance tube controls its effective inductance and, consequently, the oscillator frequency. If a low-frequency alternating voltage, say at 60 cycles, is applied to the control grid of the inductance tube, the output frequency from the oscillator will swing from a maximum to a minimum value, and back again, 60 times a second. It is desirable that the frequency change be near to time. Such a triangular or "pyramid" wave (Fig. 2) is obtained across the integrating circuit R8-C4 (bottom tap on switch S1). The output from V1, a sine wave clipped to an approximate square wave (Fig. 3), appears at top tap of S1. The pulse formed across the differentiating circuit R7-C2 is available at point 2 of S1, and at the Pulse binding post (see Fig. 4).

V2 is merely a cathode follower buffer stage, and the hexode section of V4 is a mixer for injection of a fixed frequency signal when desired.

How generator is used

In visual alignment, the same series of steps are followed as are used in the output meter method. The output of our wobbler is injected into the receiver at the usual points instead of the fixed frequency signal, and the oscilloscope takes the place of the output meter. The oscilloscope should be connected across the detector load rather than across the output transformer. The pulse output is connected to the external synchronization post on the oscilloscope. The oscilloscope horizontal sweep is set for 120 cycles per second, which results in the trace from maximum to minimum frequency being superimposed upon the trace from minimum back to maximum.

The center frequency control C18a is adjusted to the required center frequency. R2 is set at about two-thirds maximum. R10 is set at or near maximum. If the i.f. stage being checked is considerably out of line, the double-trace response curve will appear as in Fig. 5. As the trimmers are adjusted to bring the transformer into alignment, the two traces will coincide, or approximately so, as shown in the oscillogram (Fig. 6). The shape of the response curve in the usual properly aligned transformer is of this general outline with a single smooth peak. High-fidelity receivers will have curves with a flat top or double peaks. During the above operations, the frequency deviation control R10 should be adjusted to give a reasonably wide response curve without cutting off the ends.

The FM test signal is injected at the conventional points for checking the oscillator and r.f. circuits of the receiver. To obtain the necessary broadcast frequencies, a fixed-frequency signal from a conventional test oscillator is mixed in V4 with the FM signal to give the desired difference frequency. The response curves will be similar to those obtained from the properly tuned i.f. stages. The oscillator and r.f. adjustments are made for maximum height of response curve.

Whether the response curves will appear on the oscilloscope screen right side

Fig. 2—Normal pyramid (time-linear) wave

By GEORGE W. SCHULTZE

RADIO-CRAFT for MAY, 1948
up as shown in the oscillograms and drawings in this article, or upside down, depends upon the number of stages in the oscilloscope vertical amplifier, the orientation of the cathode-ray tube, and at what point in the receiver the test signal is taken off.

**Construction**

The FM signal generator was designed to go into a 7 x 7 x 7-inch enclosure. The low-frequency portion (6S37 clipper and the 6J5 buffer) is mounted in a 1¼-inch deep horizontal steel chassis. The r.f. section, including the sockets for the 6AC7 reactance tube and the 6K8 mixer, is contained in a 2¾-inch deep sheet-copper chassis, mounted vertically on the back edge of the steel chassis. This is clearly shown in the photographs (Figs. 7 and 8). The copper box is bent from 22-gage sheet, and the joints soldered. A copper back cover is secured with self-tapping screws. The same type of fastening is used to join the copper shield box to the bottom chassis. The panel can be either bakelite or (as shown) crackle-finish Masonite, 7 x 7 x 3/16 inches.

The power input socket, the binding posts, the potentiometers R2 and R10, and switch S1 are all mounted on the panel, as pictured below. The center frequency adjustment C18a and potentiometers R17 and R18 are located in the copper shield box with extension shafts extending to knobs on the panel. C18a must be insulated from the chassis by fiber washers, and the shaft couplings should be insulated. The five binding posts provide connections on the panel for the FM output, r.f. input (constant frequency generator), ground, 60-cycle wave, and pulse. The 60-cycle wave post provides a convenient connection for checking the output of the clipper circuit, as well as affording access to the three types of wave form, as selected by S1, for other fields of use. As mentioned before, the pulse output is used to synchronize the time base sweep of the oscilloscope.

V3 and V4 are either metal tubes or externally shielded glass types. If metal tubes are used, be sure to ground the No. 1 pins (internal shield). This is especially important for the 6K8 mixer. The phase-splitting condenser C7 is fastened inside the top edge of the copper box with a hole provided for external screw-driver adjustment. The center frequency range adjustment C18b is mounted to allow trimming through a hole in the back cover.

Bare, tinned wire is best for most of the r.f. wiring. All leads should be as short and direct as possible. All ground leads from V3 and V4 are brought to common single chassis connections. The tank coil L was wound on a 3/8-inch outside diameter plastic cylinder 2½ inches long. The base end of the form was plugged with a wood disc cemented in place. A hole for a 6-32 screw was drilled through the center of the plug and a hex nut cemented on the inside. The coil was then mounted on the side of the copper shield box with a counter-sunk head machine screw. The lead from R18 to the panel binding post was shielded in order to avoid low-frequency pickup. The 60-mh choke RFC6 filters out any 60-cycle amplitude modulation present in the output from V4.

The panel is backed by an iron shield which provides an anchorage for the sheet-iron cover as well as magnetic

(Continued on page 74)

**Fig. 3**—Square waveform from the plate of V1.

**Fig. 4**—Differentiated pulse output from V1.

**Fig. 5**—Trace from a misaligned i.f. circuit.

**Fig. 6**—The above circuit, properly aligned.

**Fig. 7**—Top view shows placement of parts.

**Fig. 8**—Front view. Tubes mounted on subchassis are 6AC7 and 6K8.
DESIGN of a wide-band amplifier calls for special compensating circuits to offset the drop in response at the high and low ends of the audio spectrum. As pointed out in a previous article (March, 1948), response begins to drop noticeably at the high end of the band when the shunting capacitances present a reactance about five times as great as that of the plate resistance and the coupling and load resistors in parallel. Additional losses due to degeneration in cathode and screen circuits can also occur.

These factors can be compensated for by careful design. Assume that an audio amplifier is to be designed to deliver 3.5 watts of power with response flat within 1 decibel from 20 to 20,000 cycles. Input is to be 0.16 volt r.m.s., and distortion negligible. Circuit may be that of Fig. 1.

The power amplifier selected is a 2A3, because it can deliver 3.5 watts without distortion. Specifications call for 250 volts on the plate, 45 volts cathode bias, and a 2,500-ohm load. Transconductance is 5,250 micromhos.

Manufacturers recommend that the peak a.f. signal on the grid of a class-A power amplifier equal the d.c. grid bias. Therefore we must supply a 45-volt signal to the 2A3 grid. A 45-volt signal on the grid of this tube develops 122 volts peak across a 2,500-ohm plate load resistor with a stage gain of 2.93. The peak voltage across the load is found from $E_{peak} = 1.144V\times Z$, where $W$ is output power and $Z$ is load impedance.

(Continued on page 56)

Above is the Langen 610-C, a typical example of high-fidelity audio amplifier design.

**Second of a series on wide-band amplifier construction**

**By ROBERT F. SCOTT**

Since the impedance of the parallel combination is to be about 23 ohms, and the value of the resistor is 750 ohms, it is obvious that the parallel impedance will be roughly equal to the reactance of the condenser. We can therefore simply find the capacitance that has a reactance of 23 ohms at the low-frequency limit (20 cycles). The condenser should have a minimum capacitance of 257 µF.

This value may seem unreasonably large for a cathode condenser since at it is seldom found in practice—even in video circuits—because other methods of low-frequency compensation are more commonly used.

A 500,000-ohm resistor is used in the grid circuit of the 2A3. This is the maximum permissible value according to tube manufacturers' specifications.

A voltage amplifier is needed to bring the input signal up to 45 volts peak. The 6SJ7 was selected from several tubes that will deliver this voltage because its high plate resistance and transconductance permit the use of a low plate coupling resistor and therefore its output is substantially level up to 20,000 cycles.

The high frequencies drop to 90% of mid-band level when shunting reactance, which is equivalent resistance (Req) formed by plate, plate coupling, and grid resistors in parallel. Specifications permit the signal to drop to 90%. The 90% condition is within this limit, so we use its value to compute the value of the coupling resistor for the 6SJ7.

The shunting capacitance is the sum of the output capacitance of the 6SJ7, the input capacitance of the 2A3, and stray wiring capacitance. The output capacitance of the 6SJ7 is 7 µf; the input capacitance of the 2A3 is Cgc + (G + 1) Cgp, where Cgc is grid-to-cathode capacitance (7.5 µf), Cgp is grid-to-plate capacitance (15.5 µf), and G is stage gain of the 2A3 (2.93 in this circuit). Assuming 10 µf stray capacitance, the total shunting capacitance is 89.34 or 90 µf. At 20,000 cycles, the reactance of 90 µf is 88,495 ohms.

**Fig. 1—A 20 to 20,000-cycle amplifier whose circuit constants are worked out in the text.**

RADIO-CRAFT for MAY, 1948
Push-Button Signal Generator

This European test oscillator circuit contains some ideas which have not been seen in American equipment

By ALFRED HAAS*

DESIRED especially for outside servicing, this small 2-tube test oscillator is push-button operated, and the output is continuously variable in three steps. The frequency range is in four bands: 100 to 300 kc, 400 to 850 kc, 500 to 1000 kc, and from 6 to 18 mc.

The tubes are a 6K8 triode-hexode and a 12A7 diode-pentode. The diode section of the 12A7 serves as a half-wave rectifier for the B-plus voltage. The transformer should be able to supply approximately 125 volts at 25 ma and 12.6 volts at 0.6 amp for the filaments. The heater of the 6K8 is connected across half the filament winding, or a 12K8 may be used and both tubes connected in parallel. Fig. 1 shows the circuit of the oscillator.

A 6-button d.p.d.t. push-button switch assembly is used for the band selector and control unit. The type of output is selected by pressing various button combinations as shown in Table I. Pressing No. 1 cuts off the audio, and pressing Nos. 1 and 6 together turns off the entire generator.

![Fig. 1](attachment:image1.png)

**Fig. 1—The complete schematic. The coil L1, L2 is coil No. 4. The coils 2, 3 and 5 are omitted to make the drawing simpler. These coils and their switches are connected with similar switch points corresponding with the ones shown. Trimmer is used on coil 4 only.**

Pressing various button combinations as shown in Table I. Pressing No. 1 cuts off the audio, and pressing Nos. 1 and 6 together turns off the entire generator.

**Table I.**

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Press Modulated r.f.</th>
<th>Unmodulated r.f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>2, 3, 4, or 5</td>
<td>1 and 2, 3, 4, or 5</td>
</tr>
<tr>
<td>e.f.</td>
<td>off 6</td>
<td>1 and 6</td>
</tr>
</tbody>
</table>

The attenuator is a 500-ohm potentiometer and an L-network, providing three 40-db attenuation steps. The three taps are soldered to the output jacks which are insulated from the panel by ceramic washers. Since about 100 millivolts of r.f. is available, the outputs from the jacks are 10μv, 1 mv, and 100 mv. The a.f. output is about 5 volts, so the outputs from the jacks are 500 μv, 50 mv, and 5 v. The potentiometer permits continuous variation of output voltage in each range.

A neon bulb is connected across the filtered high-voltage supply to show the condition of the rectifier. It will start to glow about a half-minute after the generator is turned on. It is placed in a hole in the panel, so that no pilot lamp is necessary. A 50,000-ohm resistor in series with the neon bulb limits the current to a safe value. The 50-ma pilot bulb in the high-voltage lead acts as a fuse if the 12A7 rectifier current rises to much more than the maximum safe value of 30 ma.

The 6K8 is used as a plate-tuned oscillator, electron-coupled buffer amplifier, and mixer. The frequency is not affected by loading, and drift is negligible.

The pentode section of the 12A7 is connected as a Hartley-type audio oscillator with the screen grid tied to the plate. Inverse feedback provided by the unbypassed cathode resistor improves the wave form. The condenser across the primary of the audio transformer should be between .02 and .05 μf for a 400-cycle note.

The a.f. voltage applied to the grid of the 6K8 is adjusted by the voltage divider across the secondary of the audio transformer. Two resistors are used, one of 50,000-ohm resistance, and the other one adjusted till the voltage across the 50,000 ohms is about 3, checked with a vacuum-tube voltmeter. This gives 50-60% modulation. An ordinary a.c. rectifier-type voltmeter may be used to read the total voltage, and the resistors proportionately to give the proper voltage drop.

The audio wave form may be checked on an oscilloscope if one is available, or by a vacuum-tube voltmeter across the a.f. transformer secondary. As the value of the cathode resistor is increased, the a.f. output voltage will also increase until a further increase of resistance causes a decrease in output voltage. Beyond this point, the output has a good wave form. The value of the cathode resistor should be slightly greater than the one corresponding to the peak reading.

No chassis is used for the oscillator, and all parts are mounted on the panel.

**Table II.**

<table>
<thead>
<tr>
<th>TABLE II, COIL DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push</td>
</tr>
<tr>
<td>L1</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>L2</td>
</tr>
<tr>
<td>26 turns, No. 36 d.s.c.</td>
</tr>
<tr>
<td>6 turns, No. 36 d.s.c.</td>
</tr>
<tr>
<td>5 turns, No. 36 d.s.c.</td>
</tr>
<tr>
<td>3 turns, No. 32 d.s.c.</td>
</tr>
</tbody>
</table>

---

*Consulting Engineer, Annecy, Haute Savoie, France.

---

Fig. 2—Rear view, showing panel mounting. (Fig. 2). The tubes are mounted on brackets made of 1/16-inch aluminum. The push-button assembly below the tuning condenser serves as a mounting base for the r.f. coils. This method insures extremely short leads between connections. The panel is made of ¼-inch aluminum to give plenty of stiffness to the assembly, and the whole unit is enclosed in a metal cabinet for shielding.

The coils are wound on ¼-inch forms with adjustable powdered-iron cores (Continued on page 60)
Transatlantic News

By Major Ralph W. Hallows
Radio-Craft European Correspondent

CURIously television is making little appeal so far to Jacques Dubois, the French equivalent of John Smith. There has been a regular television service in the Paris area for some little time, and not too bad a service either. Program times are: 1150-1205 (daily, except Saturdays and Sundays); 1600-1730 (daily, except Saturdays and every other Sunday); 2000-2130 (Tuesdays and Fridays). Times are GMT. Vision goes out on 46 mc with a peak carrier power of 30 kw, and sound on 42 mc with 5 kw behind it. Have any of you v.h.f. dx-ers picked up the audio part? I'd be rather surprised if you haven't, for v.h.f. is spanning enormous distances just now—a point to which I'll return later. The vision system is 455 lines per frame and 25 frames per second, so it will not suit American standard televisors. Either 25 frames per second or 50 frames interlaced are likely to be the standards of European countries for the frequency of their a.c. main supply is 50 cycles per second.

I don't know of any ready-for-service French televiser on the market. Certainly I have not seen one advertised in any French radio magazine. One sees a few kits of parts advertised, and there's an occasional article on how to build a televiser. But that's just about all. I believe that a few cathode-ray tubes with bigger screens than 2 to 4 inches are produced in France. The cost of the larger ones is prohibitively high. That may well be the reason why there are so few viewers of the programs of Télévision Française, the concern responsible for the present service.

Two novel circuits

Some of the new developments in broadcast receivers are a bit hard to evaluate. The technical value of some of them may be secondary to their advertising value. However, some of these "talking points" have real interest to the radionian.

The Bush Bifocal Listening is a variation of our old friend the local-distant switch. An arrangement for changing the f.f. bandwidth from 8-9 kc (distant stations) to about 12 kc (local) is linked to the volume control. On a loud local transmission the volume control is turned down and the greater bandwidth comes in. The phrase "bifocal listening" was coined by Christopher Stone: "Just as my bifocal glasses enable me to see clearly at long or short distances, so my Bifocal radio gives me good listening on near or distant stations."

The Kolster-Brandede's "bridge positive-negative feedback" links the feedback control and the volume control—rather, makes them one and the same thing. The output transformer is said to have a third winding, tapped and grounded at its center and connected across the volume control, as shown in the sketch.

It must be remembered that in most parts of the U.S.S.R. there is comparatively little man-made static to cause interference with v.h.f. transmissions.

Now, here comes a very interesting idea. It is suggested, not only that transmitters rated up to 1,000 watts can be made from standard components by amateurs, but that they should be made all over the country. These stations (which can use air-cooled transmitting tubes) won't be owned or used privately. They'll be built and brought into action, in small towns, by the cooperative effort of local folks and will then be handed over to the municipal authorities to supply the television entertainment of the townsfolk. That strikes me as a magnificent idea for getting a nation-wide television service going in the quickest possible time in a vast country which contains innumerable small towns and villages. The big snag seems to be not the technical, but the entertainment side. There's no provision for long-distance hookups, and hence the programs must, presumably, be of local origin. My own feeling is that I'd pay quite a bit to be spared nightly entertainments by my local citizenry!

Long-range V.H.F.

I often think that the writers of radio textbooks published twenty or more years ago must feel like taking running jumps into the nearest and deepest lake when they re-read some of the statements that they once made in cold, hard print. You'll find it was stated in the 1920's that frequencies above 3 megacycles were unlikely ever to be of any great value for long-distance communications. More recent writers state categorically that the range of transmissions on frequencies above 30 mc cannot be much beyond the visual horizon. It has, in fact, often been declared that with v.h.f. transmissions there is no usable ground wave and no usable sky wave, the only serviceable kind of propagation being the direct wave.

Things move so rapidly in radio today that you hardly know where you are sometimes. If ever I write another radio

(Continued on page 70)

RADIO-CRAFT for MAY, 1948
NEW... Sensational TRANSVISION Development now offers LARGE-IMAGE DIRECT-VIEW TELEVISION at low cost!

**BIGGEST VALUE in TELEVISION!**

Model 10BL TELEVISION KIT with FM Radio
- Features Beautiful CABINET with BUILT-IN LENS
- Gives LARGE 120 Sq. In. Picture.

Roto-picture effect: Picture "rotates", giving the appearance of being in focus and clearly visible from every angle! Uses 10" Electromagnetic Direct-view Picture Tube.

Features new-type cabinet with built-in lens which magnifies, clarifies and heightens contrast of the picture. The lens also creates the effect of apparent rotation of the picture, so that when the observer moves, the picture still seems to be in focus and clearly visible from any angle.

**ECONOMICAL KIT, EASY TO ASSEMBLE.**

In point of value, this Television Kit provides the opportunity of acquiring a LARGE-IMAGE direct-view television set at a VERY LOW PRICE; also very economical from a tube replacement angle. This model is available in KIT FORM, for easy assembly; no technical knowledge required. Simple step-by-step instructions are included. Saves as much as 50% over the cost of receivers with similar picture magnitude.

**TECHNICAL DATA:** Model 10BL uses a 10" Electromagnetic Direct-view Picture Tube; has complete F.M. Radio which comes completely factory-wired; receives all channels in any area; supplied complete with antenna and lead-in wire. The LENS is 15" x 11½", giving a picture size of approx. 10" x 12" or 120 sq. in.; the highly-styled cabinet measures 26" wide x 17" high x 19" deep, available in Mahogany, Walnut or Blonde finishes.

**PRICES:**
- Transvision MODEL 10BL Television Kit, with FM, 10" tube, cabinet with built-in lens, antenna, 60 ft. lead-in wire
  - List $359.00
- MODEL 12BL, same as 10BL, except that it uses 12" tube, giving picture area of 130 sq. in.
  - List $389.00

**SCOOP!**

New revolutionary MODEL 78L Television Kit with specially designed CABINET with BUILT-IN LENS.
- Uses 7" Electrostatic Picture Tube
- Gives 50 square inch picture of superior quality

**FEATURES:** Though it has a 7" tube, the effect is equivalent to a 10" set because the built-in lens magnifies the picture. Also picture performance is superior because the lens clarifies and heightens contrast of the image. Picture "rotates" apparently, as the observer moves, giving the effect of always facing the observer. This is effective to a very wide angle. Preset for 5 channels.

**PRICE:** including cabinet with built-in lens, antenna, 60 ft. of lead-in wire
- Net $189.00

**TRANSVISION "SERVICE NOTES"**

The Key to Successful Television Servicing

Transvision's "Service Notes" is a compilation of confidential Transvision notes and information, the product of experience with over 28,000 television receivers, now made available to the public.

The "Service Notes" is the most valuable compilation of instructions and data on Magnetic and Electrostatic Television Receivers. Thorough compiled in the course of servicing Transvision Kits, the information is applicable to any type of telsisvision receiver.

"SERVICE NOTES" is complete with photographs and diagrams. This information is worth a small fortune. The cost is low. LIST $2.95

All prices 5% higher west of Mississippi. All prices f.o.b. New Rochelle, N.Y.

For further information see your distributor, or write to:

TRANSVISION INC., Dept. RC, NEW ROCHELLE, N.Y.

See TRANSVISION at the PARTS SHOW: There will be a SPECIAL TRANSVISION EXHIBIT from May 10th through the 14th at the SHERMAN HOTEL (Chicago) in the GOVERNOR'S SUITE! Be sure to see the interesting new Transvision Developments in Television and F.M.
TV BEAM-BENDER
Clarostat Manufacturing Co.
Brooklyn, N. Y.

The Beam-Bender is used with television cathode-ray tubes that require an external means of controlling location. This permanent-magnet type is entirely self-contained and can be attached without tools, which also means elimination of the breakage hazard.

The unit consists of two ring magnets held in a nonmagnetic mounting collar. The magnets provide magnetic flux proportional to the required beam-bending function in the tube. The forward magnet, indicated by the arrow stamped on the mounting collar, is adjustable.

The assembly is slipped over the base of the tube and onto the right position on the neck. Three spring fingers provide an adjustable frictional fit.

Since there is no rubber or organic material in this assembly, there is no danger of the mounting adhering to the glass neck of the tube.—RADIO-CRAFT

MODERNIZATION UNIT
Radio City Products
New York, N. Y.

The models 120 and 125 are complete modernization units, designed to bring up-to-date many tube testers that have become obsolete.

Each of these units has a flexible cable with a plug that is inserted into the local socket of the old tube tester. The new tubes are then tested in the sockets provided in the unit. Sockets are included for the new miniature and subminiature tubes. Universal sockets and space are provided for additional new sockets, should new types of tubes become available in the future.

Tube-testing charts and data are supplied with the unit.—RADIO-CRAFT

V.T. VOLT-OMMETER
Electronic Manufacturing Co.
Harrisburg, Pa.

The Model 110 vacuum-tube volt-ohmmeter is designed for servicing television receivers. The d.c. ranges are

0.3, 15, 30, 60, 300, 3,000, and 15,000 volts. On a.c. they are 150, 300, 3,000, and 15,000 volts. The a.c. range is accurate to 0.3 microvolt and is maintained over a period of time.—RADIO-CRAFT

A.C. POWER PLANT
D. W. Onan & Sons, Inc.
Minneapolis, Minn.

A 3,500-watt, 50-60 cycle a.c. electric plant weighing approximately 54 pounds per kilowatt as model JCK is one of a group employing the Onan "CK" air-cooled, 4-cylinder, 2-cylinder gasoline engine as a prime mover.

The JCK-10 has electric push-button starting, in the form of a special winding on the plant's generator which serves as the cranking motor during the starting cycle. A 12-volt automotive-type battery furnishes the starting power.

The units are supplied with a 6-foot line cord and plug and a receptacle. Various ranges are available from 75 to 2,000 watts.—RADIO-CRAFT

FM ADAPTER
Schub's Radio Parts
Chicago, Illinois

This new FM adapter is installed on any AM receiver to adapt it to narrow-band FM reception.

The air-cooled engine has a re- design of the breaker points to protect it from dust and water. The new plants will produce about one-sixth hour of electricity per quart of gasoline.—RADIO-CRAFT

AUDIO AMPLIFIER
Newcomb Audio Products Co.
Hollywood, California

The Model E-10 amplifier uses push-pull 6L6 tubes in a multistage inverse feedback circuit. Power output is 10 watts at less than 5% distortion. The frequency response is from 50 to 10,000 cycles within 2 db.

Two inputs are provided: 2 mohms for a microphone, and 100 mohms for a 600 ohm pickup. The tone control is of the treble-attenuation type. A sensitivity of 60 watts and weights 10% pounds. Its overall dimensions are 12 x 10 x 6 inches.—RADIO-CRAFT

WELDED CHASSIS
E. F. Johnson Mfg. Co.
Waseca, Minn.

The new line of E. F. Johnson chassis have no overlap at the corners. This new feature permits the locating of holes all the way to the corners. Volume controls, toggle switches, etc., can be mounted flush inside the chassis, because of the single thick-glass feature. Rigidity and durability are assured by welded nickel-steel tie bars on the inside of the turned under bottom edge where they do not interfere with the mounting of components. Bottom plates may be fastened to the reinforced edges.—RADIO-CRAFT

END-LINK COIL
Pittsburgh Coil Co.
Carnegie, Pa.

This adjustable end-link coil is designed to operate efficiently in a variety of circuits and beam power tubes. Moving the end link by hand varies the coupling to the rest of the coil. It can be substituted for standard fixed end-link coils if desired. This coil is available in 750, 950, 250, and 500-watt sizes.—RADIO-CRAFT

STEP-DOWN TRANSFORMERS
Standard Electrical Products Co.
Dayton, Ohio

Staco step-down transformers permit the step operation of tubes at 15,000 to 50,000 cycles and other equipment from a 200-240-volt source.

The transformers are built of high-quality silicon steel for cool operation. Coils are layer-wound and varnish-
C**ontinuous Research**, study of thousands of cases of actual field experience now enable us to offer you the new 900A "VOMAX". Revolutionary as was the original, the new 900A forges far ahead in simplicity, dependability all-around usability.

Just 34 months ago McMurdó Silver Co. announced "VOMAX"—the first truly stable, ultra-high input resistance v.t.v.m. Lifting the v.t.v.m. out of the limited laboratory-application class, Silver engineering and use-experience made "VOMAX" the first universal v.t.v.m. Its acceptance was instant and overwhelming — for "VOMAX" will measure, at input resistance so astronomically high as not to "load down" any circuit to which it may be connected—d.c. volts, a.c., a.f., i.f. and r.f. volts, d.c. milliamperes and amperes, resistance and db.—all over tremendous range and with laboratory accuracy. Used in scores and hundreds by such competent organizations as the National Bureau of Standards, the Navy, Army, F.C.C., C.A.A., Veterans Administration, G.E., Western Electric Co. Recommended by Bendix, "VOMAX" is consistently copied, never equalled—stands today as "standard of comparison" for the entire industry.

In announcing the new "VOMAX" we think you'll agree that we can feel just a bit proud of having again done the impossible to give you the world's finest universal Laboratory Caliber Electronic Test meter at only Net $68.50.

**F**EATURES

- Non-breakable glass 7" meter completely protected behind panel.
- Single hand-convenient probe gets into tight places, banishes usual snarl of easily fast and broken test leads.
- Newer — and fewer — miniature u.k.f. tubes.
- 51 ranges at highest available a.c. and d.c. input resistance.
- Absolutely stable—one adjustment sets meter zero for all ranges.
- No grid current error. Exclusive to "VOMAX", this vital feature is carried to new heights in new 900A.
- 24 d.c. ranges at 51 and 125 milliamperes, constant input resistance, 0 thru 3, 7.5, 15, 30, 75, 120, 200, 300, 500, 750, 1200 and 3000 volts. Polarity reversing switch.
- 6 a.c./r.f. ranges, 20 u thru 300 ma., 20 megohms input resistance shunted by 7 mmfd. 0 thru 3, 15, 30, 120, 300 and 1200 volts.
- 3 db. ranges,—10/+10, +10/+20 and +20/+40 db.
- 6 resistance ranges, 0 thru 2000, 20,000 and 200,000 ohms. 0 thru 2, 20 and 2000 megohms.
- 6 direct current ranges, 0 thru 1.2, 30, 120, 300, 1200 ma. and 12 amperes.
- True vacuum tube meter in all but current functions. No low-resistance, frequency-erroneous copper oxide rectifiers.

**O**VER 37 YEARS OF RADIO ENGINEERING ACHIEVEMENT

**McMurdo Silver Co., Inc.**

EXECUTIVE OFFICES: 1240 MAIN ST., HARTFORD 3, CONN.

FACTORY OFFICE: 1249 MAIN ST., HARTFORD 3, CONN.

RADIO-CRAFT for MAY, 1948
Question Box queries will be answered by mail and those of general interest will be printed in the magazine. A fee of 50c will be charged for simple questions requiring no schematics. Write for estimate on questions that may require diagrams or considerable research. Six to 8 weeks is required to draw up answers involving large schematics.

**WIND INDICATOR**

Please print a diagram of an electronic wind velocity and direction indicator.—W.R.H., Newport, R. I.

A. Fig. 1 is the diagram requested. The contact interrupter wheel, in the velocity indicating circuit, is a small gear or commutator mounted on the shaft of an anemometer. Its purpose is to break the connections between the 6V6 grid and ground from 10 to 20 times per revolution of the shaft. One break per revolution will suffice if larger condensers and resistors are used in the range switch circuit.

Two velocity ranges are provided. One is for winds of low velocity and the other for strong winds. The sensitivity control and the 100,000-ohm range resistors should be adjusted for best results.

The wind direction indicator is designed around the Ohmite RB-2 direction-indicating potentiometer. Its shaft may be directly coupled to the shaft of the vane or a 1:1 link may be used.

The 1,250-ohm resistor in the high-voltage lead should be adjusted so the voltage regulator tubes draw 40 ma with the 6V6 out of its socket.

**SMALL PA AMPLIFIER**

I would like to have a diagram of an electronic fence charger to operate from 117-volt a.c. lines. Please include pulse rate and voltage controls.—J.Y.R., Bethlehem, Penna.

A. This fence controller (Fig. 2) has variable output and variable pulse rate. C1 and R2 control the output voltage. If C1 is made up of a number of small condensers which may be connected in parallel through a switch, a wider voltage variation is possible. R1 sets the pulse rate. This should be adjusted to produce about 1 pulse per minute.

T1 is a special fence controller transformer with a 200-volt primary and a secondary delivering an instantaneous voltage peak of 3,000 volts into an open circuit. This unit may be a Stancor type P-6126 or equivalent.

**TUBELESS CONVERTER**

I have an all-wave receiver tuning down to 20 mc and would like to increase its range to about 45 mc by using a tubeless converter like the one described on page 19 of the February 1847 issue of Radio-Craft. Can you supply the necessary coil data?—A.T.S., Cleveland, Ohio.

A. L2 consists of 11 turns of No. 10 enameled wire air-wound with an inside diameter of 7/16 inch. The coil should be about 11/2 inches long. L1 consists of 2 turns No. 18 d.c.c. wire interwound with L2. L3 has 24 turns of No. 18 d.c.c. wire air-wound on a 7/16-inch form and spaced to about 1 1/2 inches. L4 is 3 turns of No. 18 d.c.c. interwound with or closely coupled to the low end of L3. L1 and L4 may be adjusted for best performance with a particular antenna and receiver. The length of L2 and L3 may be varied to alter the tuning range.

---

**Fig. 1**—The wind indicator is accurate for low and strong winds.

**Fig. 2**—This electronic fence charger delivers about 3,000 volts.

**Fig. 3**—Schematic of the small three-tube a.c.-d.c. amplifier.
YOU’LL WANT THIS ON YOUR DOOR!

This five-color decal identifies you as the man Sylvania is talking about—in the big new national campaign now under full steam in Life, The Saturday Evening Post, Collier’s, Radio Best.

Display this decal on your door, your windows, your truck—to hook your store up with Sylvania’s nationwide advertising.

The decal is yours for the asking... in 8-inch or 12-inch size... in any quantity you want!

GET THIS DECAL IN 8-INCH OR 12-INCH SIZE

See for yourself how quickly this cartoon ad catches the eye. See how strongly it features the Radio Serviceman’s decal—your decal!

In every Sylvania ad throughout 1948... in four great, nationally-read magazines... your customers—and the people you want for customers—will see this decal over and over again. They’ll look for it when their sets need servicing—he sure they see it on your store.

LOOK FOR THE JOBBER WHO DISPLAYS THIS COMPANION DECAL

He’s the authorized Sylvania Distributor in your locality. He’s ready to supply you with top-quality Sylvania Radio Tubes and Test Equipment, for the kind of servicing jobs that will keep your customers coming back to you.

SEND THIS COUPON NOW FOR THIS FREE SYLVANIA SERVICEMAN’S DECAL

SYLVANIA ELECTRIC

Radio Tube Division, Emporium, Pa.

Sylvania Electric Products Inc.
Radio Tube Division
Advertising Dept., Room R-1305
Emporium, Pa.

Gentlemen:

Please send, free, the following quantities of the Sylvania Serviceman’s decals:

<table>
<thead>
<tr>
<th>8-inch decals</th>
<th>12-inch decals</th>
</tr>
</thead>
</table>

Name: ..................................................

Company: .............................................

Address: ..............................................

City: .................................................. Zone #...

State: ..................................................

RADIO-CRAFT for MAY, 1948
Another Good Deal—From Mallory To You

The cabinet contains—one each of these Mallory Vibrators—248—716—859—870—1100—
1501 and two each of these buffers—OT-371—

The Fastest Selling Vibrators in the Finest Line Made—
The Mallory “2448 Vibrator Deal”

Mallory, first producer of the vibrator, builder of the sturdiest, most reliable
vibrators made, offers you an attractive deal on this important replacement part.
A fast moving selection of 6 vibrators, that will cover 75% of your require-
ments, together with an assortment of 12 buffer capacitors (2 each of 6 ratings),
in an attractive metal cabinet at a net price of $24.48 to the serviceman.

This is the serviceman’s regular price for these parts; no charge is made for the
cabinet. You sell the parts for $40.80 —make your full $16.32 profit.

Your Mallory Distributor has them in stock for immediate delivery. Place your
order now, and get this handsome, convenient cabinet for your shop.

More Mallory Vibrators are in Use Than All Other Makes Combined
... PHILCO AUTO RADIOS

If the new models suddenly go dead, take a look at the i.f. transformers. Midget i.f. transformers are used in the models CR-4 and CR-6. There is very little clearance between the lungs and the can. If great care is not used when soldering leads to the lungs, solder will run down the lug and short to the can. On several sets I have found the plate or B-plug lugs shorted to the chassis.

HAROLD L. BLISS,

Townsville, Ill.

... OSCILLATOR FAILURE

Some sets play perfectly in the shop yet suffer oscillator failure when the set is returned to the owner's home. To prevent this, I have a Variac and a.c. voltmeter in the line and lower the operating voltage on the set until the oscillator fails. If the set is a 3-way portable or a.c.-d.c. model, the oscillator will probably cut out between 80 and 90 volts input. If it cuts out above 90 volts, with normal B-voltages, try replacing the oscillator tube. If this does not cure the trouble, check the components in the oscillator circuit.

JOHN B. MOORE,
Lebanon, Tenn.

... GROUNDING A.C.-D.C. EQUIPMENT

A.c.-d.c. apparatus may be operated safely when attached to ground if only one wire is plugged into the line. A good ground is attached to the equipment and only one terminal of the line cord attached to the plug. If the line cord is of the resistor type, the terminal with the resistor must be the one attached.) The plug is then inserted in the socket. If it is plugged in correctly, the equipment will operate. If the connection is wrong, no damage will be done, and the tubes will simply not operate. This is sometimes convenient to attach equipment to earth, and at other times there is danger of accidental grounding. This kink is useful in either case.

ERICA LESLIE,
New York, N. Y.

(This circuit will not work if the equipment has a negative return isolated from the chassis.—Editor)

... ECHOPHONE EC-1 AND EC-IA

If the pilot lamp burns brightly and then burns out, look for a shorted bypass condenser at the plate of the 35L6. Replacement with a 600-volt unit prevents future breakdowns of this sort.

RICHARD LYTWYN,
Detroit, Mich.

... INTERMITTENT COILS

Automobile sets and others sometimes develop intermittent noise from corrosion in the i.f., oscillator and r.f. coils caused by dampness. If the coils are in a plate circuit, shorting the plate to ground through a 2,500-ohm resistor will draw enough current through the coil to open it permanently.

R. BUCHHEL, JR.
Ferguson, Mo.

... BATTERY RADIOS

When the complaint is distortion in the audio section of farm or portable radios with 1.4-volt tubes, replace the output tube. This should be tried even when the tube and all components check good. This trouble is very common in sets with 30Q's.

JOHN MCDONALD,
Dame Fournier, S. D.

... FIRESTONE 4-A-30

If the complaint is very poor volume, look for an open screen resistor to the 6SJ7 first audio tube. Poor volume with serious distortion is often caused by the 6K6 cathode resistor changing in value. Replace with a 450-ohm, 10-watt, wire-wound unit. Reception with push-button tuning only may be due to a shorted .01 uf condenser from the screen of the 6S7 to ground. Replace with a 600-volt condenser to prevent future trouble. If the dial turns hard, look for misalignment in the guide pulley on the side of the chassis. Bending it back into alignment will remove the stiffness.

JOHN R. SIMPSON,
Gainesville, Fla.
Here's great news for FM and TV Service Shops! A new, top quality sweep signal generator—product of a manufacturer with vast resources, advanced engineering "know-how", and wartime experience in producing test equipment—now available, DIRECT FROM THE FACTORY—at a phenomenally low price!

**ECA QUALITY**

**FM & TELEVISION**

**Sweep Signal GENERATOR**

$34.95 COMPLETE

**FREQUENCY RANGE 3 BANDS**

(No band switching necessary)

- A — 2 to 77 MC
- B — 40 to 151 MC
- C — 151 to 227 MC
- D — Calibration and reference scales
- E — Dial scale length

**TUBE LINEUP**

- A — 6C4 — Fixed frequency modulated oscillator
- B — 6C4 — Continuously variable beat frequency oscillator
- C — 6G4 — Mixer — Cathode follower output tube
- D — 7Y3 — Rectifier tube

**AM SIGNAL GENERATOR**

8 RF bands. Frequency coverage 100KC-75MC. External modulation from 40 to 30,000 cycles. Internal modulation at 440 cycles. Phase shift audio oscillator and internal modulator. A.C. 105 to 120 volts, 50 to 60 cycles. Special Hammarlund variable condenser, 3 step RF attenuator. Continuously variable RF-A.F. attenuator control. Ultra Cathode follower output tube. Modulator percentage continuously variable from front panel, internal or external, 0 to 100%. Heavy 16 gauge steel cabinet. Complete with 4 (standard brand) tubes. Amphenol coaxial connecting cable, ground cable, operating instructions and guarantee.

**RADIATION LOOP AND ALIGNMENT WAND**

Provides loose coupling. Checks loop-oscillator tracking. Increases efficiency of receiver's alignment or mistracking. Enables the service engineer to make gain measurements. Professional appearance and results. May be used on any signal generator. Complete with operating instructions.

**ECA CORPORATION OF AMERICA**

353 WEST 48th STREET • NEW YORK 19, N.Y. • PHONE: CIRCLE 6-1985

**GENERAL INFORMATION**

A — High frequency modulation throughout
B — Minimum output 500,000 U/V
C — Power required 105-125 Volt 50-60 AC 35 watts
D — Power line filter built in
E — Special line impedance tuning condenser
F — Pilot light line indicator
G — Generator output can be used either frequency or RF

**FM FRONTEND**

Complete with 2 tubes, including Magic Eye, 88-108 MC.

For use with 107 MC F-S, high Q resonant tuned lines. Heavy silver overlay on lines and connectors. High frequency isolation throughout 1-RF stage. Detector, and modulator. Large 7 1/2" standard dial. Chassis floated, non-microphonic.

**ELECTRONIC CORPORATION OF AMERICA**

CIRCLE 6-1985 for MAY, 1948
THE HOTTEST VALUES I HAVE EVER OFFERED

“ASTATIC” Quality Crystal PICK-UP

This Low Price
Actually Less Than The Replacement Cartridge
Only $1.75 each

MODEL D—Combining low cost with high performance for modern standards. Ideal for manual record players. Used successfully for modern records and records up to 6-1/2" or 7-". Statuc proof Brown finish. Complete with 12"-plastic leads. Model D-3—List price $5.50

CL-497—Curved Arm Semi-Tone

THE HOTTEST VALUES I HAVE EVER OFFERED

LOWEST PRICES

WHOLESALE CRAFT for MAY, 1948

RADIO-CRAFT for MAY, 1948

49
TEST LEAD POLARITY
A bayonet plug attached to the ends of a pair of test leads makes it possible to switch them to different instruments without the need for observing polarity.

The negative lead is soldered to the shell of the plug and the positive lead attached to the center terminal. A bayonet socket is attached to each instrument. Inserting the plug into the socket makes the proper connection automatically.

JOHN J. MACGOWAN, Minneapolis, Minn.

NOVEL BAND SWITCH
While constructing a two-band receiver, I used an idea for making the manual tuning control also serve as a band-switch control. The band switch was mounted at the rear of the chassis, its shaft directly in line with the tuning control shaft. The original tuning shaft was replaced with the blade of a Phillips-type screw driver, and the only other additions were a compression spring, a short Phillips-head screw, and two metal inserts salvaged from old knobs.

The screw was set in one end of insert A and soldered into place. The assembly was then attached to the band-switch shaft. The other insert B was then attached to the tuning shaft and placed to keep the driver point about ⅛ inch out-of-mesh with the screw.

To operate the switch it is necessary only to push the tuning knob in a bit and turn to the right or left. Upon release of pressure, the compression spring between knob and shaft bracket pulls the screw-driver end out of mesh, and stations are tuned in normal way.

OLIVER HORNUNG, Chicago, Ill.

WIRE STRIPPER
A metal photo clip makes a good wire stripper for hookup wire. Merely put the wire between the jaws of the clip, squeeze them together, and pull the wire out fully stripped. This clip is also very handy for holding ends of wire together for soldering.

GEORGE WECHSLEl, Brooklyn, N. Y.

NON-SLIP LINE CORD
To anchor a thermoplastic-covered line cord simply and neatly inside the chassis, wind two or three layers of thin vinylite-covered wire onto the end of the line cord inside the set. With the flat side of a clean chisel-shaped soldering iron, heat the insulations of both the cord and wire till their surfaces merge. When the wires cool, a smooth resilient skin will cover the anchor knot.

LUDWIG FURTH, London, England

ODD SIZE RESISTORS
When I cannot obtain an odd-size value of resistor, I make one as follows: Roughen the surface of a small strip of 1/32-inch sheet mica and paint a line with India ink down the length of each side. Wrap two turns of No. 24 wire around each end of the strip and hold them in place with a conducting cement to assure a good connection. (This cement is made of powdered graphite mixed with coil dope to form a medium paste.) After the cement dries, coat the entire unit with thinned coil dope.

One resistor made in this way measured 47 megohms. Other values can be obtained by varying the amount of ink used or the size of the mica strip.

CHARLES J. APPLIQUE, Champaign, Ill.

HEADPHONE REPAIR
When headphones become defective, almost always one of the coils is found to be open. This coil can be shorted out, allowing the current to pass through the other coil. The phones are less sensitive, but still usable till replacements can be obtained.

JOSEPH FIEDLER, Worcester, N. Y.

ANTENNA SWITCHING
A simple doublet antenna is very effective for reducing noise on short-wave bands. However, an antenna of this type gives poor results on the broadcast band. To rectify this shortcoming, I used the arrangement shown, with good results. The switch is a 4-pole, 3-contact, 2-position type. Throwing it from the first position to the second converts the doublet to a T antenna and makes all the necessary changes in connections to the receiver.

ORRIS WoOLEY, Colorado Springs, Colo.

COIL WINDING TIP
It is usually hard to thread the end of a thin wire through the pin of a coil form. But if the wire is first threaded through the eye of an ordinary sewing needle, the needle then can be used to pass the wire through the hole in the pin.

RALPH WALTER, Jersey City, N. J. (The fine wire also might be soldered to the end of a heavier wire.—Editor)

DIAL CORD REPLACEMENT
When a dial cord is difficult to replace because of the position of the pulleys, a spoke from a bicycle wheel makes a good stringing guide.

Use the head of the spoke to push or lift the cord over the pulleys that cannot ordinarily be reached.

GEORGE A. FELIX, Valley Stream, N. Y.

FREQUENCY HALVING
It's easy to get on 80 meters even if you have only 40-meter crystals. Use a regenerative tetrode crystal oscillator, but plug an 80-meter coil into the socket of the plate tank circuit. The buffer and following stages should also use 80-meter coils. All the circuits are tuned to 80-meters, half the frequency of the 40-meter crystal.

Although tuning is somewhat critical, the stability is good and there are no chirps in the keying.

JOHN A. GLASS, WSSSW/2, Bismarck, N. Dakota

RADIO-CRAFT for MAY, 1948
**RADIO**

**The Model 88-A COMBINATION SIGNAL GENERATOR AND SIGNAL TRACER**

The ultimate in signal tracing procedure is achieved by the Model 88, for the use of this model, enables you to use either the broadcast signal itself or the signal injected by the Signal Generator. This is especially useful of course when servicing "dead" or "intermittent" receivers. The Model 88 you will find is the greatest time-saver ever provided for by combining a full range Signal Generator and Signal Tracer into one unit the set up time for interconnecting, etc., is entirely eliminated.

**Signal Generator Specifications:**
- Frequency Range: 150 Kilocycles to 50 Megacycles.
- The R.F. Signal Frequency is kept completely constant at all output levels. This is accomplished by use of a special grid loaded circuit which provides a constant load on the oscillatory circuit. A grounded plate oscillator is used for additional frequency stability.
- Modulation is accomplished by Grid-blocking action which has proven to be equally effective for alignment of amplitude and frequency modulation as well as for television receivers.
- Positive action attenuator provides effective output control at all times.
- R.F. is obtainable separately or modulated by the Audio Frequency.

**Signal Tracer Specifications:**
- Uses the new Sylvania 1N34 Germanium crystal Diode which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megacycles.
- Simple to Operate—Clips directly on to receiver chassis, no tuning controls.
- Provision is made for insertion of phones of any impedance, a standard Volt-Ohm Milliammeter or Oscilloscope.

**The Model S-35 REFLEX PROJECTOR**

COMPLETE with built-in driver unit conservatively rated at 35 watts—will handle up to 55 watts without blasting.

For the sound technician who demands the best in reflex speakers. Heavy gauge non-corrosive aluminum in the main trumpet section completely eliminates blasting and blaring. The Driver is conservatively rated at 35 watts and can safely handle 55 watts without blasting. It incorporates a number of new improvements. The standard metal diaphragm heretofore used has been replaced with a new plastic diaphragm. This overcomes the resonant peaks of the old type, also, because the new plastic diaphragm is absolutely impervious to atmospheric changes whereas the old type was subject to atmospheric corrosion we are enabled to guarantee the unit for one year. Model S35 provides a maximum of coverage with a minimum of power thus reducing installation costs.

**SPECIFICATIONS:**
- Power (Conservative) — 35 Watts: Air Colon 24"; Power (Peak) — 55 Watts: Bell Diameter — 50; Impedance — 4 Ohms; Frequency Range — 120 to 5,000 C.P.S.; Projection — 1/4 Mile; Finish — Attractive Two-Tone Crystalline

**The Model 88 comes complete with all test leads and operating instructions.**

**$28.85**

**ONLY $28.50**

**The Model S-35 with Built-In Driver Unit**

**$28.50**

**DEPT. RC-4 98 PARK PLACE, NEW YORK 7, N.Y.**

**GENERAL ELECTRONIC DISTRIBUTING CO.**

**RADIO-CRAFT for MAY, 1948**
BUFFALO CAR RADIO ANTENNAS

All of our car radio antennas are made of triple plated Admiralty Brass Tubing, complete with low loss aluminum and high quality brass SIDE COWL-BR-1, 3 sections extend to 66'. Your price—single unit—$1.50; in lots of 12—$1.15 ea.

SCYDAPHER-BR-2 has a heavy duty sections that extend to 80'. Your price—single unit—$2.45; in lots of 12—$2.25 ea.

TILT ANGLE-BR-3, may be adjusted to all body contours. 5 sections extend to 66'. Single unit price—$1.50; 12 lot price—$1.25 ea.

VERSATILE-BR-4, single hole fender or top cowl mounting may be adjusted to conform with all body contours. Single unit price—$2.85; 12 lot price—$2.75 ea.

THE MONARCH—BR-5, single hole top cowl mounting, 8 sections extend to 66'. Single unit price—$1.95; 12 lot price—$1.85 ea.

SEEING OUR ANTENNAS AND COMPARING, YOU WILL NEVER BUY ANOTHER MAKE!

RADIONIEL SCR 523—Very high Frequency Voice Transmitter-Receiver—100 to 166 MC. This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each such job was a separate contract. Output—WARREN Trans—AND AMPLIFIER-PUT and 3 Microwatt Receiver Sensitivity gave up to 160 miles at high altitudes. Receiver has ten tubes and transmitter has seven tubes, including both 523. Furnished complete with 17.5 volts, 20 amp, battery and the special wide band VHF antenna that was designed for that job.

The set have been removed from unused aircraft and are guaranteed to be in perfect condition. We include free parts and diagrams for the conversion to "continuously variable frequency coverage" in the receiver.

The SCR 523 complete with 24 volt dynamotor sells for only $37.95. The SCR 622 is also available with a brand new 12 volt dynamotor for only $32.55.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. S 5 BUFFALO 3, N. Y.
Due to popular demand we repeat these terrific bargains

Three assorted new MICROPHONES, including push-to-talk type...$1.49
Ten assorted R.F. Choices including high frequency...$5.35
Five assorted AUDIO or FILTER CHOKES...$0.99
One hundred assorted RESISTORS...$1.95
Ten assorted JAN CABLES, includes SCR74,622 and BC376 types...$0.99
Six assorted OIL FILLED CAP TYPE CONDENSERS, all with mounting brackets...$1.49
Ten assorted METAL & BAKELITE KNOBS—(no wooden knobs)...$0.99
Six assorted VARIABLE CONDENSERS, including butterfly types...$1.49
Six assorted ELECTRO TRANSFORMERS...$0.99
Six assorted isolantite and bakelite R.F. COILS, shielded and unshielded...$0.99

The above ten assortments totaling over $12.00 at the unbelievable bargain prices listed can be purchased for $10.00. All merchandise guaranteed to be as advertised.

Recommended Amplifier—$39.95

14-TUBE UHF SUPERHET RECEIVER—$39.95

This beautifully constructed receiver was designed especially for Signal Corps communication units and is one of the finest and most sensitive sets ever manufactured. Operating from 460 cycles, this set has two tuned RF stages, tuned converter and oscillator. Five stages, using iron-core I.F., a diode detector, tuning eye, and a two stage amplifier. These are designed to power an audio speaker or headphones. The frequency range is 155-210 Mios. It is a simple matter to operate on other bands by making a slight alteration in the tuning coils. A complete set of tubes is included with each receiver, along with a circuit diagram and parts list. The high-voltage power supply delivers 150 milliamperes, all well-filtered by a heavy-duty choke and three 7 Mfd. oil-filled condensers. This buy of a lifetime cost the government about $750. Amateurs and experimenters will find this equipment at such a tremendous saving! See January Radio-Craft, Page 57, for complete conversion to television接收器.

Radiomen's Headquarters
401 W. Lake St., Dept. S.C. BUFFALO 7, N. Y.

Buffalo Radio Supply
219-221 Genesee St.

Buffalo, N. Y.
New Radio-Electronic Patents

MULTIPLYING MACHINE


Magnetoons are well known as generators of high-power microwave energy. Here they have another important use. A pair of magnetrons is used with associated apparatus as an instantaneous multiplying machine.

A simple relation exists between the magnetic field of a magnetron and its anode voltage, when the anode current is maintained constant. For this type of operation, the anode voltage $V$ is proportional to the square of the corresponding field $H$. We may write

$$V = kH^2 = k(x + b)^2;$$

$$E_a - E_b = k[(x + b)^2 - (x - b)^2] = 4kxb.$$  

The third term of each equation is proportional to the fact that any two numbers (or quantities like 1 and 2) may be regarded as the sum and difference of two other numbers. For example, 9 and 5 are the sum and difference of 7 and 2.

The equations show that if the magnetic field of one magnetron is made proportional to the sum of two voltages $a + b$, and if the field of the other magnetron is proportional to the difference $(a - b)$, the difference between anode potentials is proportional to the product $(ab)$. Referring to the circuit diagram, 2 triodes are used as class-A amplifiers. The input voltages are $a$ and $b$, respectively. Both plate currents flow through $H_1$ in the same direction, therefore the voltage across it must be proportional to $(a + b)$. Currents flow in opposite directions through the halves of the resistors $R_2-R_3$, therefore the voltage across it is proportional to $(a - b)$. These voltages are amplified and then connected across the magnetron field coils.

It is clear that $H_1$ is proportional to $(a + b)$ and that $H_2$ is proportional to $(a - b)$. The anode current of each magnetron is held constant by a current regulator. Then, by the previous equations, the difference between anode potentials must be proportional to the product $(a+b)$.

To operate the calculator, input potentiometers are adjusted to apply desired potentials to the amplifying tubes. The product is read off at once on the calibrated meter $M$.

RADAR TELEVISION

James W. Gibbon, Avantel, N. J. (assigned to Western Electric Co.) Patent No. 2,429,932

Radar and television may be combined to form images and scenes otherwise invisible to the naked eye. Short radio waves are directed against the desired target. Reflected energy is picked up and converted into electric currents. These are video currents which may be used to control a television receiver.

The reflected radio waves are focused by an electromagnetic lens made of material having a high dielectric constant. A porcelain lens can be designed to have a radius of curvature of 18 feet and a focal length of 8.74 feet. Such a lens forms an image 2 feet square from a scene 5 miles square at a distance of 50,000 feet.

The focused image is made to fall upon a mosaic within a vacuum pickup tube. This mosaic is made of tiny rectifying elements attached to a plate. Each element is spherical in shape. The exposed portions of each element are made of copper and the parts which contact the plate are of copper oxide. When electromagnetic waves travel through these elements, they induce currents which are rectified. Positive charges appear on the exposed parts, and the plate becomes negative.

An electron beam is caused to scan the mosaic as in a conventional television tube. As the beam strikes an element it causes the latter to discharge through resistor to ground and back to the tube cathode. These video currents are amplified and reproduced.
How to Pass
FCC
Commercial
Radio Operator
License
Exams

I can train you to pass your
FCC License Exams in a few
short weeks if you've had any
practical radio experience—
amateur, Army, Navy, radio
servicing, or other. My time-
proven plan can help put you,
too, on the road to success.

Let me send you FREE the
entire story.

Just fill out the coupon and mail
it. I will send you, free of
charge, a copy of "How to Pass
FCC License Exams.," plus a
sample FCC-type Exam and
Catalog A, describing opportu-
nities for you.

Edw. H. Gufford, Vice President

Get your FCC ticket in a FEW SHORT WEEKS

IT'S EASY IF YOU USE CIRE
Simplified Training and
Coaching Methods at
Home in your Spare Time

Get your license easy and quickly and be ready for the $3000 to
$7500 jobs that are open to ticket holders. CIRE training is the only
planned course of coaching and training that leads directly to an FCC
license. Your FCC ticket is recognized in all radio fields as proof of
your technical ability. Employers often give preference to license
holders, even though a license is not required for the job. Hold an
FCC "ticket" and the job is yours!

Look what these students say:

"Thanks to this course, I now have a very good job in a local power
plant's test department. I couldn't have obtained this job without
the math and basic electrical theories in the first part of Section I
of this course."

Stud. #28693N12

"I have been working for Police Radio Station WPFS in Asheville
for five months since getting my second-class ticket."

Stud. #28658N12

"You may be interested to know that I am employed at the local
broadcast station, where I am a transmitter operator. I took and
passed the FCC examinations last February."

Stud. #27541N12

Don't Waste Valuable Time
MAIL COUPON TODAY!

Don't put off getting this valuable information. Good jobs
in radio need men like you. You can earn higher income,
earn a bank account, enjoy vacations, and have easier and
better living. But you must have your FCC License. Hurry!
Fill out the coupon right now and mail it. There is no ob-
ligation. You owe it to yourself to get the full story NOW.

Cleveland Institute of Radio Electronics
RC-5 Terminal Tower
Cleveland, Ohio

Approved for Training under "G.I. Bill of Rights"

FREE

Tells where to apply for and take the exam-
inations, location of examining offices, scope
of knowledge required, approved way to pre-
pare for FCC examinations, positive method
of checking your knowledge before taking the
examinations.

Look at the job opportunities you will have when you get your

FCC Ticket

Forestry and conservation........ $6000
Ambulance and hospitals........... 5500
Gas and electric utilities....... 3650
Gas and oil pipe lines........... 7700
Private automobiles.............. 4300
Street railways.................. 3000
Taxicab fleets................... 7000

Look at these average pay schedules for Broadcast Jobs

Reported by FCC Nationwide Survey

Position

Big Stations
Transmitter Engineer .......... $4800
Analyzer Engineer ............. 5500
Chief Engineer ................. 7700
Little Stations

Other jobs requiring FCC commercial licenses pay similar salaries.

Get ALL THREE FREE

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
RC-5 Terminal Tower
Cleveland 13, Ohio

I want to know how I can get my FCC ticket in a few short weeks. Send
me your FREE booklet "How to Pass FCC License Examinations" (does
not cover exams for Amateur License) as well as a sample FCC-type exam
and Catalog A, describing opportunities in Radio-Electronics.

NAME:

ADDRESS:

CITY:

STATE:

ZONE:

NAME:

ADDRESS:

CITY:

ZONE:

STATE:

Check for enrollment information under G.I. Bill.

OBLIGATION—NO SALES.

RADIO-CRAFT for MAY, 1948
UNIVERSITY LOUDSPEAKERS

-can whisper, too!

And that's important because the primary purpose of any loudspeaker is to convey intelligence and not just make a loud noise. UNIVERSITY loudspeakers—with the highest conversion efficiency of any speaker of comparable size—not only give maximum sound output with minimum power input, but reproduce every detail and inflection of the voice at all levels from a whisper to a shout!

A JOB-RATED SPEAKER FOR EVERY APPLICATION!

REFLEX TRUMPETS

A wide variety available for every requirement—voice, music, paging and talk-back. Weatherproof, sturdy construction for years of dependable use.

DRIVER UNITS

Several high efficiency models with contemporary power capabilities up to 25 watts and respond to 15,000 cycles. All universal impulse guaranteed for one year.

PAGING, CALL-BACK SPEAKERS

Available in many types and power ranges. Contractor design, high conservation efficiency, high sensitivity, standard and custom sizes available for applications requiring any installation.

SUPER POWER SOUND PROJECTORS

Many sizes—100, 150 and 300 watts with conservation ranges to a few watts. Excellent quality even in the low power ranges, full power ideal for installation in small rooms and church theaters.

EXPLOSION PROOF SPEAKERS

Radial and directional types. Suitable for use in mills, refineries, grain elevators, gas stations, and mines to live steam, salt-spray or complete immersion. Power handling capacity 15 watts.

24-page technical catalog available on request.

STAR TESTER

VOLT-OMH MILLIAMMETER $24.25

An all-around tester with high quality features at an amazingly low price. Built for versatility and hardiness. Gives you easy, accurate reading, with a 4¾", 400 microammeter scale. Case is metal, cradle finished. Baffles, test leads, and instructions for use.

DESIGN DATA

5-DC VOLTAGETERANGES—0 to 1000 volts
5-AC VOLTAGETERANGES—0 to 1000 volts
5-OUTPUT METER RANGES—0 to 1000 volts
5-ADJUST CURRENT RANGES—0 to 1000 mA
3-RESISTANCE RANGES—0 to 5 megohms
3-DEGIEL RANGES—10 to +54

You are using the best when you "Service with a STAR." Contact your dealer today or write us direct.

LITERATURE available on all STAR products. Write for your copies today!

STAR MEASUREMENTS CO.

442 East 35th St., Dept. G-7, New York 17, N.Y.

---

HIGH FIDELITY AMPLIFIERS

(Continued from page 36)

Since Xcc/Req = 2 at 20% level, Req equals 44,247 ohms. Plate resistance and grid leak are 1,000,000 ohms and 500,000 ohms, therefore we solve for the plate load or coupling resistor RL in the equation

\[ RL \times Rp = Xcc \]

where \( Rp \) is the plate resistance and \( Xcc \) is the grid leak of the 2A3. The equation calls for a 51,019-ohm resistor. In practice we use a 50,000-ohm resistor.

Voltagge amplifier stage

The 6J7 has a gain of 61.9, \( G = gm \times Req \), and the signal on its grid voltage must equal its output voltage divided by its gain or 45/61.9 = 0.72 volt peak.

When the low-frequency response is down 1 db from mid-band, the reactance of the coupling condenser \( Xcc \) is one-half the resistance \( Rf \) formed by considering the grid leak of the 2A3 in series with the coupling and plate resistances in parallel. \( Rf \) equals

\[ Rf = \frac{Xcc}{2} \]

We find \( Rf \) is 504,761 ohms, so \( Xcc \) is \( \frac{Rf}{2} \) or 252,380 ohms. A 0.031-µf condenser has this reactance at 20 cycles. A larger condenser—a 0.06 µf for example—may be used.

The cathode bias (3 volts) for the 6J7 is developed across a 800-ohm cathode resistor. The value of the cathode bypass condenser is computed by following the methods applied to the 2A3.

The screen resistor drops the voltage on the screen grid to 100. Its value may be calculated from Ohm's law. Screen-grid degeneration is held to a negligible value by making \( Req \times C \) equal or greater than 0.5, when \( Rf \) is the screen-grid resistor in ohms, \( C \) is the screen bypass in farads, and \( f \) is the lowest desirable frequency (20 cycles). A 250,000-ohm resistor was used in the circuit shown. Since 250,000 \( \times C \) equals 3/20, \( C = .0000000 \) farad or 0.6 µf. Degeneration decreases as \( C \) is made larger, so a 1-µf condenser may be used.

A 3-megohm resistor is permissible in the grid circuit of the 6J7. Therefore one is used to decrease the burning effect of capacitance across its input circuit.

Another stage

Our signal source develops .015 volt r.m.s. (.021 volt peak), so added gain is needed to raise this to the 75-volt level at the grid of V2. Another 6J7 was selected for the job, and circuit constants were designed in the same manner as those of V1 and V2. Note that the load resistor of V3 is much larger than that of V2. This is because Miller

(Continued on page 58)
A CHALLENGE — Order a model 247. Disregard the unbelievably low price and compare it on the basis of appearance, quality and performance to any other Tube Tester (ANY MAKE, ANY PRICE). If you are not completely satisfied with the model 247 after a 15 day trial, return it to us for full refund—no explanation necessary.

The model 247 is not surplus nor is it a flashed-over pre-war model. It is newly designed and incorporates new advances in Tube Tester design. Read the description below and order one today!

The New Model 247

**TUBE TESTER**

Incorporates a newly designed element selector switch which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the “top-cap.”

The new free-point system described above permits the Model 247 to overcome the difficulties encountered with other emission type tube testers when checking Diode, Triode and Pentode sections of multipurpose tubes, because sections can be tested individually when using the new Model 247. The special isolating circuit allows each section to be tested as if it were in a separate envelope.

The Model 247 provides a superior sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R. M. A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

**THE MODEL 650—AN A.C. OPERATED SIGNAL GENERATOR**

RANGE: 100 Kilocycles to 105 Megacycles

* RF obtainable separately or modulated by the Audio Frequency.
* Audio Modulating Frequency—400 cycles pure sine wave—less than 2% distortion.
* Attenuation—3-step ladder type of attenuator (T pad).
* Uses a Hartley Excited Oscillator with a Buffer Amplifier.
* Tubes: 6J5 as R.F. Oscillator; 6SA7 as modulated buffer and Mixer; 6SL7 as audio oscillator and rectifier.

Model 650 comes complete with coaxial cable, test leads and instructions. Housed in heavy gauge grey crystalline cabinet with beautiful two tone etched front panel.

Size 9 3/8" x 10" x 6". ...............NET PRICE: $39.95

The New Model 670 SUPER METER

A Combination VOLT-OMH-MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS.

D. C. VOLTS: 0 to 7.5/15/25/50/100/1500/10000. A. C. VOLTS: 0 to 15/30/150/300/1500/3000

Volts—OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000. D. C. CURRENT: 0 to 1.6/15/150 Ma.; 0 to 1.5 Amps.—RESISTANCE: 0 to 500/100,000 ohms, 0 to 10 Megohms.—CAPACITY: .001 to .2 Mfd., 1 to 4 Mfd. (Quality test for electrolytics).—REACTANCE: 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.—INDUCTANCE: 1.75 to 70 Henrys; 35 to 5,000 Henries. DECIBELS: -10 to +15, +10 to +25, +20 to +50.

Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5 3/4" x 7 1/4" x 3 1/2".

**NET PRICE: $28.40**

Available for Immediate Shipment From Stock—20% Deposit Required on All C.O.D. Orders

MOSS ELECTRONIC DISTRIBUTING CO.

DEPT. RC-5, 229 FULTON ST.
NEW YORK 7, N. Y.
Mail coupon for FREE copy of this great, new Concord Catalog—a vast, complete selection of everything in Radio, Television, and Test Equipment. Thousands of items . . . latest 1948 prices. LOWER prices on first-quality RADIO SETS, PHONO-GRAPH RECORD CHANGERS, RECORD PLAYERS, RECORDS—wire and disc. Port- able AMPLIFIERS, COMPLETE SOUND SYSTEMS, TERTIERS. Latest listing of all well-known, established, reputable lines of radio parts and equipment. THE PERFECTIONISTS’ GUIDE TO BUDGET BUYING! WRONG Concord’s quarter-century reputation for Consumer Satisfaction Is the reason Radio Mfg. (the Experts who Know) keep coming back to Concord. If Concord, you must be completely SATISFIED or your money will be refunded.

CONCORD RADIO CORPORATION
101 W. Jackson Blvd., Chicago 7, Ill.

Mail COUPON TODAY!
CONCORD RADIO CORPORATION, Dept. 145
101 W. Jackson Bldg., Chicago, 7, Ill.

1. Yes, rush FREE COPY of the comprehensive new Concord Radio Catalog. (Please Print)
Name: ____________________________
Address: __________________________
City & Zone: ______________________

I LLINOIS CONDENSER CO.
NOW HAS UMP!

TYPE UMP

A popular replacement twist prong line of COMPACT, HERMETICALLY SEALED, efficient, dry electrolytic condenser, is now a member of the ILLINI line of highest quality capacitors.

The “ILLINI” UMP capacitors are now available at your local jobber. Our latest catalog, listing complete Illinois line, will be mailed to you upon request.

SPECIAL AT ALMO

RCA DRIVER UNITS

Your Cost $9.95

TRANSMITTER-RECEIVER BC-645

Your Cost $9.45

HIGH FIDELITY AMPLIFIERS (Continued from page 68)

effect is negligible in pentodes. The shunt resistance due to V3 and V2 is the sum of the output capacitance of V3, the input capacitance of V2, and stray capacitance. The gain of V2 is ignored in this case. Using constants from the tube manual and assuming 10-µµf stray capacitance, we find a 285,000-ohm coupling resistor may be used. This permits V3 to develop a gain of 242—about seven times more than is required in the specifications. The additional gain available from V3 is useful in overcoming circuit losses which may be caused by reduced operating voltages and component age.

Feedback and motorboating

Degeneration and motorboating are likely to occur when three or more amplifier stages are operated in cascade from a common power supply. This is caused by the plate circuits being coupled through the impedance of the power supply and is eliminated by using a decoupling filter RF and CF in the plate circuit of V3.

In a.f. circuits, decoupling constants are selected by making RF equal to one-tenth the value of the coupling resistor—greater where power supply voltage permits. The decoupling condenser is selected to have a reactance of 20/20 or less.

This method of designing decoupling filters is restricted to a.f. circuits. Reasons for this will be given in the next article which will cover amplifiers having a range of 6 mc.

UNIVERSAL D.C. SUPPLY

Most surplus radio equipment is designed to operate from either 12-, 24-, or 28-volt d.c. power supplies. Much of this can be used in mobile amateur and emergency stations with few changes in the circuit or control systems. Such equipment can be operated from its original dynamotors or vibrapack supplies without troublesome alterations or conversions.

If 12-volt equipment is used, install a 6-volt storage battery in series with the vehicular 6-volt battery. Use a s.p.d.t. switch in place of the d.p.d.t. unit between batteries A and B. For 24- to 28-volt equipment, use 3 auxiliary storage batteries and switches as shown. The batteries are in series for 24-volt operation and in parallel for 6-volt service, charging from the automobile generator. The wire sizes shown on the diagram are the smallest that should be used under normal conditions.

C. A. LAMPHES, Waterlo, N. Y.
HEATHKIT SERVICE INSTRUMENTS
BUILD • LEARN • SAVE

HEATHKIT SIGNAL GENERATOR KIT
Every shop needs a good signal generator. The Heathkit fulfills every servicing need, fundamentals from 150 Kc. to 30 megacycles with strong harmonics over 100 megacycles covering the new television and FM bands. 110 V 60 cycle transformer operated power supply. 400 cycle audio available for 30% modulation or audio testing. Uses 6SN7 as RF oscillator and audio amplifier. Complete kit has every part necessary and detailed blueprints and instructions enable the builder to assemble it in a few hours. Large easy to read calibration. Convenient size 9" x 6" x 4½". Weight 4½ pounds.

$19.50
NOTHING ELSE TO BUY

HEATHKIT SINE AND SQUARE WAVE AUDIO GENERATOR KIT
The ideal instrument for checking audio amplifiers, television response, distortion, etc. Supplies excellent sine wave 30 cycles to 30,000 cycles and in addition supplies square wave over same range. Extremely low distortion, less than 1%, large calibrated dial, beautiful 2 color panel, 1% precision calibrated resistors, 110 V 60 cycle power transformer, 5 tubes, detailed blueprints and instructions. R.C. type circuit with excellent stability. Shipping weight 15 pounds.

$34.50
NOTHING ELSE TO BUY

HEATHKIT SIGNAL TRACER KIT
Reduces service time and greatly increases profits of any service shop. Uses crystal diode to follow signal from antenna to speaker. Locates faults immediately. Internal amplifier available for speaker testing and internal speaker available for amplifier testing. Connection to VTVM on panel allows visual tracing and gain measurements. Also tests phonograph pickups, microphones, P.A. systems, etc. Frequency range to 200 Mc. Complete ready to assemble. 110 V 60 cycle transformer operated. Supplied with 3 tubes, diode probe, 2 color panel, all other parts. Easy to assemble, detailed blueprints and instructions.

$19.50
NOTHING ELSE TO BUY

HEATHKIT HIGH FIDELITY AMPLIFIER KIT
Build this high fidelity amplifier and save two-thirds of the cost. Push pull output using 1619 tubes (military type 6S6G), two amplifier stages using a dual triode (6SN7), and a phase inverter give a linear reproduction equal to amplifiers selling for ten times this price. Every part supplied; punched and formed chokes, transformers (including quality output to 26-15 ohm voice coil), tubes, controls, and complete instructions. Add postage for 20 lbs. 12" FM speakers for above.

$14.95
NOTHING ELSE TO BUY

NEW 1948 HEATHKIT OSCILLOSCOPE KIT
A necessity for the newer servicing techniques in FM and television at a price you can afford. The Heathkit is complete, beautiful two color panel, all metal parts punched, formed, and plated and every part supplied. A pleasant evening's work and you have the most interesting piece of laboratory equipment available. Check the features - large 5" 56P7 tube, compensated vertical and horizontal amplifiers using 6527's, 15 volts to 20 M cycle sweep generator using 884 gas triode, 110 V 60 cycle power transformer gives 410 volts negative and 480 volts positive. Convenient size 8½" x 12" high, weight only 26 pounds. All controls on front panel with test voltage and test eye post. Complete with all tubes and detailed instructions. Shipping weight 35 lbs. Order today while surplus tubes make this price possible.

$39.50
NOTHING ELSE TO BUY

HEATHKIT VACUUM TUBE VOLTMETER KIT
The most essential tool a radio man can have, now within the reach of his pocketbook. The Heathkit VTVM is equal in quality to instruments selling for $75.00 or more. Features 500 microamp meter, transformer power supply, 1.5 glass enclosed dialed resistors, ceramic selector switches, 11 megohm input resistance, linear AC and DC scale, electronic AC reading RMS. Circuit uses 6SN7 in balanced bridge circuit, a 6146 AC rectifier and 40X5 as transformer power supply rectifier. Included is means of calibrating without standards. Average assembly time is less than four pleasant hours, and you have the most useful test instrument you will ever own. Ranges 0-3, 30, 100, 300, 1000 volts AC or DC. Ohmmeter has ranges of scale times 1, 1000, 10M and 1 megohm, giving range 1 ohm to 1000 megohms. Complete with detailed instructions. Add postage for 8 lbs.

$24.50
NOTHING ELSE TO BUY

HEATHKIT CONDENSER CHECKER KIT
A condenser checker anyone can afford to own. Measures capacity and leakage from .00001 to 100 MF on calibrated scales with test voltage up to 500 volts. No need for tables or multipliers. Reads resistance 500 ohms to 2 megohms. 110V 60 cycle transformer operated complete with rectifier and magic eye indicator tubes. Easy quick assembly with clear detailed blueprints and instructions. Small convenient size 9 x 6 x 4½". Weight 4 pounds. This is one of the handiest instruments in any service shop.

$19.50
NOTHING ELSE TO BUY

IDEAL FOR SCHOOLS, TRAINING COURSES, LABORATORIES-SERVICE SHOPS, HOBBYISTS.

A WORD ABOUT HEATHKIT INSTRUMENTS
All Heathkit service instruments are supplied complete in every way — grey crackle cabinets, 2 color calibrated panels, all tubes, test leads (where required) etc. All are 110 V transformer operated. Calibrations are complete and exact, 1% precision resistors are supplied where needed. Heath engineers are ready to assist and advise. Heathkits are sold direct to customer, order from this ad. All are guaranteed.

The Heath Company
DEPT C • BENTON HARBOR, MICHIGAN

RADIO-CRAFT for MAY, 1948

59


**U.S. SIGNAL CORPS 5 METER SHORT WAVE XMTS.**

(223.00 XMTS.Title is not legible)

Some content is not legible.

**SIGNAL GENERATOR**

(Continued from page 31)

(See Table II). The coil which covers the range from 400 to 550 kc has a 500-µf fixed condenser across it to extend over the low-frequency range.

There are four coils, covering a range from 100 kc to 18 mc. Only the 400-550 kc coil is shown. As a lead from the grid of the 6K5 is run to the open terminal of one of the switches, and one from the plate to that of the other switch. The hot ends of the two coils in each unit are connected to the moving arms of the switches, and the other ends of the coils to the ground. The open terminals of the switches are connected directly to grounds.

In position, or open, switch position, all coils are shorted to ground. Pushing any button from 2 to 5 puts the corresponding coil in the circuit and disconnects any coil that is already in the circuit. (Caution: Do not push more than one coil button at a time. More than one coil in the circuit causes incorrect calibration.)

To save the work of winding, standard 176-ke, 450-ke, broadcast and short-wave coils of the commercial type may be used, with some change in the ranges. By removing turns or increasing their

---

**ATTENTION: Prospectus. Exceptional Hidden Treasure!**

Do you seek hidden treasures or rare metalific ores? Do you want to develop a Metallic Hills Detector from those U.S. Army Mine Detectors Amplifiers that we get offered at a Handsomely low price? Complete Amplifiers (I-illustrated) can be built by a practised miner with a plotter, book, and what you can build on your own. Unabout good and Jack your patent. Complete Amplifiers are not covered by the wiring diagram. U.S. Army Mine Detector Amplifiers can be obtained for $2.49 each.


**U.S. SIGNAL CORPS 5 METER SHORT WAVE XMTS.**

(223.00 XMTS.Title is not legible)

Some content is not legible.

**SIGNAL GENERATOR**

(Continued from page 31)

(See Table II). The coil which covers the range from 400 to 550 kc has a 500-µf fixed condenser across it to extend over the low-frequency range.

There are four coils, covering a range from 100 kc to 18 mc. Only the 400-550 kc coil is shown. As a lead from the grid of the 6K5 is run to the open terminal of one of the switches, and one from the plate to that of the other switch. The hot ends of the two coils in each unit are connected to the moving arms of the switches, and the other ends of the coils to the ground. The open terminals of the switches are connected directly to grounds.

In position, or open, switch position, all coils are shorted to ground. Pushing any button from 2 to 5 puts the corresponding coil in the circuit and disconnects any coil that is already in the circuit. (Caution: Do not push more than one coil button at a time. More than one coil in the circuit causes incorrect calibration.)

To save the work of winding, standard 176-ke, 450-ke, broadcast and short-wave coils of the commercial type may be used, with some change in the ranges. By removing turns or increasing their

---

**ATTENTION: Prospectus. Exceptional Hidden Treasure!**

Do you seek hidden treasures or rare metalific ores? Do you want to develop a Metallic Hills Detector from those U.S. Army Mine Detectors Amplifiers that we get offered at a Handsomely low price? Complete Amplifiers (I-illustrated) can be built by a practised miner with a plotter, book, and what you can build on your own. Unabout good and Jack your patent. Complete Amplifiers are not covered by the wiring diagram. U.S. Army Mine Detector Amplifiers can be obtained for $2.49 each.

New 1948 and F.M. Manuals

BIGGEST BARGAIN IN RADIO DIAGRAMS

Make these two new mammoth volumes your money-saving source for data on all recently released receivers. Learn about modern circuit developments, be ready to repair any new radio no matter how complex. You pay only $2 for each of these large manuals. With these two volumes on your workbench there is nothing else to buy, nothing else to pay—a whole year of radio diagrams and service data yours for a couple of dollars total. Again Supreme Publications beats all competition and gives radio servicemen greatest bargains in service information. Other volumes for previous years described below. No-risk examination granted to servicemen.

FIND ALL RADIO FAULTS DOUBLE-QUICK

You can speed-up and simplify radio repairs with SUPREME PUBLICATIONS Manuals. Service radios faster, better, easier, save time and money; use these most-often-needed diagram manuals to get ahead, earn more per hour. For the remarkable bargain price (only $2 for most volumes) you are assured of having in your shop and on the job, needed diagrams and other essential repair data on 4 out of 5 sets you will ever service. Every popular radio of all makes from old-timers to new 1948 sets, including F.M. and Television, is covered. Clearly printed circuits, parts lists, alignment data, and helpful service hints are the facts you need to improve your servicing ability. Save hours each day, every day, begin to earn more by making repairs in minutes instead of hours. Let these manuals furnish you with diagrams for 90% of all sets. There is no need to spend large sums for bulky, space-wasting manuals, or to buy additional drawings every few weeks; be wise, use SUPREME Manuals to get the most in diagrams and service data for the smallest cost. Be money ahead with Supreme Publications.

Use coupon to order manuals for examination

Use all popular sets from 1925 to 1948.

Record Changers Manuals

Post-War Models


Pre-War Models

Just when you need it—newly assembled thousands of pre-war (before 1945) automatic record changers, manual units, pickups, wireless pick-ups, recorders, and combinations. Hundreds of mechanical and electrical diagrams. 128 large pages: size 8½ x 11 inches. Price only $1.50, postpaid.

Select Supreme Diagram Manuals and Record Changer Books you want to examine. Send the convenient no-risk trial coupon. Use the money in your own home or shop for 10 days at our risk. Decide for yourself that Supreme Publications are the greatest values in service data. You may return unsatisfied, return manuals and receive your money back.

Supreme Publications

PUBLISHERS OF RADIO BOOKS, MANUALS, AND DIAGRAMS

9 South Kedzie Ave., Chicago 12, Illinois

RADIO-CRAFT for MAY, 1948
ATTENTION!!

ALL SCR-522 OWNERS

Remote Control Bases for B.C. 612C, Brand New in Original Package. Consists of 5 miniature push buttons, 5 Western Electric Blue Push Assemblies, 1 Blue Push Button, 1 White Push Button, all located in Black plastic box.

For only... $1.25 ea.

Antenna Plug 41-PO-1 for SCR-522.

STEEL CHASSIS

10 x 17 x 3 $1.38
8 x 11 x 3 $1.57
7 x 12 x 3 $1.57
6 x 14 x 3 $1.57

STEEL CANS AND BOXES

44c
85c
95c
12c

1/4 INCH STEEL PANELS

5% x 10 $1.09
6% x 12 $1.01
7% x 15 $1.04

All above Black Crackle finish. Gray panels to order.

RELAYS

CS—DIFFERENTIAL RELAY

Dual coil with armature mounted between coils. All contacts normally open. Operates 200-250 Volt. 250 Volt coil 3 amp. 320 Volt coil 2 amp. Available in 24 volt D.C. and 110 volt A.C. Models. 100,000 ohm shunt. 2.95 furnished.

SELENIUM RECTIFIERS

FEDERAL TYPE Half wave 100 Ma. 6000 V.-0.50.

METERS

5-0-5 AMPS D.C. charge & discharge 50,000 ohm 8.95
6-0-6 AMPS. R.F. O.C. 50,000 ohm 24.95

ELECTRO METER 12 volt supply. Sensitive type. Grand Slam, with 100,000 ohm shunt.

WIRE WOUND Potentiometer

100,000 ohm. precision made. G.E. type. 25 watt, 4% tolerance. Brand new...

MICHAEL CONDENSERS

.01—500V Postage Stamp...

GROUND TRANSFORMER as per Schedule

1-3 1-3 1-3 1-3 1-3 1-3...

BOOM CONDENSER .01-500V Postage Stamp...

LEEDS RADIO CO.

75 Vosey Street Dept. R.G.

Quality—Price-Dependability

BC-645A 450MC X-Mitter-Receiver

BRAND NEW Complete with Tubes including 2...

TUBES

8BP1 CR Tube 9G Green screen brand new...

8HP4 CR Tube 5W White screen brand new...

812 Dual Beam Power Tetrode...

816 H.F. Tube Triode...

2SC4 Triode 2N Output 68V 3W 506...

$7.95 Each

DYNA MOTOR 3047


$10.00 Each

ITEMS YOU MAY BE LOOKING FOR

15 2BA Xlite Diodes. 25c ea.

15 2BA Xlite Triodes. 25c ea.

$1.00 Each

Brand New $2.95

MICA CONDENSERS .01—500V Postage Stamp...

100 for $4.75

100 for $4.75

Noise Reduction

(NOISE REDUCTION

Continued from page 23)

its original frequency. Filters can therefore be used to eliminate the undesired harmonics.

Two filters are used for maximum effect, one at the input and the other at the output of the channel. Each is designed to attenuate response outside of a given octave. To cover the whole audio range, many separate octave-filtered channels in parallel must be used. However, the higher frequencies carry most of the noise, so the lower sound register (up to several kc) may be transmitted through a separate parallel channel with no need for noise reduction.

For home reproduction of phonograph selections two channels are sufficient. One can pass up to 3 kc with no noise reduction. The other can be an octave-filtered channel transmitting 3-6 kc. For still higher fidelity, more channels are required. One circuit has been designed with four channels. Three of them are filtered to transmit the following octaves respectively: 1.5-3 kc; 3-6 kc; 6-12 kc. The other channel is a low-pass network which transmits frequencies below 1.5 kc. Block diagram appears in Fig. 3.

Advantages claimed for the octave-transmission system are: There is no audible "swish" due to time constants because the circuit operates instantaneously. Furthermore, the output level is identical with the input for volume greater than the threshold value. Finally, the circuit requires practically no maintenance and is easy to operate.

The author will be pleased to answer any questions in connection with the above article. Simply address I. Queen, care of this magazine.

Polarimeter Tester

On a.c. operated instruments, it is often necessary to determine the line polarity to avoid shocks and possible damage to meters and components. Determine which prong of the line plug must be grounded and screw one terminal of a small neon lamp to it. To the other terminal of the neon lamp attach a short piece of wire with an insulated phone tip at the end. Insert the plug into the outlet and touch the phone tip to the grounded plate or screw of the outlet box. If the lamp lights, reverse the plug.

The lamp is very small and fits neatly into a recess cut in the body of the plug. The plug is wrapped with transparent tape to hold the lamp firmly.

J. Semrin

New York, N. Y.
REPORTS were received this month from Gil Harris of Massachusetts; Charles Edwards of Massachusetts; Charles H. Fuller of New York; the Department of State; and the Canadian Broadcasting Corporation. Several new frequencies are now in use by the U. S. shortwave stations. The log this time went to press before the information was received and therefore the necessary changes were not made. The following information supplements that given in the list:

WRUW, Boston, on 11.720 to Central America from 1730 to 1900 and 2000 to 2400 hours, EST. WRUX, Boston, 17.750 to Europe from 1435 to 1715 hours. WLWR2, Cincinnati, 15.530 from 1800 to 2400 to South America, KCBF, Delano, 9.700 to Japan and China from 0400 to 0930 hours. KCBR, Delano, 9.750 to the Philippines and the East Indies from 0400 to 1000 hours. KCBF, Delano, 11.810 to Alaska from 2000 to 2200 and 2215 to 2400. KNBA, Dixon, 6.060, to Hawaii from 0400 to 1005. KNBI, 6.120, to China and Japan from 0400 to 1005. KNBX, Dixon, 11.790, to China and Southeastern Asia from 0400 to 1005.

KNBX, Dixon, 15.250, to South Pacific islands from 0600 to 1700 to South America from 1900 to 2400. WCDCA, New York City, 11.830 to Mexico from 0900 to 2200. WCBN, New York City, 15.270 from 1115 to 1630 to Europe and to South America from 1645 to 1700. WCBX, New York City, 17.830 to Europe from 1115 to 1830; to South America from 1645 to 1700. KGBX, San Francisco, 11.730 to the Philippines from 0030 to 0345 and to the East Indies from 0400 to 1005. KWIX, San Francisco, 11.860, to Japan and Korea from 0400 to 0930. WGEO, Schenectady, 15.330, to Europe from 1115 to 1730.

A LISTENING SHELL

An artillery shell that listens and records what it hears is the invention of three inventors in the New York area, Harvey Fletcher, John F. Muller and Karl D. Swartzel, Jr. The projectile was originally intended as a means for testing the possibility of producing audio-proximity fuzes for anti-aircraft shells, instead of the radio-proximity fuses which are now in use. The patent, No. 2,438,384, has been assigned to the Bell Telephone Laboratories.
Get Your ALLIED Catalog Now

172 Value-Packed Pages Including Everything New in Radio...

FIRST WITH

TELEVISION by hallicrafters

Amazing Performance at Low, Low Cost!

Fully described in ALLIED'S latest Catalog—the new Hallicrafters Model T-34 Television Receiver for use in all television areas! Here's perfected, clear, sharp, bright Television at low, low cost. The 7" diameter viewing tube provides a brilliant picture 53" long by 4" high—a full 23 square-inch picture area. Push-button tuning is factory-pre-set to the 13 television channels. Receive the station in your area just by pressing the proper button. Easy to operate! Combined power switch and contrast control turns set on and regulates picture for best definition; brightness control adjusts for best viewing brilliancy; horizontal and vertical controls frame picture properly; fine tuning with FMC range provides exact tuning of sound channel. FM audio channel circuit eliminates man-made static. Has built-in 4" x 6" oval FM speaker; plenty of audio output and exceptional tonal fidelity. Distinctively styled, completely self-contained in furniture steel cabinets finished in rich silver-gray with air-dizzed top; handsome control panel in two-tone gray. Overall size, 20½" long, 9½" high, 16" deep. For 105-125 volts, 50-60 cycles AC. Complete with tubes and operating instructions. Underwriters' approved. Shpg. wt., 45 lbs.

$169.50

Easy Payment Terms: $33.90 down, $31.98 monthly for 12 months.

THE WORLD'S LARGEST RADIO SUPPLY HOUSE

ALLIED RADIO

Everything in Radio and Electronics

FREE

172-Page Buying Guide

MORE THAN 10,000 ITEMS

Everything in radio for everyone in radio! Complete lines of all leading makes of parts and equipment—all from one great, centralized source. For newest developments and best values, see your ALLIED Catalog.

TELEVISION & HOME RADIOS

A special selection of outstanding models—table radios, consoles, combinations, FM-AM—plus new Television, offered first by ALLIED at real savings. Hand-picked models—the choice of experts!

AMATEUR STATION GEAR

Here's heaven for the Ham! You'll find everything you need for your shack in the new ALLIED Catalog. See all the latest releases in receivers, transmitters, parts, station equipment—biggest Ham listings in radio!

NEW P.A. EQUIPMENT

Packaged, ready-to-use Sound Systems; amplifiers guaranteed for one full year; everything in speakers, microphones, P.A. accessories, intercom and recording equipment—leading headquar- ters for Soundment

Send for Radio's Leading Buying Guide

Send FREE New ALLIED Catalog.

Send ALLIED Easy Payment Plan details and order blank.

Address

City Zone State

ALLIED RADIO CORP.

833 W. Jackson Blvd., Dept. 2-E-9

Chicago 7, Illinois

Full Payment

Part Payment

Balance C.O.D.

Enclosed $  

Send FREE Hallicrafters' T-34 Television Receiver.

RADIO-CRAFT for MAY, 1948
Serviceshop Tests Serviceshops

By ERIC LESLIE

"K"NOWLEDGE Precedes Intelligent Action." This old proverb is truer in radio than in almost any other branch of modern industry. The progressive radio technician is an avid reader of radio magazines, books and manuals and a steady patron of radio-electronic schools. These are available in quantity, so he has little difficulty in keeping abreast of the technical advances in radio.

But when it comes to setting up a business of his own—to actually establishing a service shop—the radio technician has no knowledge to guide him. Starting with a given capital, he wants to know the answers to such simple questions as "How much rent can I afford to pay?" or "What part of my investment should I devote to test equipment?"

One of the leaders in bringing technical knowledge to the radioamateur, Howard W. Sams of the PhotoFact Service, decided to prepare a study on this important serviceman's problem. He found that nobody had any facts on which such a study could be based. And there seemed no way to get them. Various surveys had turned up bits of information on the business side of radio servicing, but these scattered and unrelated items were of little use to the radio technician starting up in business.

There was but one way to get the information—actually establish an experimental radio service shop, and learn the hard way—the only way a would-be serviceman can now learn anything about the business angles of his trade. Sams decided to start his own shop and learn by experience the opportunities and pitfalls of radio servicing.

The first step was into one of the pitfalls. A likely location was chosen. It was selected to combine low rent with a large volume of traffic past the store. An apparently ideal spot was found at

Work on the new Sams' test bench. Left portion is part of a second identical bench used to double length. The large stock of meters represents part of Sams' equipment-testing program.

RADIO-CRAFT for MAY, 1948
the crossing of two main traffic arteries and a store was rented.

Only after starting work in the new shop was it noted that other considerations than rent and prospective trade are important in selecting a location. The new place was noisy. The trackless trolley past the shop daily took hundreds of prospective customers past the door, but it also sent out high-pitched broadcasts with each shower of sparks from the overhead conductors. Flashing neon signs on the two filling stations across the intersection also made plenty of noise, as did those of the supermarket next door. "Signal tracing" showed that three doctors and one dentist—with X-ray machines—were located in the block.

Sams wrote his heading for Lesson One: "Check your proposed location for noise as well as its business possibilities."

Lesson Two was a design project. Problem: To find or design an efficient and suitable workbench. Sams had learned from many servicemen what the majority wanted was something relatively inexpensive. For those who could afford higher-priced benches, there were excellent commercial models. The designers abandoned tradition and struck out along revolutionary lines. The bench they produced consists of two parts: a flat top and a pair of shelves behind it. These shelves are the novel feature.

The back of the average bench is used as a panel for instruments. But most instruments used today are the portable type. In servicing FM or television sets—where two or three instruments may be connected to the same receiver—the mobility and flexibility of the portable instrument are especially important. This bench is designed for use with portable instruments. They can be stacked on the lower shelf at bench level and directly behind it, and used either in place or pulled out to best position. Those used less can be kept on the upper shelf.

Another point in favor of the shelves is that customers dislike to see their sets scattered over the floor, where someone may step through the loudspeaker. The shelves provide space for such radios. Receivers whose repair is temporarily interrupted—while waiting for parts, for example—can also be lifted to a shelf. This frees bench space and thus adds to virtual bench area. Another feature the technician will appreciate is the overhang at the front. See drawing, Fig. 1. Much repair work is done sitting down, and the overhang provides kneeroom. There is an accompanying disadvantage—the drawers must be spaced a few inches below the bench top for accessibility. Shelf space in the compartments beside the drawers permit storage of parts, radios, or larger tools, depending on the serviceman's need and the other fittings of the shop.

The bench may be expanded by placing its end to the wall and putting a second bench on the other side of the shelf rack. Two repairmen can then work without pelting each other's way, but both within reach of instruments.

(Continued on following page)
ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY
YOU NEED NO ADDITIONAL PARTS!

THE PROGRESSIVE RADIO KIT IS THE ONLY COMPLETE KIT
Oversteers 110-120 volts AC/DC. Contains everything you need. Instruction Book, Metal Chassis, Tubes, Condensers, Resistors and all other necessary radio parts. The 50 page Instruction Book written by expert radio engineers and instructors teaches you to build radios in a professional manner. This kit is built in a simple one piece enclosure. Each individual circuit incorporates new arrangements of detectors, RF and AP amplifiers and transformers. This kit is also suited for building of home, band, grid and loop detectors. Used by Laqueur, Allen and Armstrong experimenters, utilies screen-grid and control-grid modulation. Each vacuum tube and amplification section employed in these circuits. The circuits are designed to provide excellent performance. Also contains sufficient parts, including 1 receiver, 3 audio amplifiers, and 3 transmitters. The sets start with simple circuits of 1 tube plus rectifier, gradually grow more complex, and finish with several examples of radio sets using tubes plus rectifier.

PROGRESSIVE RADIO KIT ONLY $14.75

SPECIAL FREE OFFER
Electrical and Radio Test Test absolutely FREE with each Progressive Radio KIT PLUS FREE membership in Progressive Radio Club. Enclose for free expert advice and consultation service with licensed radio technicians. Write for further information or ORDER YOUR KIT NOW!

ESPEY CUSTOM-BUILT AM-FM HIGH FIDELITY RECEIVERS—Model No. 7-BC

Your Price $34.00
$28.00 deposit required with C.O.D. orders

PROGRESSIVE ELECTRONICS CO. Depl.RC-12
457 UNION AVE. B. 117 NEW YORK

LESSON THREE is on test instruments themselves. What instruments does the technician use most, and which can the small shop most easily do without? Are the test instruments offered to the radio repairman exactly adapted to his needs?

To get the answer to these questions Sams enlisted the test instrument manufacturers. Cooperating with the fullest, they have supplied specimens of practically all devices of test equipment currently on the market. All these will be used in checking radios on the bench. Not only will new conclusions be drawn, but weak and strong points of individual pieces of equipment will be noted and the manufacturer advised. Thus both manufacturer and his eventual customer, the radio technician, will benefit.

The new clinic expects to reverse the history of the small neighborhood radio shop. Many a serviceman has started in a small way and built up a reputation for skillful and reliable servicing, then moved on to the steadier dealer servicing, with its better income and reduction in the number of individual problems. Sams—reputation already assured plans to start with very small dealer or manufacturer servicing. When some experience in general servicing has been obtained, the doors will be opened to radio owners of the neighborhood and the shop will proceed to the more advanced subject of individual customer servicing.

The lessons will be learned in this pioneer effort should be very valuable to the American radio technician. Indeed, there are so many things to be learned and this is so obviously the common sense way to learn them, that the onlooker can only echo Sams himself and ask, "Why hasn't someone done it before?"
Why play "PENNY-ANTE"... when your business is at stake?

A good reputation, like goodwill, is built by many deeds, but may be destroyed by a single dissatisfied customer. Your reputation is too valuable to risk for the few pennies "saved" by buying inferior or unknown "bargains." That's why we keep repeating "Your Reputation and your customers deserve the best!" And the best means Sprague.

SPRAGUE TM TUBULARS—The first truly practical MOLDED Paper Tubular Capacitors!

SPRAGUE ATOMS—Universal Midget Dry Electrolytics!

SPRAGUE LM—Universal Mounting Replacements!

SPRAGUE EL—Self-Mounting Midget Can Type!

THESE SPRAGUE PRODUCTS ARE UNCONDITIONALLY GUARANTEED!

When used at their capacitance and voltage ratings, these Sprague Products are unconditionally guaranteed to render satisfactory performance.


(JOBBIN G AND DISTRIBUTING ORGANIZATION FOR THE PRODUCTS OF THE SPRAGUE ELECTRIC COMPANY)
THE PRICES SPEAK FOR THEMSELVES

TELEVISION

COAXIAL CABLE, 72 ohms, 100 foot roll... 6.95
COAXIAL CABLE, 72 ohms, 500 foot roll... 32.10
TWIN LEAD IN WIRE, 300 ohms, 100 foot roll 1.95
TWIN LEAD IN WIRE, 300 ohms, 1000 foot roll 17.50
FOLDED DIPOLE ANTENNA, reflector type 7.25

FM CONDENSER & COIL KIT, with instructions and schematic diagram... 4.35
INTERCOMMUNICATION SYSTEM, master & station complete with 8 tubes... 17.87
VOLUME CONTROLS, 50m, ¥1, i or 2 years, all with switches... .89
OUTPUT TRANSFORMERS, matching 504, 15$, push pull... 6.86
TOGGLE SWITCHES, S.S.S., 15c, D.S.T... 25c, D.P.D.T... 49c
SELENIUM RECTIFIERS, 15 ma... 49c

CONDENSERS

.001- .004... $1.50-
.004- .008... 7c-
.02- .08... 4c-
.08- .15... 3c
.15- .25... 2c
.25- .35... 1c-
.35- .50... .9c-
.50- .75... .7c-
.75- 1.0... .6c-
1.0- 2.0... .5c-
2.0- 3.0... .4c-
3.0- 4.0... .3c-
4.0- 5.0... .2c-
5.0- 6.0... .1c-
6.0- 10.0... .08-
10.0- 20.0... .06-
20.0- 30.0... .04-
30.0- 50.0... .02-
50.0- 100.0... .01-
100.0- 150.0... .005-
150.0- 200.0... .003-
200.0- 300.0... .002-
300.0- 500.0... .001-
500.0- 1000.0... .0005-
1000.0- 2000.0... .0002-
2000.0- 5000.0... .0001-
5000.0- 10000.0... .00005-
10000.0- 20000.0... .00002-
20000.0- 40000.0... .00001-
40000.0- 80000.0... .000005-
80000.0- 160000.0... .000002-
160000.0- 320000.0... .0000005-
320000.0- 640000.0... .0000002-
640000.0- 1280000.0... .00000005-
1280000.0- 2560000.0... .00000002-
2560000.0- 5120000.0... .00000001-
5120000.0- 10240000.0... .000000005-
10240000.0- 20480000.0... .000000002-
20480000.0- 40960000.0... .000000001-

RADIO TUBES—KNOWN BRANDS—BULK

80. 5Y3GT, 6Y4GT, 6C4, 9002... Each... .42
3A5, 1525, 2550GT, 35owed... .45
6F6GT, 6J7, 6SA7, 6SK7, 6SO7... .47
36, 37, 77, 78, 6H6, 6D6... .49
12AT7, 12BA6, 12BE6, 190T7... .49
12SA7, 12SK7, 6F6GT, 75... .49
6J7, 6G7, 6G6, 68F6, 68NT... .55
36A5, 35L6, 5685, 56L6, 50Y6... .55
43, 6A7, 6AS, 7BT, 25L6... .59
024, 6X6GT, 1F7, 7N7, 7T4... .65
16A6GT, 1A6GT, 1H6GT, 1T6GT, 1N6GT... .74
154, 15S, 15U, 174, 3Q4, 3Q6, 3S4... .79
14A7, 14B6, 14G6, 35T4, 50AS... .95
1L6, 6AC7, 6EL9, 6DJ9, 50Z9... .95
1LC5, 1LH4, 1L6, 1L7, 1L723, 1L726... .95
25AE5, 11LT7G, 11N7GT, 11T7PT... 1.35

FREE

RADICAT RATION CATALOG

TELEVISION SIMPLIFIED

By Mildred S. Kruger

with instructions for installing and using television receivers. Technical material on form. In 8vo. 55c.

TRANSGATIONAL NEWS*

(Continued from page 38)

book, I think I'll play for safety. In the final revision of the proofs, besides changing every "is" into "may be" and every "know" into "believe," I'll insert "probably" into most of the statements. The objections to investigation follow 504, 15$. push pull... 6.86

RADIO TRANSFORMER KITS... 59, 15c.

TOGGLE SWITCHES, S.S.S., 15c, D.S.T... 25c, D.P.D.T... 49c

SELENIUM RECTIFIERS, 15 ma... 49c

BROOKS RADIO DIST. CORP.-80 Vesey St., (Dept. A) New York 7, N. Y.

FREE RADICAT RATION CATALOG

TELEVISION SIMPLIFIED

By Mildred S. Kruger

with instructions for installing and using television receivers. Technical material on form. In 8vo. 55c.

RADIO TRANSFORMER KITS... 59, 15c.

TOGGLE SWITCHES, S.S.S., 15c, D.S.T... 25c, D.P.D.T... 49c

SELENIUM RECTIFIERS, 15 ma... 49c

BROOKS RADIO DIST. CORP.-80 Vesey St., (Dept. A) New York 7, N. Y.

RISCO HAS IT

V. M. MIXER CHANGER
PLAYS 16" and 12" records on 55c.

DOBYOLA, $13.75

G. L. RECORDERS

Hingle Speed, 135 Speed, Ga. Speed, $3.65. Dual Speed... $2.50. off on Radio-Continued Recording

SERVICE'S SPECIALS

100-INSUL. 198, 884, M. I. 2W... $1.45
100-INSUL. 198, 884, M. I. 2W... $1.45
10-ACTUATED COND. ARM. 2W... $1.65
10-ACTUATED COND. ARM. 1.5W... $1.85
10-ACTUATED VOLUME CONTROL... $2.25
NEON TESTERS

ALLENE PHONO MOTES

ASTATIC 21.25 or BRUSH GLABRE PICKUP... 1.79

PHILO AMPLIFIER

Wiring 552, J-34... $2.75

Wiring 552, J-34, 555... $2.75

25% on C.O.D. orders. Orders Filled as Received

FREE Catalog "C" Just Out

RADIO TECHNICIAN'S EQUIPMENT

35 WEST BROADWAY N. Y. 7

RADIO MEN SERVICEMEN BEGINNERS

MAKE MORE MONEY EASILY—QUICKLY

$250, WEEKLY POSSIBLE

We Show You How

Information Free

MERIT PRODUCTS

216-23Y 12W... 27.50 NEWFIELD GARDENS 15, N. Y.

SHANEY'S

NEW 20 STEPS TO PERFECT AMPLIFICATION

AMPLIFIER CORP. of AMERICA

398-10 Broadway - New York 13, N. Y.

Do you need BINDING POSTS?

The XL PURE POST won no scoring awards. Constant Contact and Instruction Sheet. Made of All Aluminum Type 80 A-1. No screws. Electron Tube Type Wire at 15c each. Type A for all Tube or 8-12.4 Stains. Proven to Without Binding Posts in 250 tubes. 1.50

X. L. RADIO LABORATORIES

420 West Chimes Ave., Chicago 18, Ill.

RADIO CRAFT for MAY. 1948
WIRE & TAPE RECORDING COMPONENTS.

- Essential "hard-to-get" parts for use described in Radio Craft. 12/4 wire, 20-Amp. 120 volt. 100,000,000 M.C. RECORDING-PLAYBACK HEAD. Precision engineered and tested. Visible proof of quality for a life-time. \( \text{\$6.95} \)
- PM-4 RECORDING MOTOR. Heavy duty, 120 VAC. 3000 R.P.M. New design. Adjustable to W.W.R.D. \( \text{\$4.95} \)
- ALUMINUM ERASE MAGNET. \( \text{\$1.00} \) for tape宫殿 for W.W.R.D. \( \text{\$4.95} \)
- TUBES! TUBES! TUBES! All in perfect condition, but some will be rare. Most must be priced at \( \text{\$5.00} \) per set. Every tube guaranteed 90 days. \( \begin{array}{ll}
\text{567} & \text{\$3.00} \\
\text{675} & \text{\$4.00} \\
\text{697} & \text{\$4.50} \\
\text{50,000} & \text{\$5.00} \\
\text{50,000} & \text{\$5.00} \\
\text{50,000} & \text{\$5.00} \\
\end{array} \)
- TUBE DROPS. \( \text{\$15.00} \) per dozen, quality guaranteed. Shortages of these and more for only \( \text{\$2.50} \).

ALARM CLOCK USES LIGHT

An electric alarm clock that will even awaken deaf persons is now on the market. In use, the bed lamp is plugged into the clock. As long as the clock is running, the alarm lamp, the lamp starts flashing on and off. A penetrating buzzer warning sounds seven minutes after the flashing starts. If the deaf person is not awakened, installation of a small photoflood bulb in the bed lamp is guaranteed to produce results in the most stubborn cases.

ALARM CLOCK USES LIGHT

An electric alarm clock that will even awaken deaf persons is now on the market. In use, the bed lamp is plugged into the clock. As long as the clock is running, the alarm lamp, the lamp starts flashing on and off. A penetrating buzzer warning sounds seven minutes after the flashing starts. If the deaf person is not awakened, installation of a small photoflood bulb in the bed lamp is guaranteed to produce results in the most stubborn cases.

WIRE & TAPE RECORDING COMPONENTS.

- Essential "hard-to-get" parts for use described in Radio Craft. 12/4 wire, 20-Amp. 120 volt. 100,000,000 M.C. RECORDING-PLAYBACK HEAD. Precision engineered and tested. Visible proof of quality for a life-time. \( \text{\$6.95} \)
- PM-4 RECORDING MOTOR. Heavy duty, 120 VAC. 3000 R.P.M. New design. Adjustable to W.W.R.D. \( \text{\$4.95} \)
- ALUMINUM ERASE MAGNET. \( \text{\$1.00} \) for tape宫殿 for W.W.R.D. \( \text{\$4.95} \)
- TUBES! TUBES! TUBES! All in perfect condition, but some will be rare. Most must be priced at \( \text{\$5.00} \) per set. Every tube guaranteed 90 days. \( \begin{array}{ll}
\text{567} & \text{\$3.00} \\
\text{675} & \text{\$4.00} \\
\text{697} & \text{\$4.50} \\
\text{50,000} & \text{\$5.00} \\
\text{50,000} & \text{\$5.00} \\
\text{50,000} & \text{\$5.00} \\
\end{array} \)
- TUBE DROPS. \( \text{\$15.00} \) per dozen, quality guaranteed. Shortages of these and more for only \( \text{\$2.50} \).

ALARM CLOCK USES LIGHT

An electric alarm clock that will even awaken deaf persons is now on the market. In use, the bed lamp is plugged into the clock. As long as the clock is running, the alarm lamp, the lamp starts flashing on and off. A penetrating buzzer warning sounds seven minutes after the flashing starts. If the deaf person is not awakened, installation of a small photoflood bulb in the bed lamp is guaranteed to produce results in the most stubborn cases.

WIRE & TAPE RECORDING COMPONENTS.

- Essential "hard-to-get" parts for use described in Radio Craft. 12/4 wire, 20-Amp. 120 volt. 100,000,000 M.C. RECORDING-PLAYBACKHEAD. Precision engineered and tested. Visible proof of quality for a life-time. \( \text{\$6.95} \)
- PM-4 RECORDING MOTOR. Heavy duty, 120 VAC. 3000 R.P.M. New design. Adjustable to W.W.R.D. \( \text{\$4.95} \)
- ALUMINUM ERASE MAGNET. \( \text{\$1.00} \) for tape宫殿 for W.W.R.D. \( \text{\$4.95} \)
- TUBES! TUBES! TUBES! All in perfect condition, but some will be rare. Most must be priced at \( \text{\$5.00} \) per set. Every tube guaranteed 90 days. \( \begin{array}{ll}
\text{567} & \text{\$3.00} \\
\text{675} & \text{\$4.00} \\
\text{697} & \text{\$4.50} \\
\text{50,000} & \text{\$5.00} \\
\text{50,000} & \text{\$5.00} \\
\text{50,000} & \text{\$5.00} \\
\end{array} \)
- TUBE DROPS. \( \text{\$15.00} \) per dozen, quality guaranteed. Shortages of these and more for only \( \text{\$2.50} \).

ALARM CLOCK USES LIGHT

An electric alarm clock that will even awaken deaf persons is now on the market. In use, the bed lamp is plugged into the clock. As long as the clock is running, the alarm lamp, the lamp starts flashing on and off. A penetrating buzzer warning sounds seven minutes after the flashing starts. If the deaf person is not awakened, installation of a small photoflood bulb in the bed lamp is guaranteed to produce results in the most stubborn cases.
A 'NATURAL' FOR RADIO MEN!

Train for Good Pay in ELECTRIC MOTOR REPAIR

The busiest, most profitable electrical service of all!

ELECTRIC MOTOR REPAIR is a big, profitable, 120-page training book that can quickly help you learn this important work at home—for only $5 for the complete course. Written especially for beginners. Tells you what to do—exactly how to do it. Everything shown and explained, simply, thoroughly and understandably. Based on what you can learn from this alone, you can train for prompt, profitable service on practically every electric motor in common use.

AN UNCROWDED, BIG-PAY FIELD!

The electric motor repair report is a valuable, well-paid mail. There are big opportunities for the work almost everywhere. Statistics show there are 15 million motors in use in the United States alone. This means more to oil burners, air conditioners, record players, dishwashers, refrigerators, clothes washers, fans, and many more! And there are millions more in industry! Good motor repairmen are scarce. Every motor or appliance that uses motors must send motors back to the factory for repair or to motor dealers!

NO PREVIOUS TRAINING NEEDED

ELECTRIC MOTOR REPAIR book teaches you the work from the beginning. Every important step is illustrated, both in text and visually by more than 200 special illustrations. Quick reference stencils show how to handle specific jobs. Ideally used for training beginners and reference in busy motor shops. Covers practically every modern motor type and "make" mechanical and electrical. Book divided into 6 sections so that both text and related illustrations can be studied together.

BORROW IT FOR 5 DAYS

Send coupon now. Practice from ELECTRIC MOTOR REPAIR for 5 full days. See how interesting the work is—how rapidly it can be learned. Then, if, not more than satisfied, return book and your money will be cheerfully refunded and no questions asked!

ALL THIS... for only $5!

ELECTRIC MOTOR REPAIR includes complete discussions of motor parts, connections, reversing, troubleshooting, winding, etc. Gives full instructions on all types of phase motors; synchronous motors; synchronous and direct-current motors; polyphase; alternating-current and fixed-wound type; universal, shunt-pole and the motor: 4-generator; synchronous motor and other variable. Assemble and test each motor is detailed. Written in clear language. Trains you to be paid $5.00 an hour. 120 pages, $5.00.

YOU CAN'T LOSE ON THIS OFFER!

Dept. RC-58, Murray Hill Books, Inc.
323 Madison Ave., New York 17, N. Y.

D Rush me a copy of ELECTRIC MOTOR REPAIR for 5-DAY TRIAL EXAMINATION. I agree to return book and my $5.00 refund within 5 days if I am not completely satisfied. If I keep book and return money, I'll also add my state sales tax. Money refunded within 5 days if you are not satisfied in every way. Send me ELECTRIC MOTOR REPAIR now. I understand that if I return book and $5.00 refund within 5 days, I'll get money back. I understand this trial offer is good only as long as stock lasts. I understand I'll get ELECTRIC MOTOR REPAIR book only if I return book and $5.00 refund if unopened within 5 days. All rights reserved. Copyright, 1947, Murray Hill Books, Inc.

MAY SPECIAL

RESISTOR KITS $1.45
100 assorted carbon and wire wound resistors—1/2 to 10 watt. Wide range of values. All standard values at good prices.

CONDENSER KITS $1.75
56 assorted paper and mica condensers. All standard values... at good prices.

WIRELESS PHONES

Phone Pk. Amplier $2.95

Mikes and Phone Ampliers $1.45
This unit and complete with all parts needed. Includes 5 tubes and 2 transformers. All wired and tested. Diagram supplied.

RADIO PARTS

Antique Crystal Pickups $1.89
Antique Crystal Ornaments $1.25
L-48
Selenium Rectifiers, 100 MA $0.00
1/4 Mag. Volume Controls & Stn. Long Shaft
Occ. Chk. 16A27 $1.10
16

STANDARD MAKE CONDENSERS

S669-150v $ .45
D667 .60
S690 .75
D620-$1.00
D604 3v or 4v or 5v $1.15
D607 15v or 25v $1.50
608 15v $16.40
D610 45h 35v $1.50
634 100h 16v $1.60
650 50h 15v $1.75
635 25h 15v $3.50
629 10h 15v $4.00

All prices F.O.R. N.Y.O.--G.C.O.D. 25% Off

THE ROSE COMPANY
88 West Broadway, Dept. (C) N.Y., N.Y.

RESISTANCE-CAPACITANCE OSCILLATORS

The resistance-capacitance tuned oscillator in Fig. 5 is used for the generation of audio frequencies. Frequency is controlled by an R-C network that provides regenerative coupling to a feedback amplifier. Main design points in this circuit are to use as few bypass condensers as possible and to make the ones used of high capacitance to minimize phase shift at very low frequencies. The amplifier must be designed for wide-band response to prevent phase shift at the higher frequencies and must also use a large amount of negative feedback. A 5-watt, 117-volt lamp is usually used in the cathode of the oscillator to provide the negative feedback. The lamp also automatically controls the amplitude.

Audio frequencies may be produced by a beat-frequency oscillator (Fig. 6), which is a combination of two r.f. oscillators, one fixed at about 100 kc and the other variable. The two outputs are fed into a mixer, then amplified. The difference between the 2 frequencies represents the audio output. A very wide range of frequencies extending well into the r.f. region can be covered with this type of circuit.

The b.f.o. has several drawbacks. The chief one is the tendency of the oscillators to "lock in" with each other at low frequencies. Unless filters are used to get together with careful design, cross-modulation of the higher harmonics occurs. For this reason the b.f.o. feedback circuit is rapidly displacing the b.f.o.

Electron-coupled oscillator

Buffer stages are needed between most oscillators and their loads. A load connected to an oscillator changes the current in the tank circuit which in turn affects the frequency and might even stop oscillation entirely. If the load varies the oscillator will be adversely effected. The buffer stage can be eliminated by using an electron-coupled oscillator (Fig. 7). This is the Hartley circuit

LABORATORY TYPE OSCILLATORS

(Continued from page 27)

Fig. 6—A typical beat-frequency oscillator, which is a combination of two r.f. oscillators, one fixed at about 100 kc and the other variable. The two outputs are fed into a mixer, then amplified. The difference between the two frequencies represents the audio output. A very wide range of frequencies extending well into the r.f. region can be covered with this type of circuit.

The b.f.o. has several drawbacks. The chief one is the tendency of the oscillators to "lock in" with each other at low frequencies. Unless filters are used to get together with careful design, cross-modulation of the higher harmonics occurs. For this reason the b.f.o. feedback circuit is rapidly displacing the b.f.o.

Electron-coupled oscillator

Buffer stages are needed between most oscillators and their loads. A load connected to an oscillator changes the current in the tank circuit which in turn affects the frequency and might even stop oscillation entirely. If the load varies the oscillator will be adversely affected. The buffer stage can be eliminated by using an electron-coupled oscillator (Fig. 7). This is the Hartley circuit

Fig. 7—Electron-coupled Hartley oscillator with a few changes. The screen grid is used as the anode and output is taken from the plate. The cathode is at an alternating potential above ground, but the screen is grounded.

The electron stream which reaches the plate is "modulated" at the frequency of
oscillation, and by inserting a tuned circuit in the plate lead as shown in the figure, it can transform the r.f. energy by either capacitive or inductive coupling to an external load. The plate circuit is at all times well shielded from the oscillating circuit, because the screen is grounded at radio frequency.

In all the above types of oscillators good wave form has been one of the most important features to be considered, but one oscillator with very bad wave form is much used—the multivibrator (Fig. 8). It is useful because it can "count down" a higher frequency to a lower one in predetermined steps. One important use is to divide the frequency of a crystal oscillator into a frequency suitable for running a synchronous clock. In this case, the crystal oscillator usually has a frequency of 100 or 1,000 kc. The output triggers the multivibrator, which generates subharmonics of the original frequency. By using two multivibrators, an output of 1 kc—or even down to 10 cycles—is entirely possible. The output will be just as accurate and stable as the crystal oscillator itself.

The wave form of the multivibrator is rich in harmonics that are usable up to the two- or three-hundredth. The output harmonics of a 10-kc multivibrator may be used to spot points on a receiver dial 10 kc apart up to at least 2 megacycles.

AMPLIFIER WITH FOUR INPUTS

Amplifier has four input channels and separate treble and bass controls. Push-pull 6L6's are used in the output stage.

The two microphone stages are unique in that d.c. from the cathode bias of the 6L6's is used on the filaments to reduce the hum level. A pair of 12SJ7's may be used in place of the 7C7 tubes if the 6L6 cathode bias resistor is changed to 280 ohms, 10 watts. The 7F7 is an electronic mixer and can be replaced with a 4SC7 or a 4SL7.

EUGENE K. GOODWIN,
Los Angeles, Calif.

THE COLLINS FM-AM TUNER

The last word in high fidelity, laboratory performance

AM

- EMPLOYS OUR 25-C BAND PASS TUNER
- 20 KC BANDWIDTH
- 530 to 1700 KC
- DELAYED, AMPLIFIED AVC

FM

- ARMSTRONG CIRCUIT
- 1 TUBE CIRCUIT
- 3 J.F. STAGES
- 2 LIMITERS
- 88-108 MC
- NEW 6SL7-G TUNING EYE

CHECK THESE ADDITIONAL FEATURES

This is the finest u.v. magentic and controlled by any other set tuner now on the market. q Heavy duty power supply included. q Two complete Tuners, only Audio Tube envelope. q Voltage regulated power supply. 17 Tubes in standard model. q Available with a wide selection of extra accessories.

Not a production line radio, but carefully built by expert technicians who know their business, in an integrated radio receiving system, with high fidelity components, the performance is breathtaking.

You will not be completely satisfied until you have the Collins Tuner in your home.

WRITE FOR TECHNICAL FOLDER "RC" AND PRICES

COLLINS AUDIO PRODUCTS COMPANY, INC.
WESTFIELD, NEW JERSEY
P. O. BOX 300
WILLIAMSBURG 2-4090

EASY TO LEARN CODE

It is easy to learn or increase speed with an Instructograph Code Trainer. It affords the quickest and most practical method yet devised. For beginners. Available tapes from beginner's alphabet on up to typing on subjects. Read range 1 to 40 WPM. Always return tape when finished.

ENDORSED BY THOUSANDS!

The Instructograph Code Trainer enables students of all ages to become proficient typists. The expert instructor and unique teaching method in this latest and most effective system have received many endorsements from users. The INSTRUCTOGRAPH COMPANY was founded in 1923, and has trained thousands of students in shorthand and typewriting.

INSTRUCTOGRAPH COMPANY
4701 Guardian Rd., Dept. RC, Chicago 40, Ill.
WOBBLULATION SIGNAL GENERATOR
(Continued from page 35)

Fig. 9—The power supply and connecting cable. Note error in polarity of C20 and C21.

Fig. 10—How zero beat looks on 'scope screen.

Fig. 11—Positioning node to center of trace.

shielding. The binding posts, of course, must be insulated from the chassis. No pilot light was installed in the wobblulator, as this feature was incorporated in the power supply. All power is carried from the power supply to the signal generator through a rubber-covered multi-conductor cable.

The power supply

The power supply (Fig. 9) was designed for universal use. The case is identical in size to the FM signal generator. The transformer for the universal supply can be the type frequently used in tube checkers, providing a high voltage for B-supply and various voltages for filaments. The author removed the filament windings from a large receiver power transformer (noting the turns/volt ratio) which had the excess space in the winding window. A new filament winding was then wound, providing taps at the proper points for filaments up to and including 35 volts.

Precise voltage regulation of the B-supply is usually desirable for applications such as our FM generator. The original model did not include this feature, although voltage regulators were tried in some of the tests. The two VR tubes and the 2,500-ohm dropping resistor R25 shown in broken lines may be added within the same cabinet. When the regulator tubes are installed, S3 should be a d.p.s.t. switch.

Adjustment and calibration

After the usual checks have been made on filament, plate, and screen voltages, the unit is ready for adjustment. First check both the input and output of the buffer tube V2 for proper form of all three wave shapes (Figs. 2, 3, and 4). The voltage gain of V2 will be slightly less than one, and the input and output wave forms should appear practically identical. While the wave shapes are being checked, the oscilloscope vertical input should be connected at the grid of V2 or V3 (binding post W). The square wave will show considerably greater amplitude than either of the other two, and great enough to allow production of a sizable trace without using the oscilloscope vertical amplifier. This method should be used to see the true shape of the square wave because the usual single-tube amplifier found in most oscilloscopes will distort such a wave shape. The triangular or pyramidal wave is the one in which we are particularly interested.

Assuming everything has gone well so far, we now have linear triangular excitation for the frequency modulator. Start adjustment of this section of the unit with C7 at maximum (closed), R10 at maximum, and C18b partly open. The setting of C18b is unimportant for the moment. Connect the FM output to the oscilloscope vertical amplifier and adjust the oscilloscope sweep to 60 cps. Connect the output of a constant-frequency test oscillator (signal generator) to the r.f. terminal of the wobblulator.
sweep can be determined. The desired maximum sweep is 60 kc or a deviation of 30 kc each side of the center frequency. The exact amount of maximum deviation is not critical as long as it is adequate.

The value of R13-C7 determines the relationship between the out-of-phase voltage on the reactance tube grid and its plate current. Adjust C7 to give the desired 60 kc sweep. When R13-C7 comes too small, oscillation over part of the sweep cycle may be blanked, as evidenced by a 'scope trace such as Fig. 12, obtained on the oscillator plate. Parasitic oscillations and complete instability can also result. Extending the sweep too far will also give a non-linear grid potential vs. frequency characteristic for the reactance modulator.

The final adjustment consists of setting the range of center frequency, after which the dial on C18a can be calibrated. The center frequency of the FM signal output at any particular setting of C18a is determined as follows. The FM output is connected to the oscilloscope vertical input. The constant-frequency generator signal is injected at the r.f. terminal of the wobbler. The oscilloscope horizontal sweep is adjusted to 120 sweep cycles per second. When the constant-frequency signal lies within the deviation of the FM signal, a double trace will appear on the 'scope, each trace being one-half of Fig. 10. When the zero beat points on the two superimposed traces coincide at the center, the constant signal is at the same frequency as the center of the FM signal. C18b is adjusted to give the desired center or carrier frequency range as determined by readings taken at the maximum and minimum settings of C18a. Varying C18b, of course, moves the range up or down the scale of frequencies as well as widening or contracting the range somewhat. It may be necessary, therefore, to alter the inductance of L slightly.

With the end points at the desired values, it is now necessary only to set the constant frequency at, say, 5-kc intervals over the selected range, bring the zero beats together on the superimposed 'scope traces, and mark the dial on C18a. The spaces between the 5-kc marks can then be divided into five divisions to give 1-kc calibration. The calibration will be essentially linear. Final calibration should be done with all shields and covers in place. Needless to say, the calibration will be no better than that of the fixed-frequency test oscillator used.

VOLUME EXPANDER
You may want to try a simple volume expander which will increase the dynamic range of phonograph records or radio programs. The only materials required are two flash-light bulbs (3½-v., glass), and a piece of 3-cell flash-light seemed to be the most satisfactory in the model constructed), two 1-ohm resistors (a 4-inch length of No. 26 nichrome wire makes a very satisfactory 1-ohm resistor), and enough wire to connect these components together (as shown in the diagram).

At low levels, the lamp filaments pass little current and are quite cold. The resistance is low (in the order of several ohms) thereby almost completely balancing the volume expander bridge circuit to produce a small output to the loudspeaker voice coil leads. When the magnitude of the sound is increased, the lamp filament heat up, and their resistance increases considerably, unbalancing the bridge circuit to produce a much greater output to the loudspeaker. In this way, changes in the dynamic level are accentuated.

To connect the volume expander to your radio or phonograph, disconnect the leads of the loudspeaker voice coil and insert the expander between the secondary of the output transformer and the voice-coil leads.

With the components used there may be too little or too much expansion to suit your taste. Substitute higher-voltage radio pilot-lamp lamps (such as 6-volt, brown-head) to reduce the amount of expansion, or lower-voltage lamps to increase it. If you wish to use the expander for music only, a simple double-pole, double-throw toggle switch which may be inserted in the circuit to break the legs of the bridge in which the lamps are inserted.

MILTON SNITZER,
Brooklyn, N. Y.

This circuit is an adaptation of one developed by L. A. de Rosa and described on page 746 of the April, 1937, issue of Short Wave & Telephony and page 21 of the July, 1937, issue of Radio-Craft, in which issues the system was described in some detail.

USING OLD SPEAKERS
I have found a use for the old dynamic speakers that are often given away to servicemen. I use them as auxiliary speakers for a public address system and energize the fields from a dry-rectifier power pack inside the speaker housing.

Bennett LEVINE,
Newburgh, N. Y.

(The resistance of the speaker field must be high enough to prevent excessive current from passing through it and the rectifier—Editor.)
WIND GENERATORS
(Continued from page 33)
replaced. Brushes should also be replaced if they have worn down to where they do not hold their proper position in the brush holders. The mica between the commutator segments should be below the level of the copper bars. If it is not, it should be undercut, as the raised mica will prevent the brushes from making proper contact with the commutator. An ordinary hacksaw blade of the right thickness may be used.

Incidentally, an open bypass condenser or arcing at the brushes—caused by several reasons including those mentioned above—will cause static on the radio.

Check the field for continuity and voltage. If the field current has to be turned way up and the third brush all the way into the direction of rotation to make the generator produce a nominal amount of current, or if the strongest wind doesn’t suffice to bring the output up to normal, the armature is either open or shorted. In either case, it should be sent to the manufacturer or a motor shop for test and repair.

Generator speed has to be up to normal before maximum output can be expected. It can be checked without using a tachometer, by observing the governor. If the wind is strong enough to make the governor act, the generator is up to speed and should deliver its rated output. To make certain the governor is actually operating, slow the prop by applying the brake used to lock the prop when the generator is not being used, and watch to see if the governor relaxes.

Some of the governors turn the prop out of the wind. Others change its pitch, and still others throw out vanes which act as air brakes. No matter what the principle, the action is the same. They keep the prop’s speed below its feeding its rated level. For example, Windcharger Models 617 and 1217 are set for 1,100 r.p.m. Governors can be relied on to do their job when in good condition and their action unhampered.

Insufficient Power Problems
Lack of power over a period of time can be traced to one or more of the following: improper adjustment of control equipment, lack of sufficient storage-battery capacity, an undersized plant, or a plant poorly located with respect to the wind. An unrealized load may cause a complaint of low power. An example is a refrigerator lamp that doesn’t come on when the door is closed. The lamp might draw a mere 25 watts, but, running 24 hours daily, it would draw a sizable amount of power. Other examples are a partially shorted motor and a shorted incorrectly rated electric iron, any or all of which would cause the plant owner to believe he is consuming less power than he actually is.

Going back to the adjustment of controls, the smaller the type of generator use the simple third brush and reverse current relay adjustments and controls. The third brush is connected to the field
and supplies it with a portion of the current generated. Moving the brush against the direction of rotation increases the field strength and output. The reverse current relay (left relay in Fig. 1) is a simple cutout relay with a dual coil arrangement. One coil of fine wire is shunted across the generator output, and another of heavy wire is in series with the load and the contacts. Both are on the same core. When the generator starts to deliver current, the shunt coil is energized and closes the relay, connecting the generator to the load. When the wind slows, the battery voltage tends to drive the generator as a motor. The current, reversing through the heavy coil, opens the relay and breaks the circuit.

A typical adjustment for a Wincharger 6-volt relay would be: closing voltage, or cut-in: 6.9 to 7.8 volts, reverse or opening current: 1.5 amperes.

These measurements can be made with voltmeter and a 20-0-20 ammeter. To simulate a no-wind condition, the brake can be applied, slowly and the generator slowed down until the reverse current opens the relay.

The larger plants have slightly more complicated controls. They dispense with the third brush and control the voltage with compound-wound field or a rheostat in series with the field (or both). To cope with fully charged batteries some of the control panels have a relay with contacts in series with the field and shorting a trickle-charge rheostat. This appears on the right side of Fig. 1. When the battery voltage comes up the relay opens, putting the rheostat in series with the field and so lowering the generator output to a predetermined level.

Incidentally, operation of these relays is affected by room temperature, which should be checked before corrections are made.

Lack of sufficient storage capacity usually leads to continually run-down cells. Run-down cells, operated continuously instead of up around 1.250, will sulphate—develop a hard film on the surface of the plates that prevents the plates from taking a charge. The cure (when it works) is a long, slow charge. Prevention technique is to watch the hydrometer reading and charge the cells once a month until they emit gas for a few hours. This will also equalize them and bring their specific gravity up until their charge is equal.

Lack of capacity leads to a high charge and high discharge rate which shortens the life of the battery. Further, a discharged battery will freeze at a much higher temperature than will a fully charged one.

A word of warning. Take care when you climb the tower! Make certain the guys are in place and secured. Make certain no one is going to fool with the controls and relays. The generator, run as a motor, can easily throw you off the tower. Disconnect the batteries before going up. And stay off in a strong wind with the brake which locks the prop may loosen, and let go. One whack from the revolving prop can cut you in two.

This vibrator replacement guide will bring you up to date on vibrator interchangeability. It is cross indexed in three ways to save your time and remove guess work. The first printing is limited so be sure to get your copy now. Remember James vibrators work better and last longer because they feature exclusive (1) Patented Push-Pull Action, (2) Frame-Mounted Cooler-Operation, (3) Adjustable Contacts. Prompt shipment on all types.

Ask your Radio Parts jobber or write
JAMES VIBRAPOWER Co.
3224 W. Armitage Ave. Chicago 47, Illinois

MONEY TALKS!

DOUGLAS OFFERS THE LOWEST OF LOW PRICES ON THE MAP!

TELEVISION KITS BY TRANSVISION

WE GUARANTEE A WORKING KIT!


12" Standard Television Kit $339.95

12" Deluxe Television-FM Radio Kit $339.95

7" Television Kit $169.95

7" Republic Kit $169.95

16" Republic Kit $199.95

COMPLETE LINE OF TELEVISION COMPONENTS IN STOCK—DEALER'S PRICES UPON REQUEST

Douglas TV Tubes Kit—Complete with tubes, cabinet, all necessary parts. Your cost... $124.48

Free small soldering iron with each kit. Phone Motor and pickup kit, Your cost...

Speaker kit—100 watt motordriver. No. 1, 2 wait.

Douglas Automatic Radios: Short and 1P reports. Repairs on continuous motion.

Special Low Price...

Webster 100. Your cost...

Webster 200. Your cost...

WEBSTER BUYS

4" Alnico slug FM $4.83

5" Alnico slug FM $4.83

6" Alnico slug FM $4.83

7" Alnico slug FM $4.83

Webster Model 90 wire wound to compact attractor case comes with 3 wire speaker, hand made and instruction sheet...

R.C.P. MODEL 720 FM SIGNAL GENERATOR $49.95

H.C.P. MODEL 710 BROADCAST GENERATOR $49.95

H.C.P. MODEL 710 BROADCAST GENERATOR for standard broadcast transcriptions. Frequency: 490 ke, 490 to 1000 mc, and 500 mc. Broadcast band alignment is provided for 89-108 band tuning. Complete with $179.95

THREE-WAY PORTABLE KIT—A.C. DC. and Battery. Complete with portable case, speaker and all necessary parts included. Your cost...

MARION 9" PANEL METER 0-1 ma, 0-3 ma, 0-5 ma, 0-500 µa. SPECIAL...

DOUGLAS RADIO SUPPLY COMPANY, INC.

DEPT. A-1

128 GREENWICH STREET

NEW YORK 4, N.Y.

WRIGHT VERIFIED SPEAKERS

They Glorify the Tone

WRIGHT, Inc.

2234 University Avenue

St. Paul 4, Minn.
Radio - Television - Electronic Parts & Equipment Specials

TELEVISION-CATHODE RAY HIGH VOLTAGE

2000 volt D.C. Power Supply
Why bother with bulky and dangerous 6 cycle line, high voltage R.F. power supplies when you can purchase a complete 2000 volt D.C. power supply, ready to plug into the 110 volt A.C. power line. The ridiculously low price has been made possible by a fortunate mix of high quality components. These units are brand new, completely tested and guaranteed. Price $7.95

4000-6000 VOLT TELEVISION SUPPLY
Similar to the unit above, but has a much higher D.C. output voltage available for use with the new 7” and 10” television tubes. Price $12.95

TELEVISION BOOSTER
Increases signal strength to the television receiver 16-18dB. Rejects unwanted off-channel interference. Simply installed by connecting in series with antenna terminals of receiver, self-securing screw type. Three models available
Model TVL—Channels 1 thru 6
Model TVL-7 thru 13
Model FM—80-108 Mc (FM Band) Available in Black, Mahogany or Mahogany Finish Size: 3” x 6” x 6” Price $26.95

PHOTO-ELECTRIC TUBE
GE type PT23 sensitive gas phototube suitable for regular and scientific light. Has four screw socket and Cathode light sensitive element. Price $2.95
Cathode-ray tube Mask and Mountings brackets for 6” tubes. Excellent for use with 6” television sets or oscillators. Price $0.25
Chroma panel chokes for above-4½6” diameter opening—suitable for use with cathode-ray tubes or round dials. Price $0.25

TELEVISION PICTURE TUBE—a flash electronmicroscope type. Fitted with N.V.C.23 tube used by GE in their television sets. Can be used in other sets designed specifically for electromagnetic deflection. Simply remove 1 screw head. Complete with instructions booklet...$13.95

A SCIENTIFICALLY DESIGNED PHONO SCRATCH FILTER
Resonates to filter out record imperfections effectively reducing objectionable scratch sound without altering the musical quality of phonograph records. Contains a Hi-Fi SERIES resonated circuit. Tested by means of an audio oscillator and were found to give 22 db. attenuation with very few static noises. Appearance may be changed by means of a SPECIAL MINIATURE SKELTON, Vienna, Ill., is a hard-working radioman. Like the majority of the profession, he will give you a competent job on your set, and a square deal on the price. With parts and tubes now generally available, 2-day service is the rule. So what? There are thousands of guys like that over the country? Well, there is a difference. Paul is one of the small but growing number of "service-men on wheels"—his only means of getting about being a wheelchair.

An automobile accident seven years ago crushed his spine and left his legs permanently paralyzed. His health was gradually restored, and his physical needs were well cared for, but he was oppressed by the growing futility of a life that did nothing but exist from one day to the next.

The radio was his greatest source of enjoyment. One day about 3 years ago he switched on for fifteen minutes of news analysis. The old Motorola warmed up smoothly, gave with the commercial, then squeaked, grunted, and died. That was the last straw. The only radioman in town had gone to the army a month ago, and there was no other set in the house. New radios, of course, were only a memory.

There was a screw driver and pilers handy, and Paul figured a pile of junk was just as good as a radio that didn't work. At least that's what he thought until a lunatic's dream of parts, wires, and connections confronted him. Grabbing the chassis firmly with his left hand, he probed every accessible spot with his right index finger. A large metal tube was intriguing, and he took a good grip on the heavy wire leading to it. The shock wore off in about half a second.

"It was pure luck," Paul told me, "but that Motorola played after I put it back in the cabinet. Sleep came hard that night, but it was because I felt so good; I had accomplished something useful! Pretty commonplace as that may sound, but it gets out and hits the ball every day, but a million bucks wouldn't have pleased Paul Skelton on his way to pick up a radio.

RADIOMAN ON WHEELS

By RICHARD LAURENCE
me more. The next day I thumbed through the magazine ads of the various correspondence schools, and picked out one by the heads-or-tails method."

With the aid of the State Rehabilitation office, I was enrolled with National Radio Institute, Washington, D. C. As far as he knew, ohm was something that rhymed with home, so the first lessons pushed him around a lot. Paul had the habit of working with cold sweat and cursing himself, the radio, and that multimeter. The lady came back and looked the set over critically. "Is that little wire over there supposed to be there?"

He turned the set on and touched the loose end of the resistor to the various terminals around it. On the third try—music! He knew then they hadn't been kidding when they said to take a minute to look the set over thoroughly before starting trouble shooting procedures.

Trouble shooting broke down on the next set too, and it was guess and test until a shorted coupling-condenser showed up. With the realization that there was plenty more to learn, Paul turned back to the course. Experience and study gradually made servicing more and more of a pleasant task, and the shortage came into the picture. Fifty percent of the jobs had to be turned back unfixed because there is no substitute for a burned-out tube. The school sent a list of wholesale radio supply houses in the area, but a score of letters produced not a single tube. He thumbed through the Sears, Roebuck catalog until he came across their list of available numbers. And there, in the next year and every tube they sent put to a radio back in working order.

Paul is over the hum now as far as technical knowledge is concerned. He more than understands his simple small gas motor with a small gasoline motor, and which has gears, throttle, and brake completely hand-controlled. The tires are small—4-ply pneumatic, just like an automobile, and with that he is able to get out on the streets and go anywhere in town.

Thus he is able to pick up and deliver some small sets. Due to the fact that his sitting-up time is limited by the spinal condition, he has to do part of his work while lying on his side in bed. Try it sometime! He hopes to be able to stay up the whole day eventually, and do all his work sitting at the bench.

There is new, adequate test equipment in the shop now, and the money he has earned has enabled him to build up a stock of tubes, parts, and diagrams.

Of course, there are plenty of aggravations. He can't follow a radio into the home and see that it is hooked up properly, nor can he go after the chassis from a console model. Similarly, a lot of profit is missed on installing and servicing auto sets. To realize their full potential, a person handicapped in this way should have an active partner or employee so that he can devote his time to bench work and servicing has put Paul back on the road to being a useful, self-sufficient citizen, and he believes it offers perhaps the best opportunity of any available field. He knows that nothing else could be as satisfying.

OCCUPANCY AD-LETS

Advertisements in this section cost 50¢ for each insertion. Names, addresses and initials must be included in all advertisements. All classified advertisements unless placed by an accredited agency, will be accepted for less than ten words accepted. Ten percent discount for four insertions. Order through solicitors. Union service misleading advertisements not accepted. Advertisements are not due until the first of each month. Advertiser must be at least a year old. No用于 ads on sales.

2 YEARS EXPERIENCE RADIO REPAIRING AT YOUR DIGNITION. I'm a qualified master whom you can follow step by step. No formulas or calculations. Our regular time to minimum is $20.00 postage or $10.00 by mail. Many classified ads have been removed. 1461-2 Grandin, Detroit 2, Michigan.

PHONOGRAPH CATALOGUE. 35c. CATALOGUE PARA- MOUNT, K-231 East Market, Willow-Belle, Pom."
CHEAP AND EFFECTIVE NOISE LIMITER

Noise limiters have been much in the news of late. Limiting is effective against the many types of sharp impulses that constitute most of the random racket heard in urban areas as well as a good portion of plain old static.

For maximum utility a limiter should be applicable to any existing receiver without alterations to the latter, inex-

This limiter is a simple and compact device. It is inexpensive, simple, and as usable for c.w. as for phone reception.

This simple noise limiter can be constructed for as little as two dollars at current prices. However, the average experimenter already has most of the parts in his junk-box, with the possible exception of the crystal diode. A 1N21 crystal was used because it was available, but any equivalent type may be readily substituted.

The principle of this type limiter is as follows: the diode is biased at 1½ volts by the dry cell and does not conduct until the audio voltage exceeds the bias voltage. When the signal exceeds the bias, the diode conducts, short-circuiting the headphones for the duration of the noise impulse. This amount of bias allows a 5-volt audio signal which is a comfortable signal in the headphones.

The switch enables the operator to cut the limiter out of the circuit at will. It is wired so that it opens with the threshold control at the minimum-resistance setting. The variable resistance permits the best setting to be made for any set of conditions.

The unit does a splendid job on c.w. operation. There is a small amount of audio selectivity, but the most impressive result is the a.v.c. action. Tuning across strong local c.w. signals is no longer an ear-splitting experience. Furthermore, it is possible to copy signals through static or man-made noise that would ordinarily make reception impossible.

The limiter is built into a discarded i.f. can, although it can be made in several other ways as well. The parts are wired together, and the cables are attached. The unit is then pushed into the can with the control shaft brought out through a hole in the closed end. Line the can with stiff paper to avoid short circuits between can and wiring.

The size of condenser C is determined by experiment and will vary with some receivers depending upon the output circuit. In this model it is 0.1µf. There is no drain on the dry cell, and it should last a year or two.

The limiter works best with a strong signal. In use the receiver audio gain is advanced to the point where headphones volume falls to increase in proportion to the noise setting. This is the point where limiting begins.

The dx hunter will find this limiter a fine protection against tin ears caused by tuning in powerful stations while scanning the shortwave bands. It has no effect on the weak signals but holds the strong ones down.—Otto Woolsey W0SGG

NOVEL CODE OSCILLATOR

A dual-triode, high-frequency miniature tube is used in this code oscillator. The circuit is simple and can be constructed compactly because it does not use a transformer. A 45- or 67½-volt battery is more than enough to operate this oscillator with good output into a pair of headphones. If a speaker is desired, increase the voltage to 90.

The pitch is varied by using different values for C1. The pitch is lowered by using a smaller capacitance.

Ralph Day.

Monetor, N.B., Canada.

Radio Thirty-Five Years Ago

In Gernsback Publications

Hugo Gernsback

Founder

Modern Electricity

1908

Electronic Experiments

1917

Radio News

1919

Science & Invention

1920

Radio Craft

1929

Short-Wave Craft

1930

Wireless Association of America

1938

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

From the ELECTRICAL EXPERIMENTER,

May 1914.

How to Calibrate E. L. Co. Slide Plate Condensers by C. Loazer

Design and Construction Details of Radio Antennae, Part II, by H. W. Secor

The Wireless Society of London

Hertzian Wave Collision

Boston Talks With Nagasaki by Wireless

Signals Via Wireless 6,000 Miles

Wireless Currents on Metallic Conductors

Radio-Craft for May, 1948
straight out. Frequency can be changed by adjusting the trimmer condenser in parallel with the tank coil; the relay plate current is controlled in part by the antenna trimmer.

A base of %4-inch plywood, hallowed to receive part of the relay, is affixed to the bottom of the panel by small brass screws. The receiver base is felt-lined, and both receiver and transmitter housings were painted with black crinkle-finish lacquer. The hollow panel was built up of white pine.

Any small h.f. oscillator can be used. The oscillator employed here was a type 2A5 twin triode in a push-pull circuit. Fig. 5 is the schematic, and a photograph of the transmitter with covers removed is shown at the right in Fig. 2. Two No. 412-E batteries were used to save space. A length of flexible 2-conductor wire is lead out of the transmitter to a leaf-type switch. The tank coil is 8 turns of No. 12 bare copper wire, %4-inch inside diameter, and a one-turn coil covered with insulation acts as an antenna and coupling coil. The r.f. choke is similar to the one in the receiver. Two C-cells in series with a slide switch furnish the filament supply. To conserve space the condensers and resistors are wired directly onto the base of the tube.

The receiver unit is turned on just previous to the demonstration by rotating the dumper screwhead with a screwdriver. The operator then explains the wonders of the series by touching up, auto radio aerial signals or building, and tuning for station signals by using the variable condenser as a handie-talkie. The front panel is not illuminated. The normal operating temperature is never below 70°.

**CORRECTION**

The grid coil L1, in the phone oscillator diagram on page 77 of the January, 1948, issue, is shown with a direct short circuit across its terminals. The diagram should show a 360-uf condenser inserted in the lead which shorts L1. A standard-size condenser in a small compression type may be used.

Our thanks to Mr. Thomas A. Stoner of Wauwatosa, Wisconsin, for this correction.
ELECTRETS
(Continued from page 21)

Electrets in general
Electrets made in heated sand, the heat being brought up slowly and the charging voltage allowed to stay on until the sand cools to room temperature, are the most consistent in their characteristics. The quicker the wax is melted and the shorter the charging and cooling period, the quicker the electret reverses. Some electrets will never show a positive polarization. Both sides may indicate a minus field though one side will usually show much greater charge than the other. A quickly made electret is more prone to show this effect than one made slowly. Some electrets were made with raw high a.c. These were generally minus on both sides. Some of these minus-type electrets are over three years old and are just as active as those made in the conventional manner.

Electrets are extremely subject to moisture. Dipping in a moisture-repellent solution has been tried with poor results. A very good and practical method for keeping electrets is to wrap them in foil and place in can with a dehydrant.

Electrets show the greatest charge if tested immediately when removed from their short-circuiting foil wrap. Repeated discharge tests show a gradually diminishing spark. This, when considered with moisture effects, indicates a use where the unit can be enclosed almost to a short circuit and, if possible, space included for renewable dehydrant. A condenser mike or phono pickup could be made in this manner. Electrets have been made from the size of a 25-cent piece to 4 inches in diameter, and apparently the size can be increased.

Thus, perhaps, a large diameter electret can be used as a condenser loudspeaker. The charge can be placed on wax from any angle that physical conditions will allow, therefore indented areas can be molded in so as to allow free vibration of the diaphragm. As an alternative, small electrets can be assembled in the same plane of polarization to any desired area, with air space included, giving the same field as a one-piece unit. The voltage to use for charging electrets of any size is that just under the breakdown point.

It should be understood that the electret represents a static charge and is not a source of power in the usual sense. We must do work in front of the surface to get an indication. The polarization is not a surface effect. The writer has shaved an electret from .18-inch thickness down to .120-inch and could still get a good spark discharge.

A group of finished electrets is shown in Fig. 6, Nos. 1 and 2 have foil partially removed and illustrates manner of wrapping. Nos. 1, 3, 4, and 6 are made with carnauba and Halowax; No. 2 with carnauba and resin; and Nos. 5 and 6, carnauba, resin, and Halowax. No. 6 has top plate left in position as when charged. No. 4 is cracked badly due to quick cooling.
COMMUNICATIONS
NO LICENSING IN BRITAIN

Dear Editor:
I have to thank you for your letter dated November 30, with the advance clipping Should Servicemen be Licensed?
The problems which may make necessary the licensing or control of the radio service trade in the U.S.A. are apparent over here, but we do not admit that state or official control will be necessary, and it is certainly not desirable.

We are able to handle the matter in another way, since the trade is well organized at all levels in the Radio Manufacturers Association, the Radio and Television Retailers Association (with its affiliated organizations), the Scottish Radio Retailers Association and the Northern Ireland Radio Retailers Association) and the Guild of Radio Service Engineers. My organization is the accepted representative body for the employed radio service engineer throughout the British Isles, and we have comprehensive agreements with the above-mentioned organizations as to wages and working conditions. Various standing joint committees deal with other aspects, such as juvenile technical training (apprentices), trade practices, etc.

It has been recently agreed to set up a Radio Service Trade Register, with representatives from all the organizations concerned forming the Register Council. Minimum technical requirements have been laid down, and all engineers are invited to apply for registration.

The trade has agreed to recognize as qualified radio service engineers only those whose names appear on the Register, and a Certificate of Registration will be issued. Suitable propaganda will be undertaken to bring the meaning of the Register home to the general public. There seems to be no doubt that this scheme will eventually give us the control necessary to eliminate the undesirable elements.

It should not be necessary to add that, although the Register is sponsored by the various trade organizations, it is open to all who can prove their competence, whether members of their appropriate associations or not.

J. H. Cousey, Secretary
Guild of Radio Service Engineers,
Holland-on-Sea, Essex, England.

I LIKE R-C BECAUSE . . .

Dear Editor:
I have been reading and enjoying your magazine for several years. There are several reasons why I like Radio-Craft.

1. The R-E MONTHLY REVIEW and NEW PATENTS present an excellent coverage of the current trends in radio.
2. Your articles, such as December's Radio Delinquent, gives food for thought about new possibilities for electronic developments.
3. Radio-Craft is not primarily a service journal. Your policy of printing

"belong to the radio of the month club."

RADIO-CRAFT for MAY, 1948
Train in Electronics, Radio, Electricity for a substantial career in industry—or a business of your own. Prepare in one year to be a Technician—or in two additional years secure a Bachelor of Science Degree in Electrical Engineering with major in Electronics. More than 35,000 former students in industries the world over, 1,538 students now enrolled from 48 states and 13 overseas countries. Faculty of 72 specialists. Write for catalog and Personal Guidance Questionnaire—also mention course in which you are interested.

Terms start JULY, September, January

W. J.

SCHOOL OF ENGINEERING

A TECHNICAL INSTITUTE

Dept. RC 548

North Broadway, Milwaukee, Wis.

THIS COUPON MAY PROVE TO BE THE KEY TO YOUR SUCCESS IN ELECTRONICS

MELVILLE RADIO INSTITUTE

The Progressive Radio School

Managed by Radio Men

Recognized by Industry

Approved for Veterans

WRITE

NOW

MELVILLE RADIO INSTITUTE
RCA

Melville Blvd., 15 W., 46th St., N. Y. 19, N. Y.

Send me without obligation information about your intensive courses.

☐ Radio Technician

☐ Radio & Television Servicing

☐ Radio Communications

☐ Fundamental Radio Mathematics

My Name

Address

NOW

WANTED

Men and Women to Fill Top Radio Jobs!

Interested in working in the exciting field of Radio—of making a good income for yourself? The Melville Radio Institute can help you. Thousands of men and women have completed our courses and are now filling important positions in the Radio Industry. If you have the ability and wish to become a radio or television technician, we will help you get started.

FOR FULL INFORMATION WRITE

MELVILLE RADIO INSTITUTE

Melville Blvd., 15 W., 46th St., N. Y. 19, N. Y.

RCA INSTITUTES, Inc.

Free through technical courses in all technical phases of Radio and Television

DAY-SUMMER

WEEKEND ARTS

VETERANS: RCA Institute is approved by the N. Y. State Board of Education. Write for Catalog. 20-68

RCA INSTITUTES, Inc.

A Division of Radio Corporation of America

330 West 6th Street

Radio Institute

New York 1, N. Y.

FREE BOOK

The Code Speed Code Speed System Book of Particulars

Dept. 3-E, Box 100

DeClerk-Coller System Co.

Dancer C. Collins

RCA CRAFT for MAY, 1948

TELEVISION 1948!!

Train at an Institute that pioneered in TELEVISION TRAINING since 1928.

Morning, Afternoon or Evening Session in laboratory and theoretical instruction, under guidance of experts; covering all phases of Radio, Frequency Modulation, Television, lead to opportunities in Industry, Broadcasting or own Business. Licensed by N. Y. State. Approved for Veterans.

ENROLL NOW FOR NEW CLASSES YOURSELF

RADIO-TELEVISION

INSTITUTE

480 Lansing Ave., N. Y. 17 (46th St.)

Plaza 3-4062 Blocks from Grand Central

A CAREER WITH A FUTURE!

LEARN RADIO!

IN ONLY 10 MONTHS

PREPARE FOR A GOOD JOB!

COMMERCIAL OR TELEVISION RADIO BROADCAST ENGINEER

RADIO SERVICE MAN

For free illustrated booklet "How to make Radio Pay" address:

RADIO INSTITUTE

341 East 12th Street, New York 3, N. Y.

LEARN RADIO!

PREPARED, SERVICE, BROADCAST, TELEVISION, MARITIME OPERATING, AERONAUTICAL, FREQUENCY MODULATION, RADAR.

In LEARN RADIO! Classes now forming for the summer term June 1, Entrance Exam May 17.

FELLISH SCHOOL OF RADIO, ELECTRONICS TELEVISION and AERO ELECTRICAL ENGINEERING

38 West Middle St., Baltimore 1, Md.

CO-RESPONDENCE COURSES IN RADIO AND ELECTRICAL ENGINEERING

ELECTRICAL ENGINEERING.

ELECTRICAL ENGINEERING.

TRI-STATE COLLEGE

3145 College Avenue

Columbus, Indiana

RADIO COURSES

Preparatory, Service, Broadcast, Television, Marine Operating, Aeronautical, Frequency Modulation, Radar.

COURSES IN RADIO AND ELECTRICAL ENGINEERING

ELECTRICAL ENGINEERING.

RADIO INSTITUTE

341 East 12th Street, New York 3, N. Y.

RCA INSTITUTES, Inc.

MAKE GOOD IN

RADIO-TELEVISION

Hollywood Exports

Help You

Win through Technical Training in Radio, Television, Electronics, and Allied Industries. Famous RCA's have produced experts. Write for free catalog. A full year's intensive training gives you a position in the best-established organizations in the United States. An exciting field for the ambitious, capable, young man or woman 18-30 years old.

FREE BOOKS


Prepare to enter the Navy, Coast Guard, Merchant Marine or Air Force. Also eligible for Battle Stars. Receive Radio-Telephony. R. T. A. Approved for Veterans.

RCA CRAFT FOR MAY, 1948
COMMUNICATIONS

NO LICENSING IN BRITAIN

Dear Editor:

I have to thank you for your letter dated November 20, with the advance clipping Should Servicemen be Licensed?

The problems which may make necessary the licensing or control of the radio service trade in the U.S.A. are apparent over here, but we do not admit that state or official control will be necessary, and it is certainly not desirable.

We are able to handle the matter in another way, since the trade is well organized at all levels in the Radio Manufacturers Association, the Radio and Television Retailers Association (with its affiliated organizations, the Scottish Radio Retailers Association and the Northern Ireland Radio Retailers Association) and the Guild of Radio Service Engineers. My organization is the accepted representative body for the employed radio service engineer throughout the British Isles, and we have comprehensive agreements with the above mentioned organizations as to wages and working conditions. Various standing joint committees deal with other aspects, such as juvenile technical training (apprentices), trade practices, etc.

It has been recently agreed to set up a Radio Service Trade Register, with representatives from all the organizations concerned forming the Register Council. Minimum technical requirements have been laid down, and all engineers are invited to apply for registration.

The trade has agreed to recognize as qualified radio service engineers only those whose names appear on the Register, and a Certificate of Registration will be issued. Suitable propaganda will be undertaken to bring the meaning of the Register home to the general public. There seems to be no doubt that this scheme will eventually give us the control necessary to eliminate the undesirable elements.

It should not be necessary to add that, although the Register is sponsored by the various trade organizations, it is open to all who can prove their competence, whether members of their appropriate associations or not.

J. H. CORBETT, Secretary

I LIKE R-C BECAUSE . . .

Dear Editor:

I have been reading and enjoying your magazine for several years. There are several reasons why I like RADIO-CRAFT.

1. The R-C MONTHLY REVIEW and New Patterns present an excellent coverage of the current trends in radio.

2. Your articles, such as December’s Radio-Piloted Flight gives food for thought about new possibilities for electronic design.

3. RADIO-CRAFT is not primarily a service journal. Your policy of printing the R-C for MAY, 1948
**GREEN SAVES YOU MONEY**

**DRAKE NO. 55 SOLDERING IRON**
60 Watt with 5/8" Tip
Highest quality Nichrome used in porcelain element. Excellent for home use, complete with 8 ft. heater cord, rubber plug and small stand. Gun metal finish. SPECIAL $9.75

**A REAL SPECIAL**
**4 PRONG UNIVERSAL TYPE VIBRATORS**
Standard type replacement for Filister, Motorola, etc. List 22.50. **EXTRA SPECIAL** 98c

**TUBE SPECIALS**
**Brand New Standard Brands**

| Part No. | Price
|---------|------|
| 8115 | $2.95
| 845 | $2.90
| 408RT | $2.85
| 6AS7GT | $2.90
| 12AT7 | $3.00
| 12AT7GT | $3.00
| 12AU7GT | $3.00
| 15AU7 | $3.00
| 50W4 | $1.15
| 50W1 | $1.15

**MINERVA "Challenger" Model 410A FULL SIZE TABLE MODEL**
Unsurpassed in power, tone, balance and round performance. Featuring 14 tubes, plus selenium rectifier, full flexible, 6' Antenna, complete, full vision, side rule dial. $12.75 NET

**SPECIALS**
Bundle of 24-6" Spaghetti...$3.18
**Famous 8 Tube Crystal Microphone with table stand**...4.95
115-Mpf Ballast...Rectifier...29 Mfd 150 V Tubular Condensers...24
Kit of Antenna...& RF Coils (broads...65
10 Mfd...3 Tube Phone Amplifiers...used 50c...
100cc...100QC Tubes...tubes...2.95
Mics Condenser Kit, 22 popular sizes...1.15
RT/DT Toggles Switch, hat handle...35
DP/DT Toggle Switch, long handle...69
35 Mfd 150 V Tubular Condenser...38
AO-DC Chokes, small size, 250 ohms...39
Open Circuit Phone Jack...22
Manda Pilot Bulbs...40, 41, 42, 44, 46, 47, 51, 65 (Box of 10)...44
5 Mfd 450 V Tubular Condenser...33
Kit of 100 assorted Resistors, 1/2 W, 1/8...60
5W, 250W, 60 Watt...1.95
Single Pentode output...49
Single 500d Output...44
20/26 Mfd 150 V Tubular Condenser...44
10 ft. Leads...49
Diode Cord, medium gauge, Needle, 100 ft. 38
35 Mfd, 150 V Tubular Condenser...59
Test Leads, flexible, 60" long. Phone Tips or needle points (specify)...45

**AMPLIFIER CORP. OF AMERICA**
398-10 Broadway • New York 13, N.Y.

**MIRACLE KIT VALUES!**

**PROG OSCILLATOR**

| Part No. | Price
|---------|------|
| 9000 | $2.75
| 10 Watt 8 TUBE MULTI-STAGE B.C. TUBES & TRAYS...$3.95
| UNIVERSAL TROUBLE SHOOTER KIT...$3.95
| 5 Tubes...$3.95
| 3 Tubes...$3.95

**UNIVERSAL TROUBLE SHOOTER**
All parts included 5 Heavy Duty Speaker D. 5 Universal Diode Tubes. Write for list of barcodes in Radio and Electronic Specialties, 115 Goodman, free copy...by R.C. HENDRICKS

**WANTED**
Universal general corp.
325 Canal St., New York 13 (Dept. E-9) Walker 5-5643

**RADIO TESTING EQUIPMENT REPAIRS**
All types and models expertly repaired and calibrated FREE ESTIMATES

**METROPOLITAN ELECTRONIC & INSTRUMENT CO.**
42 Warren St., New York N. Y. Write for new catalogue of all new equipment makes of Radio and appliance testing equipment.

**DON'T WASTE GOOD SPACE!**
**Dear Editor:**
Please, please stop wasting space—valuable space—in Radio-Craft telling servicemen how to run their business. And this stuff about licensing servicemen! They license doctors and lawyers—and they don't guarantee their continued license. Let the good servicemen go about their business unperurbed. The service field will never be crowded for the GOOD serviceman.

Don't print so many how-to-build articles that ordinary people can never hope to build—like the 17-tube FM receiver. I'll bet that not 25 of your readers built it. Why not concentrate on more simple educational articles?

H. W. SMITH, W3LOS, KNAA.
Fredericksburg, Texas.
(What say, servicemen and constructors—Editor?)

**IMPROVED SIGNAL TRACER**
**Dear Editor:**
In the February, 1947, issue you published details of the probe tracer, with which diagram I've been experimenting ever since. You would probably be interested in the final (or at least, the latest) result.
For its size and efficiency, the original is possibly the best tracer diagram...
you have published, to say nothing of its low cost. All parts except the tube and batteries came from the junk-box.

The latest result, built into an overnight project in my home shop, is a 20-megohm grid leak that works much better than the 2-megohm valve leak in the original. I also changed the 500,000-ohm volume control to one of 250,000 ohms. Otherwise the hookup remains the same except for the necessary changes in using it with a separate probe.

Finally, I hooked a milliammeter in the plate circuit with a double-throw switch, providing both visual and aural checks. All of which adds up to a mighty efficient and easily portable tracer. More power to RADIO-CRAFT!

R. C. SANDISON, Denver, Colorado.

LIKES CRYSTAL SET

Dear Editor:

I built the Modern Midget Crystal Set described in the January issue. It is the best-performing crystal set I have ever made, and I have been experimenting with these sets for more than 20 years.

This receiver separates stations like a superhet and the volume it delivers for its size is amazing. I can operate a small speaker on a signal from a 5,000-watt station six miles away.

The sensitivity is so good that hooking the antenna to a metal bridge lamp gives reception almost as loud as with an outdoor antenna.

Mr. Grace's idea of using two secondaries appears to be the secret of the performance of this set. Funny we never thought of trying that.

JOSEPH AMOROSO, Richmond, Va.

PORTABLE ANTENNA

Dear Editor:

The one drawback to my 2-tube regenerative portable receiver was that it needed a rather long antenna. After tacking a small plate of galvanized iron on the heel of each shoe and connecting them in place of the antenna I found that the set pulled in the local stations satisfactorily when I walked on the damp ground.

BEN GREENE, Jr., Tuscaloosa, Alabama.

(Here at last is the true portable, rotatable antenna. But what happens on a boardwalk or clean dry sand? On second thought, the equipment could be used as a soil analyzer, the strength of signals showing the conductivity characteristics of the ground immediately below.—Editor)

The June RADIO-CRAFT will be a special FM number, full of articles on FM theory, FM construction and FM servicing. The most popular FM receivers and tuners will be reviewed and there will be a new and up-to-date list of FM stations.

RESERVE THIS ISSUE AT YOUR NEWSDEALER'S TODAY
Train in Electronics, Radio, Electricity for a substantial career in industry—or a business of your own. Prepare in one year to be a Technician. OR in two additional years secure a Bachelor of Science Degree in Electrical Engineering with major in Electronics. More than 35,000 former students in industries the world over, 1,538 students now enrolled from 48 states and 13 overseas countries. Faculty of 72 specialists. Write for catalog and Personal Guidance Questionnaire—also mention course in which you are interested.

Terms start JULY, September, January

MILWAUKEE SCHOOL OF ENGINEERING
A TECHNICAL INSTITUTE
Dept. RC 548
North Broadway, Milwaukee, Wis.

MELVILLE RADIO INSTITUTE
The Progressive Radio School
Managed by Radio Men
Licensed by the N. Y. State Board of Education
RECOGNIZED BY INDUSTRY
APPROVED FOR VETERANS

RADIO TELEVISION INSTITUTE
480 Lexington Ave., N. Y. 17 (46th St.)
Plaza 3-4865 2 blocks from Grand Central

DELEHANTY SCHOOL OF RADIO & ELECTRONICS & TELEVISION
105 East 13th Street, New York, N. Y., DEPT. B
LICENSED BY STATE OF NEW YORK

WANTED
Men and Women to Fill Top Radio Jobs!

 Worried about your future? Longing for a career that means more money, success? It's yours if you hurry to fill the great demand for qualified radio personnel needed everywhere. Training now available! memor, disk jockey or radio technician. Complete day and night time classes. Hundreds of thrilling jobs await you—key positions in radio stations, airlines, and maritime service. Free placement service offered. Write for our catalog outlining the courses offered. Approved for Veterans.

Don Martin School of Radio Arts
1655 North Cherokee St.
Hollywood 28, Calif.

TELEVISION 1948!!
Train at an Institute that pioneered in TELEVISION TRAINING since 1938. Morning, Afternoon or Evening Sessions in laboratory and technical instruction, under guidance of experts, covering all phases of Radio, Frequency Modulation, Television. Lead to opportunities in Industry, Broadcasting or own Business. Licensed by N. Y. State. Approved for Veterans. ENROLL NOW FOR NEW CLASSES. Visit, Write or Phone.

RADIO-TELEVISION INSTITUTE
480 Lexington Ave., N. Y. 17 (46th St.)
Plaza 3-4865 2 blocks from Grand Central

LEARN RADIO!
IN ONLY 10 MONTHS PREPARE FOR A GOOD JOB!
COMMERCIAL OPERATOR (CODE) BROADCASTER SERVICEMAN

DESHANEY SCHOOL OF RADIO & ELECTRONICS & TELEVISION
105 EAST 13TH STREET, NEW YORK, N. Y., DEPT. B
LICENSED BY STATE OF NEW YORK

RADIO COURSES
Preparatory, Service, Broadcast, Television, Marine Operating, Aeronautical, Frequency Modulation, Radar. Courses now forming for the fall term June 1, Entrance and May 17. Veterans, Literature.

COMMERCIAL RADIO INSTITUTE
33 West Biddle St., Baltimore 1, Md.
BOOK REVIEWS


It is indeed difficult to review "The Handbook" for we feel that it is too well known to need an introduction. We cannot imagine anyone with an interest in radio without at least one edition in his possession.

The latest edition of the handbook has 25 chapters—four more than last year. We cannot compare these editions by counting chapters. This year, the editors have found several opportunities to combine theoretical and construction material. For example: the material that was in the chapters on radio-frequency power generation and transmitter construction in previous editions has been combined in a chapter on high-frequency transmitters. When theoretical and practical material is correlated in this way, the reader is often able to grasp difficult ideas that he is unable to understand from orthodox texts.

In addition to the usual transmitter and receiver circuits, there are five new chapters devoted exclusively to v.h.f., u.h.f. and microwave techniques and equipment. The vacuum-tube data tables have been brought up to date to include the latest tubes.—R. F. S.


Written to provide needed information on radio servicing especially for the beginner, the authors assume that the reader already has a knowledge of radio theory, but theory is reviewed wherever they feel it will clarify a procedure.

The book is clearly and comprehensively written and profusely illustrated with pictures and schematics of typical circuits and modern receivers. Complete summaries and study helps, together with questions dealing with actual service problems, are found at the end of almost every chapter.

Outstanding features are the stage-by-stage analyses of the different receiver circuits and components, discussion of the faults most likely to develop, and explanations of the testing procedures used to locate them.—H. W.


This book was written expressly for the student who is preparing to take the examinations for commercial radio operator's licenses.

The questions which appear in the book are derived from the FCC's pamphlet, "Study Guide and Reference Material for Commercial Radio Operator's Examinations." Selections of questions from this pamphlet make up each examination. Following each question is its answer, given in the most simple and direct form, yet designed to give the student the background on the theory or practice involved.—H. W.


The problem of replacing tubes in unmarked sockets of radio receivers is simplified by this new book. It contains 1,880 diagrams showing the socket locations of almost 5,400 different sets produced under 107 trade names. The book is also useful in identifying a tube whose type number has been worn off or before being removed from the set.—R. F. S.

PRACTICAL AMPLIFIER DIAGRAMS, by Jack Robin and Chester E. Lipman. Published by Os-tronic Publications. Spiral binding with flexible paper covers, 6½ x 11½ inches, 41 pages of diagrams and pages of parts lists and instructions. Price $2.00.

Schematic diagrams, parts lists, and instructions for building 45 different types of audio amplifiers are included in this book. The diagrams include a hearing-aid, recorder and playback amplifiers, public address systems, phono amplifiers, intercommunicators, and transmitter modulators. The intercommunication diagrams are for battery, a.c.-d.c., and quick-heating a.c. models. The amplifiers range from a 1-tube, 1-watt job to a 75-watt multi-channel amplifier.

Most of the circuits described are designed to pass frequencies between 50 and 12,000 cycles. There are some high-fidelity designs designed to pass frequencies up to 20,000 cycles.—R. F. S.

TRADIO-Ette

Here's the key to more profits every day!

Here's one of the finest business opportunities in years. You can cash in on the fact that people like radio with their meals. That's why Tradio-ette—a small, compact coin-operated radio designed for restaurant and tavern booths—has become so nationally popular. Plays 15 minutes for 10c.

Small Thousands of high-yield locations are available to you get in on the ground floor. Only a small investment needed to operate this lucrative full or part-time business. Tradio is the nation's leading manufacturer of coin-operated radios.

For Complete Details... Contact Us Today WRITE Dept. U6

More Features

for your money in this miniature

AM SUPERHET TUNER

With self-contained Power Supply by "Adapto-l"

Adapto offers the outstanding buy in compact, all-am AM Superhet Tunes 540 to 1700 Kc. Here are just a few of the useful applications—

Highly suitable for use in combination with wire and tape recorders. Ideal in record player makes phone-radio combination... Has many experimental uses. Tuner for custom-built radios.

For modernizing obsolete radios and PA systems... For conversion of military, marine and short wave receivers to broadcast band at the flick of a switch.

Circuit Features—Self-contained POWER SUPPLY for 3-15V, AC-DC 50-60 cycle... Three tube circuit of conventional design using the latest miniatures and dual-type tubes... Permanently tuned, drift-free L.F. COMPACT: Approximately 3 3/4" x 3 3/4" x 3 3/4" line. Available in complete sets with tubes. Sold by West of Rochester, FOB Brookln, N. Y. Special to radio dealers, or write for further information to:

ADAPTO CO., 120 New Lots Ave., Brooklyn, N. Y.

Radio Engineering

FM—Television—Broadcast

Police Radio, Marine Radio, Radio Servicing, Avia-
tion Radio and Other High voltage applications. Through trained in all branches of Radio and Elec-
tronics. Modern, up-to-date equipment. 60-in-
ch laboratories, ample housing facilities, no over-
crowding. Student development of practical skill in practical training. Approved for Veterans.

VALPARARISO TECHNICAL INSTITUTE

 Dept. C

VALPARARISO, INDIANA

Radio Engineering

FM—Television—Broadcast

Police Radio, Marine Radio, Radio Servicing, Avia-
tion Radio and Other High voltage applications. Through trained in all branches of Radio and Elec-
tronics. Modern, up-to-date equipment. 60-in-
ch laboratories, ample housing facilities, no over-
crowding. Student development of practical skill in practical training. Approved for Veterans.

VALPARARISO TECHNICAL INSTITUTE

 Dept. C

VALPARARISO, INDIANA

RADIO-CRAFT for MAY, 1948

87
INDEX TO ADVERTISERS

TUBULAR ELECTROLYTICS

Fresh stock Fully guaranteed
30-50 mfd. 150 V. 12.50 each 32.50 doz.
4 mfd. 660 V. 4.50 each 36.00 doz.
15 mfd. 300 V. 10 for 24.00 each 24.00 doz.
8 mfd. 900 V. 12 for 1.75 each 18.00 doz.
Postage extra, 25¢ extra on COD.
Write for our free bona fide listing featuring "AMERICA'S BEST BUYs"

POTTER RADIO CO.
1312-1314 McGee St.
Kaisit City 6, Mo.

WE REGRET
Due to lack of sufficient space more than three and one-half pages of advertising have been omitted from this issue.

PEN-OSCIL-LITE
Extremely convenient test oscillator for all radio work. A portable with a 500-psi. pressure range, from 100 to 1,000 V.D.C. Operates from 6 to 12 V.D.C. at 120 V.A.C. ONLY $1.95. GIVE US A CALL.

NATIONAL PLANS COMPANY
P. O. BOX 28, K. STATION, NEW YORK 23, N. Y.

RADIO-CRAFT FOR MAY, 1948

Published in the U. S. A.
Somewhat More Silent Than a TOMB!

It's Impossible to Hear a Mallory Control Operate!

Even super-sensitive meters, built for the U. S. Navy to inspect delicate electronic communication equipment, do not show an audible sound level when Mallory carbon controls are tested.

Mallory carbon controls give you totally silent operation—the tapers are smooth and accurate to assure maximum adjustment in the proper ranges—the overall resistance values are uniform and the life of the control is the longest ever provided. This kind of quality keeps customers satisfied.

Mallory has given you so many "firsts" in the field of radio-electronic replacement parts that you know Mallory products are the finest that can be produced! Sell them with confidence, install them with ease. The Mallory line of Volume Controls, Capacitors and Vibrators has been standardized; they are a profitable line to stock.

"Good Service for Good Business"
A business plan that will raise the earnings of radio-electronic servicemen. One important item in the plan is a unique system for following up your customers for repeat orders. And there are ways of linking your name with the Mallory trade mark, to get the benefit of Mallory advertising. Better ask your distributor about it!

WHAT WILL MALLORY DO NEXT?
See Us at the Radio Parts Show

MALLORY
APPROVED PRECISION PRODUCTS
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA
This New IRC JUNIOR Control Cabinet Belongs on Your Bench

Here's one selection of 9 "hot-number" controls, switches and shafts you'll use every day! The new IRC Junior Control Cabinet contains 9 of the most-used ½, 1 and 2 meg. type D controls with the added adaptability of the tap-in shaft feature—plus 4 switches and 4 special shafts.

This inexpensive assortment of popular controls will save you time and money, and reduce your need for exact replacements. Factory-packed in a handsome four drawer cabinet of sturdy cardboard. Cabinet attractively finished in blue, yellow and silver with twelve individually identified compartments. Order the new inexpensive JUNIOR Control Cabinet from your IRC Distributor today. International Resistance Company, 401 N. Broad Street, Philadelphia 8, Pennsylvania. In Canada: International Resistance Company, Ltd., Toronto, Licensee.

HERE’S WHAT YOU GET

<table>
<thead>
<tr>
<th>IRC Control Type</th>
<th>Resistance</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>D13-133</td>
<td>500,000 ohms</td>
<td>A</td>
</tr>
<tr>
<td>D13-133X</td>
<td>500,000 ohms</td>
<td>B</td>
</tr>
<tr>
<td>D13-137</td>
<td>1.0 meg.</td>
<td>A</td>
</tr>
<tr>
<td>D13-137X</td>
<td>1.0 meg.</td>
<td>B</td>
</tr>
<tr>
<td>D13-139</td>
<td>2.0 meg.</td>
<td>A</td>
</tr>
</tbody>
</table>

Purpose: A - Tone or Audio Circuit controls; B - Tapped for tone compensation.

SWITCHES

<table>
<thead>
<tr>
<th>#41</th>
<th>S.P.S.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#42</td>
<td>D.P.S.T.</td>
</tr>
</tbody>
</table>

SHAFTS

1. Type "A" double-fluted tap-in shaft is included with each control—plus.
2. Type "E" with universal shunt for special type push on knobs.
3. Type "H" with universal groove for many Delco, RCA, Sears-Roebuck and Westinghouse models.