The famous Model 80 Even Speed Alliance Phonomotor operating on 110 or 220 volts is made for motor operating on 110 or 220 volts has an input of 78 RPM. It has a smooth, no gear—runs at a constant speed—making whisper quiet, positive friction-rim drive. Ample proportioned, positive friction-rim drive with large oil reservoir assures long life. A slip-type fan gives no oil to oil operation—no gears avoids any possible injury.

The Alliance Model K Phonomotor, a 25 cycle companion to the Model 80, operates on 110 volts, 25 cycles with one watt input. Motor and idler plate on Alliance phonomotors are all shock mounted to the cabinet mounting plate, to minimize vibration.

MINIATURE MOTORS THAT MAKE 'EM MOVE

- Light weight, compact, interchangeable power sources
- Small motors that can be mass produced at low cost
- Are in rapidly growing demand! And Alliance has a "Head Start" in making millions of small electric motors.

- Alliance phonomotors drive most of the turntables, record changers and recorders for the radio-phonograph industry. And Alliance Powr-Pakt Motors rated from less than 1-400th h.p. up to 1-20th h.p. will drive fan blades, motion displays, projectors and actuate switches and controls!

- Write today...find out how Alliance Motors can help to drive your products to market!

WHEN YOU DESIGN—KEEP
calliance

MOTORS IN MIND

ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO
I Will Show You How to Learn RADIO by Practicing in Spare Time

You get parts to build this Vacuum Tube Power Pack: make changes which give you experience with parts of many kinds; learn to correct power pack troubles.

Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.

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

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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 WITS 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 JOB SHEETS. You LEARN Radio principles from my easy-to-grasp, illustrated lessons—PRACTICE what you learn with parts I send—USE your Radio shop to make EXTRA money from home—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!

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 Television and Electronics become available to the public! Send for free books now!

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Mail Coupon for Sample Lesson and my 64-page book. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal.

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Mail Coupon for SAMPLE LESSON and my FREE 64-page book, "How to Be a Success in RADIO—Television, Electronics." Mail coupon or write at once. Address will help. Please write plainly.

Name

Address

City (Please include Post Office Zone Number)

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This month's issue is dedicated to the memory of Jan Publishing - a true pioneer in radio and electronics publishing.

COVER PHOTO
By Arthur E. Haug Staff Photographer
A typical Christmas scene in a home where children and adults alike received the cherished gift of a new radio. These lucky youngsters received a Motorola "Playmate Jr." from Santa. This little portable is a 3-power, $5 lb. unit made by Galvin Mfg. Corp.
Hallicrafters PRESENTS THE

Another first! Greatest continuous frequency coverage of any communications receiver—from 540 kc to 110 Mc

This is the long-awaited Hallicrafters SX-42, a truly great communications receiver. The tremendous frequency range of the SX-42, greater than ever before available in a receiver of this type, is made possible by the development of a new "split-stator" tuning system and the use of dual intermediate frequency transformers. Packed with advance features that every ham and every other radio enthusiast desires, the SX-42 clearly lives up to the Hallicrafters ideal of "the radio man's radio."

From now on watch Hallicrafters—the name that's remembered by the veteran, preferred by the radio amateur. See your distributor for demonstration of the SX-42 and for colorful literature describing this great set in complete technical detail.

$250.00
Amateur Net
Adjustable Base for "eye-angle" tuning No. B-42
$7.50 APPROXIMATE

Because of the precise and thorough engineering that must be done on the SX-42 and because the parts supply has not been continuous, top production peaks have not yet been reached. In the immediate future deliveries will necessarily run behind the demand, but the SX-42 is definitely worth waiting for.
Each of the new 1946 FADA models shows that high degree of national popularity—that amazing consumer sales appeal which indicates true leadership!

FADA leadership is based upon a 25 year record of performance — superior tone, superior beauty, superior engineering . . . plus 25 years of consistent national advertising and sales promotion.

FADA leadership is reflected in sales! For greater sales—this year, and next year and the years to come — you can depend on FADA — "the radio of tomorrow — today!"

YOU CAN ALWAYS DEPEND ON

FADA Radio
Famous Since Broadcasting Began!

FADA RADIO AND ELECTRIC COMPANY, INC., LONG ISLAND CITY, N. Y.
NOW SPRAYBERRY
RADIO TRAINING
GIVES YOU
8 BIG KITS OF RADIO EQUIPMENT
WITH A
COMPLETE 6 TUBE SUPER-
HETERODYNE RECEIVER

YOU LEARN
RADIO SERVICING
THROUGH INTENSIVE "SHOP-BENCH" PRACTICE

YOU DO EXPERIMENTS,
CONSTRUCTION,
TROUBLE-SHOOTING

I'll show you how to perform over 175 instructive Ex-
periments—how to build countless Radio Circuits. You'll learn a new, fast way to test Radio Sets with-
out mfg. Equipment.

I give you a fine, moving-iron type
Meter Instrument on Jewel Breg-
ings—for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional accuracy and speed.

You'll get valuable experience and practice building this Sig-
nal Generator and multi-purpose
Tester. Makes a breeze out of
Fixing Radios and you don't have
to spend money on outside,
ready-made equipment.

Soldering, wiring, connecting
Radio parts... building circuits
with your own hands—you can't
beat this method of learning. When
you construct this Rectifier and Fil-
ter, Resistor and Condenser, etc., you get a really practical
slant on Radio that leads to a
money-making future.

HERE'S THE LATEST, SIMPLEST WAY TO
TRAIN at HOME for a GOOD LIVING
in RADIO-ELECTRONICS & TELEVISION

I train your mind by putting you to work with your
hands on a big 6-Tube Superheterodyne Receiver.
And, believe me, when you get busy with real
Radio Parts — 8 big Kits of them — you really
LEARN Radio and learn it RIGHT! You get the
practical stuff you need to be able in Radio, and
that's what it takes to make money. You don't have
to worry about what to do with these 8 Kits of
Parts. Step by step, I show
you how to build circuits,
test, experiment, trouble-
shoot. And you don't need
any previous experience. The
Sprayberry Course starts	right at the beginning of
Radio! You can't get lost!
Simplified lessons, coupled
with real "Shop" practice, makes every subject
plain and easy to understand and remember.

A BUSINESS OF YOUR OWN...
OR A GOOD RADIO JOB

Soon after you begin Sprayberry Training, I'll send
you my sensational BUSINESS BUILDERS. You'll
find out how to get and do neighborhood Radio
repair jobs for nice profits and rich experience
while learning. This sort of work can easily pave
the way for a Radio Sales business of your own.
But with Sprayberry Training, you're not limited.
You can swing into any one of the swiftly expand-
ing branches of Radio-Electronics INCLUDING
Radio, Television, FM, Radar, Industrial Elec-
tronics. Be wise! Decide now to become a fully
qualified RADIO-ELECTRONICIAN. Get full details
about my Training at once! Mail coupon below for
my 2 big FREE Books.

MAIL COUPON TODAY!

SPRAYBERRY ACADEMY OF RADIO
P. O. Sprayberry, President, Suite 2517, Pueblo, Colorado

Please rush my FREE copies of "How to MAKE MONEY in RADIO,
ELECTRONICS and TELEVISION," and "HOW TO READ RADIO DI-
AGRAMS AND SYMBOLS."

Name._________________________________________Age________

Address___________________________

City____________________________ State_____

(Mail in envelope or postcard on penny postcard)

January, 1947

SEND FOR THESE FREE BOOKS

"How to Read Radio Diagrams and Symbols"

Here's a valuable and wonderfully com-
plete new book which explains in simple
English how to read and understand any
Radio Set Diagram. Includes translation
of all Radio symbols. Send for this vol-
ume at once! It's free! Along with it,
I will send you another Big Free book
describing in detail my Radio-Elec-
tronic Training.

SPRAYBERRY ACADEMY OF RADIO
P. O. Sprayberry, President, Suite 2517, Pueblo, Colorado
FOR THE RECORD

BY THE EDITOR

SINCE V-J Day independent radio service dealers have limped along on a starvation diet of tubes and replacement parts and haven't been able to offer new radios to customers. They have been forced to support their businesses by repairing those that were sold to customers. They had to maintain a stock of replacement parts to keep the business running. But they have been given an oversized stock of advice on how to run their businesses and have been told about their reputations.

When you replace an old, worn changer, or construct your own radio-phonograph combination—do as so many others have wisely done—choose Webster. Known for their high fidelity of reproduction, precision-made parts, and smooth, dependable performance, Webster Changers are truly "The Choice of Music Lovers."

Model 50

Shuts itself off after the last record has played! Plays "inside-out" or home recordings when in manual play position. Cushioned spindle protects records, Webster 4-pole, shaded pole motor, improved rim drive, feather-touch pick-up, and simplified changer mechanism for long dependable service. All parts heavy gauge, copper-plated steel. Plays ten 12-inch or twelve 10-inch records. Dimensions: 14" x 14" x 9" overall (6 1/2" above main plate, 2 1/2" below.)

Model 50

Compact, efficient, Model 50 is designed for use in small units where space is limited. It has the Webster two-tier banded construction of changer mechanism, cushioned spindle, manual play position, improved rim drive, and feather-touch pickup. All parts are heavy gauge, copper-plated steel, and built for long dependable service. Plays ten 12-inch or twelve 10-inch records. Dimensions: 12 1/2" x 12 3/4" x 9" overall (6 1/2" above main plate, 2 1/2" below.)

The choice of music lovers

WEBSTER CHICAGO
510 BLOOMINGDALE AVE., CHICAGO 39, ILLINOIS

(Continued on page 155)
NEW!

HALLICRAFTERS SX-42

Here's the NEW SX-42—the receiver that sets a new standard in radio performance. Covers everything. Frequency range of 540 K.C. to 110 MC., brings you high-fidelity broadcast reception—world-wide short-wave coverage—PLUS true high-fidelity FM broadcast reception (all FM frequencies), and hi-fi phonograph reproduction. The new SX-42 is brilliantly designed to bring you more features, more operating thrills than you've ever thought possible. Wide-vision no-glare dials, AM-FM signal level meter, six-position selectivity control, dual IF system, separate sensitivity and volume control, NEW SIMPLIFIED controls for family use. Designed for top-flight reception—in the home, or for Amateur and Commercial communication work. Net, less Speaker $250.00

THE RME 45

The famous RME 45 Receiver delivers peak reception on all frequencies 550 to 34,000 K.C. Features full-vision calibrated dial using a single control for two-speed tuning. Includes five Amateur bands with ample band-spread. Has DB-calibrated signal level meter; 5-step variable crystal filter; Automatic Noise Suppression; stable, variable-pitch band oscillator, and a host of other features. Housed in handsome streamlined metal cabinet with matching speaker. Net, with Speaker $198.70

NATIONAL NC-2-40D


Speaker in matching cabinet, Net $16.44

Order Your
Communications Receiver
from ALLIED

You Get Earliest Delivery from ALLIED

because ALLIED is the world's largest distributor of communications equipment. Naturally, we receive manufacturers' shipments quickly—and these shipments of highly diversified gear are completely centralized for faster handling. All this means that you get faster service on your orders—handled, of course, with customary ALLIED efficiency and expert attention. Your orders to ALLIED are orders for earliest delivery.

FREE! ALLIED'S Latest Catalog

ALLIED RADIO
Everything in Radio and Electronics

January, 1947

ALLIED RADIO CORP., D. L. Warner, W9BC
833 W. Jackson Blvd., Dept. 1-44-A, Chicago 7, Illinois

1. Enter order for.............. Model
2. Enclosed $..................Full Payment
3. Part Payment (Balance C.O.D.)
4. Send full information on Communication Receivers and Time Payment Plan, without obligation.
5. Send FREE 1946 ALLIED Catalog.

Name...........................................
Address........................................
City........................................Zone State

www.americanradiohistory.com
HERE'S HOW Federal Helps You to Bigger Profits and Better Service, with the New Miniature Selenium Rectifier

Everybody benefits from Federal's miniature 5-plate selenium rectifier — the new replacement for rectifier tubes in all AC-DC radio receivers. Jobbers and dealers get a fast-moving item that will ring up added profits... radio repair men earn extra money and give better service... and the customer gets finer performance from his set.

Since the first announcement of these miniature rectifiers, the response has been tremendous — but production is in full swing and you can still get all you want, when you want them.

And now, Federal offers you these three big sales-boosters, to help you cash in on this new market. They're free with every order, even if it's for only one standard package. But the supply of these sales helps is limited, so be sure to send for yours today! Simply fill in and return the coupon below.

*RADIO JOBBERS — these "sales promoters" will help you to build up a big demand for this new radio component. And Federal welcomes inquiries regarding territories now available for jobbers and sales representatives to handle the new Miniature Rectifier.

1. FREE SALES-CREATING WINDOW POSTER

This big 17-by-22 inch, 3-color poster, mounted on your window, wall, or counter, will let prospects know that you have this remarkable new rectifier for sale. It gives all the sales points at a glance — the facts that will turn prospects into customers.

2. FREE SELF-SERVICE COUNTER DISPLAY

Each standard package of 12 rectifiers opens up into this striking 3-color "self-service" counter display — an automatic salesman that makes it easier for your customers to buy. And every rectifier unit is individually boxed in an attractive carton. They stack neatly on your shelves and take up very little space.

Federal Telephone and Radio

Export Distributors: International Standard Electric Corp. 67 Broad St., N.Y.C.
3. **FREE "HOW-TO-DO-IT" SERVICE MANUALS**

Seven valuable service manuals, including an instructive 8-page booklet which gives simple, step-by-step directions for installing Federal's miniature rectifier in place of a tube. "Before-and-after" circuit diagrams, plus detailed photographs, show what to do and how to do it. You'll be surprised to find how easy it is.

![Image of a Federal miniature rectifier]

---

**ORDER YOUR FEDERAL MINIATURE RECTIFIERS TODAY—SHIPPED BY RETURN MAIL**

**CORPORATION**

Newark 1, New Jersey

January, 1947

---

**FEDERAL TELEPHONE AND RADIO CORPORATION**

200 Mt. Pleasant Ave., Newark 4, N. J.

Dept. F959

Yes, Federal — I want to cash in on your offer. Send me number of packages checked below — plus complete sales accessories. □ check or □ money order enclosed.

**SELENIUM RECTIFIER, 403D2625, 100 Ma**

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>PRICE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Package (12 Rectifiers)</td>
<td>$12.00</td>
</tr>
<tr>
<td>4 Packages (48 Rectifiers)</td>
<td>$48.00</td>
</tr>
<tr>
<td>8 Packages (96 Rectifiers)</td>
<td>$89.28</td>
</tr>
<tr>
<td>12 Packages (144 Rectifiers)</td>
<td>$129.60</td>
</tr>
</tbody>
</table>

*Excludes state and city use and sales taxes.

No order accepted for less than one package.
PRODUCTION TRENDS during the coming year will be toward quality and away from quantity, late-1946 market conditions indicated. Even before OPA ceilings were off table sets, supply was far enough ahead of demand to result in price wars in some metropolitan areas. At year-end, small-model inventories in retail outlets were ample. It follows that new-year production programs will be accent console sets. Lagging items—FM-AM receivers, radio-phonograph combination consoles, and television sets—were beginning to perk up even early last fall, and should make the headline production story when the score is in for 1947. But don’t discount the importance of table sets in the ‘47 market. They’ll be evident in large numbers in the FM-AM field, and welcome to them. FM stations are particularly eager to see the small sizes in big production to build a listening audience large enough to attract advertisers.

FIRST BREAK in television production was dramatic—during September, 3,242 units were turned out, as contrasted with a total of 225 for the previous eight months. Other items moved upward, receivers with FM facilities totalling 17,541 as compared with 13,892 in August. Console combinations hit a new high of 105,944—ahead of the same month in 1941, corresponding pre-war period. Two of the chief blocks to big production seemed on the way to elimination, with an increased supply of lumber and gang condensers coming off the fall production lines. Most of the big sets appeared monthly in the fall and early winter, and indications are that ‘47 would be a banner year.

THE NEW YEAR will certainly be significant so far as television broadcasting is concerned. Latest available figures indicate that a total of thirty-seven stations should be broadcasting before mid-year, with more than forty additional applications under consideration at the Federal Communications Commission. FCC also began early in December to consider the problem brought up by commercial color television stations and the technical assets of this kind of equipment. Columbia Broadcasting System is behind this one and seeks permission to operate in the band 480 to 920 megacycles. Enthusiasts for color predict wide use of the media for outdoor as well as studio picture-casts, day or night.

NOT TO BE OVERLOOKED in the radio fireworks for ‘47 are FM broadcasting activities, which promise pleasant development—and competition. Reports from the field indicate that any FMer who is on the air and in full swing by mid-year will be lucky, but from then on the going should be good. Chief causes for delays are two: sold production will not catch up with demand for at least six months, and most new stations are having difficulty finding good broadcasting sites—high land is essential. Production promises to be on the way to catching up with demand by mid-year and experts are predicting that as many as 30 per-cent of the listener audience will be confirmed FM enthusiasts by January, 1948.

STATION COMPETITION promises to be stiff in highly concentrated population areas. FCC has pending a high of thirteen FM applications in the New York City area, Chicago is second with five, Los Angeles has asked for ten, Boston, Cleveland, and Washington eight, Pittsburgh and Indianapolis seven. A few stations are already on the air. Commercially, even ones that are yet to open report ready acceptance from advertisers. Time has been sold for WRCM, New Orleans, and KOPY, Houston; also for projected stations at Allentown, Pa., and Evanston, Illinois. Best advertising slogan comes from KOZY, Kansas City pioneer station: “FM Means Folding Money—for You.”

ADVERTISING in the FM field already shows signs of jumping into the battle between FCC and the AM networks on the length and quality of advertising blurs. The FM boys show signs of siding with FCC in the battle. Typical is an announcement by WQGW, FM-AM outlet operating in the Washington area. “No commercials will be permitted longer than one minute,” says station policy. “At least fourteen minutes free of advertising will proceed and fourteen minutes of free advertising will follow each commercial.” Admitting that “the majority of listeners are enthusiastic
THEY'RE BETTER THAN EVER

and they cover every requirement

1 Better impregnation to eliminate moisture
2 Better hermetic sealing for longer life
3 Quality control during manufacture

MALLORY PAPER TUBULARS

YOU want quality in the paper tubulars you buy — of course! Otherwise your replacement work won't stand up. Mallory gives you the quality you want.

But Mallory gives you quantity, too. Quantity in a wide assortment of ratings and sizes that meet all requirements that come your way.

That's the story in a nut shell — whether you're looking for wax impregnated cardboard tubulars or oil impregnated ones. The Mallory Catalog and your Mallory Distributor both prove that —

YOU EXPECT MORE AND GET MORE... FROM MALLORY

P.R. MALLORY & CO. Inc.
MALLORY
APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

January, 1947
The new addition to our plant provides increased production facilities to enable us to fill the backlog of orders now on hand.

**SPOT RADIO NEWS**

about commercial radio as it is," the station reports that "a minority—roughly one-third of the population—is dissatisfied with excessive commercialism" and proposes to "appeal particularly to advertisers seeking to reach that audience."

Quality of advertising copy will also be reviewed before it goes on the air. "The station will seek to insure that the products advertised, the claims made, and the advertising copy used will conform to the station's policy to reach "intelligent listeners." . . . If all this seems to be words from the mouth of FCC, it is perhaps worth adding that general manager at WQW is Edward M. Brecher, from 1941 to 1945 assistant to FCC chairman James Lawrence Fly and subsequently a special analyst in FCC's law department. But the station's policy perhaps indicates a significant trend—FM's determination to bring advertising quality up to the quality of FM broadcasting. Whether it will succeed is one of the interesting 864 radio questions that may be answered in 1947.

**NON-PROFIT FM STATIONS** will also figure in the broadcasting new deal. More than sixty educational institutions are already licensed, have received initial authorization or have applied to operate non-profit stations as this goes to press. Six stations are already on the air. Indications are that most states plan to establish networks linking county and municipally operated stations into state-wide systems. The early-bird interest of schools and colleges in the new radio equipment came as no surprise to FCC—educational institutions, it reports, were among the pioneers in broadcasting, at witness WHA of the University of Wisconsin, oldest university-operated station, which has furnished uninterrupted service for a quarter of a century . . .

**WASHINGTON** may become national headquarters for FM broadcasters, following preliminary meetings there this fall and early winter toward organizing into an association. As this goes to press, major policies were being worked out to formalize the group and decide how wide to set the scope of its membership. That the new outfit will not be lacking in enthusiasm is indicated by a recent statement by Everett M. Dillard, KOZY head in Kansas City and also licensee for WSDC, Washington. Said Mr. Dillard: "If I were to tell you of a new atomic propelled automobile which would replace our present gasoline propelled type of vehicle, you would be startled and aware of a new era in transportation. FM, so far as radio is concerned, is to AM what atomic power in the automobile would be to gasoline power. Nothing can stop it!"

**FM PROGRAMMING** is one of the most serious problems on the immediate horizon. Chief hope of new sta-

(Continued on page 18)
NOW IN YOUR OWN HOME Learn RADIO ELECTRONICS

The Practical "HOME-TESTED" Modern "A-B-C" Way

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! 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 FM 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, Facsimile 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

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DeForest's Training, Inc.
2535-41 North Ashland Ave., Dept. RN-D1
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________________ Zone________ State________

☐ If under 16, check here for special information.

☐ If a discharged Veteran of World War II, check here.

January, 1947
Donald McNicol's RADIO'S CONQUEST OF SPACE now being offered for the first time.

It is the story of men—amateurs, tinkers and famous scientists—who wrestled from the Universe one of its greatest secrets. It tells what they did and how they did it in piecing the gigantic Radio puzzle to get its CONQUEST OF SPACE is not only a book to be read for fun. Equally important, you'll find in it a wealth of background knowledge available to all radio men and experimenters. Contains 247 pages and dozens of illustrations. Only $4 complete. Use coupon.

ALFRED A. GHIRARDI
the man who has started thousands of students on successful careers by making Radio-Electronics easy to learn.

A FEW NIGHTS OF THIS CAN PAVE THE WAY TO A PROSPEROUS FUTURE OF

Ghirardi's COMPLETE BASIC RADIO-ELECTRONIC TRAINING for beginners

for only $5 ($5.50 foreign).

NO PREVIOUS TRAINING NEEDED

36 Big Courses in One

Here are a few of the things about which RADIO PHYSICS COURSE teaches you:

- Sound, Speech, Music
- Electronic Theory
- Electric Currents
- Electrical Circuits
- Resistance
- Inductance
- Electromagnetism
- Electronic-Induction
- Condensers, Coils
- Alternating Currents
- Transformers
- Filters
- Measuring Instruments
- Radio Waves
- Vacuum Tubes
- Detectors & Amplifiers
- Tube Action
- Radio-Frequency
- Alternating Currents
- Superheterodynes
- Radio Amplifiers
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SPOT RADIO NEWS

Teleran is the brain-child of Loren F. Jones, a pilot and one-time ham radio operator, who has been working on it since 1941, but didn’t get very far during the war years, when RCA was busy with more urgent problems. Resuming his development about a year ago, Jones expects to see it at production stage within five years. Ground- and air demonstrations should be ready within a little more than a year. Teleran is a coined word—TELlevision plus Radar Air Navigation—and grew out of RCA experience with airborne radar dating from 1935 and with airborne television, dating from 1936.

IN ITS SIMPLEST FORM,” to quote Mr. Jones, “Teleran employs a ground search radar which surveys the air space and displays the information obtained on a cathode ray tube. This radar presentation is viewed by a television camera, a map of the area is superimposed either optically or electrically, and the combination picture is broadcast by a television transmitter. The pilot sees his plane as a spot of light moving across the map; other planes are similar spots, or pips, moving along their actual routes.” Greatest Teleran achievement is taking actual radar and other heavy equipment out of the cockpit, where weight is a tremendous factor.

Teleran will, of course, be less expensive than radar equipment—Jones estimates that with a mass market a unit can be bought for as little as $500. Although this price is still high for the average amateur pilot, Jones feels that the system will pay off in safety and efficiency when there are enough planes in the air to make installation worthwhile. Regardless of the future, FCC is regarding it as a potential factor in the airways of the future, and if it develops, even to a small degree, it should open new vistas—not to mention a number of new jobs—for those interested in electronics.

IF YOU OWN a taxi-cab radio unit, you can tune in on other two-way taxi radio hook-ups clear across the country, according to frequency assignments recently announced by FCC. Same thing applies to other radio systems now being assigned to urban use. Reason for the assignments is that FCC has been flooded with demands for experimental operations in the field of general mobile service in big cities. To meet the demands, the Commission devised a temporary frequency assignment plan to be followed so that everybody has an opportunity to see if the radio is fitted to his needs. Assignable channels for land stations and mobile stations are six—152.03 mc., 152.15 mc., 152.27 mc., 152.39 mc., 152.51 mc., and 152.63 mc. The same number of channels have been assigned for mobile stations only—157.29 mc., 157.41 mc., 157.53 mc., 157.65 mc., 157.77 mc., and 157.89 mc. Channels 152.27 mc. and 157.99 mc. may be assigned to taxicab systems, while department stores, delivery services, ambulance services and the like will get 152.15 mc. and 157.41 mc. Other channels will go chiefly to experimenters in the field and to existing general communications common carriers. “In no event,” FCC has ruled, “will any land station be permitted to use a mobile frequency” without a mobile hook-up.

CLOserLY LINKED with these channel allocations was FCC’s recent announcement following recommendations from all parties concerned that readjustments were being made in allocations in the 152-162 mc. band. Chief reason was given as “the desirability of having a standard international maritime band in the v.h.f. region—a need recognized at the meeting on radio aids to marine navigation in London. At this meeting it was revealed that the United Kingdom had already allocated four pairs of single channels each 100 kc. wide between 156 and 162 Mc. U.S. representatives faced with “insurmountable” obstacles in obtaining agreement on frequencies elsewhere in the v.h.f. spectrum, decided to go along with the British allocations.

FCC reports big activities in the maritime radio field, and a bright future. Safety and distress services will be standardized as the result of the international agreements, and communications are developing rapidly between ships of all nations and land bases associated with shore-based radar transmitters and harbor control facilities. Fog as a major menace in crowded sea lanes will, it is implied, soon become a thing of the past. Another aspect of marine radio with a brightening future is the use of v.h.f. radio telephone from ship to shore near large ports. Radio will also figure more markedly as an intercommunication device in inland waters, especially among all types of water craft on rivers, lakes and oceans connecting the United States and Canada and the United States and Mexico.

Two interesting developments in the experimental field showed up a few weeks ago on the FCC dockets. One was the granting of a permit for an experimental class two station near Cleveland, Ohio, to be used in connection with development and testing of facsimile equipment. The permit went to Acme Newsgraphics, Inc., which is to say to the United Press, Scripps-Howard newspapers and other affiliates. It includes permission to experiment with transmitting pictures over long distances—to Acme posts in Europe and South America. Frequencies: 3492.5 4797.5, 6425, 9135, 12862.5, 17310, and 23100 kc. on a temporary basis; power 1000 watts; A4 emission. (Continued on page 166)
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January, 1947

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A glance at the new Duodecal socket shown below will demonstrate the complete fulfillment of television's demand for a socket of full flexibility and highest quality for the new series Duodecal base television viewing tubes.

This is typical of the pioneering which has established Amphenol leadership in the design and manufacture of TV and FM components.

The activity of Amphenol engineers in the higher frequencies enables them to sense in advance the needs in these fields. The new Duodecal socket is but one of many such Amphenol firsts which include efficient Hi-Q tube sockets, octal angle sockets for cathode-ray and other tubes, Twin Lead parallel transmission line, FM and television receiving antennas, solid dielectric coaxial cables, and special-use cables for television color cameras and for facsimile.

Write for Data Sheets on these new products.

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FEATURES OF THE DUODECAL SOCKET

- Six locations for bringing leads out radially in one bundle assure a neat wiring harness, and minimum space requirement.
- Rear socket cap totally encloses connections, eliminating breakage at solder terminals due to flexing. Electrical shock hazard is minimized.
- An extra opening is provided for bringing high-voltage grid lead out separately when this is desirable.
- Latest wrap-around type cadmium-plated phosphor-bronze contacts provide four lines of contact on each tube pin.
- Cap and body of socket are molded black electrical bakelite.
- Spring ring assembly eliminates screws and drive pins.
RBL-2
RADIO RECEIVER
Navy Type CNA-46161

Built by National Company, these are brand new and come complete with tubes and ready to operate except for connection to speaker. It is a 7 tube superhet receiver covering 300-600 KC in six bands. The circuit employs both low and high pass filters and adjustable audio limiter. Tubes used: 2 14H7, 1 1417, 1 14R7, and 1 28D7. Output impedance 1.25 ohm with provision for 400 ohm by slight circuit change. Complete with headset and extension for operation from any 24-28 V. DC source. Current consumption .15 amp. May be used in fighter planes by connection of dry batteries to give necessary voltage. No high voltage power supply used which gives the set maximum efficiency. Dimensions: 7 1/2"x4"x4 1/4". Weight, 4 lbs.

Price - New ......... $6.95 ea.

BC-1206-C

Built by Setchell Carlson, this is a light weight, 5 tube superhet receiver covering 200-600 KC radio beacon frequencies. Complete with the following tubes: 51457, 1 5146, 1 5147, 1 5147G, and 1 5154Q. Output from 110 V. 30-60 cycle AC source. Dimensions: 12 1/2"x3 1/4"x1 1/2". Weight: 80 lbs.

Price - New ........ $6.95 ea.

RADIO SET SCR-510 Brand-New


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Use for parts, etc. Contains: 30-9-30 2 1/8" DC ammeter, 6-300 2 1/8" AC voltmeter, 60 amp push-button switch, .01 and .3 mfd. 600 V. cond., 10 mfd. 60 V. cond., 2 ohm rheostat, 15 amp. filter choke, binding post, etc.

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The Bliley CCO (crystal controlled oscillator) is the only test instrument available to radio service technicians that features:

**DIRECT CRYSTAL CONTROL**

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There is nothing complicated about the Bliley CCO. Simply connect it to the receiver to be tested and select the frequency desired. The crystals are instantly on frequency as soon as the oscillator is energized. It will save you hours of time, eliminate guess work and increase your prestige as a radio service technician.

The CCO is a “techniquility” product of the same engineering skill and craftsmanship that have kept Bliley Crystals foremost in dependability in the frequency control field for over 15 years.
Many thousands of amateurs are using the new HQ-129-X communications receiver. Rarely has a new product been so widely approved in so short a time. The reason is simple—36 years experience and a record of high accomplishment build confidence. The HQ-129-X is an outstanding value from the standpoint of performance and cost.
For peace or war, the radio control of airplanes and rockets marks a new era in aviation history.

Drones dropped a practice smoke bomb off Santa Rosa Island. This involved opening the bomb bays, releasing the bomb and closing the bomb bays, all by remote control.

The two drones which spanned the Pacific were veterans of the Bikini atom bomb blast. Together with a number of other AAF drones at Bikini, they gathered invaluable data which will enormously increase scientific understanding of atomic phenomena.

The current drone research program is being pushed with high intensity by Headquarters Army Air Forces through its technical branch, the Air Materiel Command, located at Wright Field, Dayton, Ohio. However, the present activity is just one facet of the total investigation into the application of radio control to flight. It is an integral part of the research program which began with the development of target planes and is currently concerned with guided missiles and completely automatic flight.

The latest model in the target plane

Radio jeeps, near runway, control take-off and landing of the drone planes. One works the elevators and throttles of the drone while other controls direction.

An American Army Air Force, technically superior in all phases of air defense or warfare, is a tired world's surest guarantee against the terror of war. Rockets and missiles, controlled by radio, traveling at supersonic speeds and equipped with atomic warheads, shatter the imagination.

But in August the Army Air Forces revealed that two B-17 Flying Fortresses had flown the Pacific without pilots aboard though the news received but slight attention, it pointed the road to future military and civilian aerial activity.

The flight from Hawaii, known as Operation Remote, took to the air at Pile and flew 2600 rugged overwater miles before coming down at Muroc Army Air Field, California. The drones were accompanied by mother planes which directed all their flight operations by radio. Throughout the 14 hours and 55 minutes of the record-breaking journey, the mother planes maintained contact with their crewless charges at distances varying from 200 feet to three miles.

Before landing at Muroc, one of the

*This article was prepared by the Information and Public Relations Division, Headquarters Army Air Forces, New York, New York.
Functional block diagram of conversion unit PH-522/AXT-2 used in drone plane.

Block diagram illustrates stage-by-stage operation of T-61/AXT-2 transmitter installed in drone airplane.

AN/ARW-18 radio control transmitter installed in the "mother" plane.

Radio receiver and selector, AN/ARW-1, installed in the drone aircraft.
The control box which relays "commands" from the "mother" plane to the drone. Above the control box is shown the television scope which allows the pilot to view the instrument panel in the drone being controlled or alternately, permits him to see the area directly in front of the drone plane. This equipment should find wide application in the testing of experimental models of aircraft, thus eliminating the necessity for endangering a test pilot's life.

category is the PQ-14. Controlled by radio and maneuvering much as an enemy combat plane would under field conditions, the PQ-14 is a lifelike target which eager marksmen actually can shoot down.

In operation, the PQ-14 is trailed at a safe distance by a mother plane, much as in the Operation Remote set-up. A pilot sitting in the co-pilot's seat of the mother ship holds a small control box on his lap. Flipping a lever on the upper left hand corner of the box gives the pilot the function he wants. Small lights indicate the number of functions the drone will perform and give the pilot a check on the operation desired.

On the lower right hand side of the control box a small metal "stick," similar to an airplane control stick, is moved to give the horizontal and vertical movements demanded of the PQ-14. Another switch is available on the control box for auxiliary operations.

A frequency-modulated, ten-channel radio receiver relays the "commands" of the mother plane to a gyro-stabilized, remote flight control unit which actuates hydraulic servo motors. This unit corrects the three functions of roll, pitch and yaw, and, in addition, applies the brakes. Through its use, the PQ-14 is enabled to perform maneuvers including 70-degree banks and dives.

Such auxiliary operations as throttle control, retracting and extending of the landing gear, and raising and lowering of the flaps, are accomplished by radio activation of small electric motors which are installed as standard equipment in the target plane. Coordination between the control plane and the target plane is instantaneous.

Drones were in operational use during the recent war. War weary B-17s, which had flown full quotas of missions against German installations, were used as guided missiles in a project known as Operation Castor. The planes were not outfitted to take off by remote control. A minimum crew took them up and, after the mother plane assumed radio control, parachuted to earth.

The first Flying Fortress flown in this operation was directed at the submarine pens at Heligoland, Germany, on September 11, 1944. Unfortunately, it was shot down by anti-aircraft fire 1000 feet short of its goal. Another, guided to these same high-priority objectives in October, destroyed 2¼ acres of buildings in the target area.

In current usage, such as the trans-Pacific flight, the drone is equipped (Continued on page 137)

Functional block diagram of the R-68/AXR-1 television receiver used in "mother" plane.

January, 1947 27
A Stabilized Modulated OSCILLATOR

By ALBERT E. HAYES, Jr., W1IN/3
Consulting Engineer

Presenting a novel method of eliminating the frequency modulation usually attendant in modulated oscillators.

Our old friend, the modulated oscillator, so popular during the early days of radio telephone transmission, has fallen into disrepute, due to some of its inherent "bad habits." These "bad habits," or shortcomings, are, in the main, the introduction of spurious and undesired frequency modulation, and the fact that a modulated oscillator can not be modulated 100% without distortion due to the extreme falling off in amplitude on the negative modulation peaks where the anode voltage would approach zero for 100% modulation.

The second-mentioned shortcoming may be avoided by limiting the degree of modulation to 50% or less, as is done in conventional signal generators used by the radio serviceman, and the first-named shortcoming, the attendant and undesired frequency-modulation, is lessened, but not eliminated by this expedient. The elimination of this spurious frequency modulation has been the subject of intensive study by the writer, and a circuit has been developed which enables a conventional radio frequency oscillator to be modulated upwards of 80% in amplitude without any trace of spurious frequency modulation.

The section enclosed within the dotted rectangle "A" in Fig. 1, illustrates a conventional triode tube $V_1$ connected in a Hartley circuit as is done in many of the signal generators used by the radio serviceman. It is true that other arrangements are often used, but it will become apparent that the Hartley circuit has been chosen for reasons of illustration only, and that the method of stabilization to be described may be applied with equal facility to other oscillator circuits without introducing new factors or considerations.

The parallel resonant circuit $L_1, C_1$, connected in the anode-grid circuit of the triode, is normally considered to be the frequency determining element in such an arrangement. It is known, however, that the condenser $C_1$ is shunted by several "invisible" capacitivities, such as, for example, the distributed capacity of the circuit wiring, the grid-plate capacity of the vacuum tube, and reactance presented to the resonant circuit by the space current within the tube itself. This space reactance varies with the amplitude of the applied plate voltage, and it is this reactance which causes frequency modulation of a self-controlled oscillator when an attempt is made to produce an amplitude modulated output signal.

This space reactance causes a change in the effective resonant frequency of the circuit by an amount which is proportional to the percentage of its magnitude compared with the magnitude of the capacity of the condenser $C_1$. It can be seen, therefore, that the effect of the space reactance may be minimized by the use of a large condenser $C_1$, so that the space reactance is but a small percentage thereof, and therefore causes a small net change in the resonant frequency of the circuit. This expedient, the use of a "high $C_1$" tank circuit, is well-known to all engineers skilled in the design of self-controlled oscillators, and has been used in most signal generators where stability of frequency is of paramount importance. The use of a "high $C_1$" tank circuit, however, lowers the over-all efficiency of the oscillator and increases the tank circuit losses. Further, this does not completely prevent frequency modulation, but merely minimizes it. The addition of the reactance tube circuit in Fig. 1 illustrates an arrangement for an amplitude modulated oscillator which completely eliminates frequency modulation and still permits complete flexibility of tuning of the oscillator proper.

A modulation transformer is connected in the plate supply circuit of the oscillator tube $V_1$ in the conventional manner, and the plate of the modulating tube $V_2$ is connected to the primary of the transformer. A reactance tube frequency modulator is connected between the plate of the oscillator tube and ground in the manner well known in the frequency modulation and automatic frequency control fields. The control grid of the reactance tube is connected to the output of the modulator tube $V_2$ through a gain control potentiometer $R_n$, a reversing switch $S_n$, an audio interstage transformer $T_n$, and a condenser $C_n$.

In operation, the frequency modulation attendant on the amplitude modulation produced by the tube $V_2$ is cancelled or "bucked" by an opposing fre-
Frequency modulation produced by the reactance tube \( V_i \). The amount of frequency modulation produced by the reactance tube may be made equal to the spurious frequency modulation by adjustment of the setting of the potentiometer \( R_s \), and may be made to either aid or oppose the spurious frequency modulation by proper setting of the reversing switch. The setting of the switch must be determined by experiment, for the reactive changes introduced by the amplitude modulation of the entire circuit of the oscillator tube may be either capacitive or inductive, depending upon the mode of operation of the particular oscillator circuit used. By experiment it is possible, therefore, to set both the reversing switch and the potentiometer so that there are no frequency modulated components present in the output of the modulated oscillator.

If the oscillator is being used as a signal generator to align or calibrate a receiver, the potentiometer and the reversing switch may be set by adjusting for the minimum "width" of the generated signal on the tuning or aligning control of the receiver under test. This position may be determined very rapidly when the user has become accustomed to the "feel" of the controls. The use of a cathode-ray oscillograph to set the controls is, of course, the quickest and simplest method.

In addition to its use in stabilizing signal generators, test oscillators, and the like, the above-described scheme has proved very worthwhile in reducing the bandwidth of the 144 mc. amateur transmitter at WIIIIN. All stations worked reported that our signal is as sharp as the best of the crystal-controlled transmitters.

Referring now to Fig. 2, it will be seen that a push-pull TNT oscillator using an 832 dual beam tetrode, is connected in the conventional manner to a 6V6 modulator through a conventional modulation transformer \( T_3 \). The 6V6 modulator is driven in the normal manner by a carbon microphone through a microphone transformer \( T_3 \). The reactance tube frequency modulator comprising a 6SJ7 pentode, is coupled to the untuned grid coil assembly \( L_m \), \( L_s \) by means of a third winding, \( L_m \), connected between the two halves of the grid coil. Coils \( L_m \) and \( L_s \) are each wound on a form one quarter inch in diameter and consist of 3 turns each of \#14 tinned, spaced about the diameter of the wire. The spacing between turns is adjusted to provide feed-back at the desired output frequency. The coil \( L_m \) comprises 10 turns of fine wire one quarter inch in diameter on a polyethylene rod which is supported by the coils \( L_m \) and \( L_s \), \( L_m \) and \( L_s \) each consist of 2 turns of No. 10 wire \( \frac{1}{2} '' \) inside diameter with spacing the diameter of the wire, and \( \frac{1}{2} '' \) between coils. \( L_s \) is 2 turns of the same size, mounted between \( L_m \) and \( L_s \). The values of the various circuit components associated with the 6SJ7 reactance tube, were determined experimentally and may have to be changed if widely different lay-outs of components are used. The values indicated in the circuit diagram, however, will probably be satisfactory in most instances.

It can not be over-emphasized that the extremely high operating frequency of the system shown, introduces problems of reactance tube design not met with in conventional arrangements.

The gain control \( R_s \) connected in the grid circuit of the 6SJ7, is used to adjust the "counter deviation" until it exactly matches the deviation caused incidentally by the 6V6 amplitude modulator. This gain control \( R_s \) will probably have to be readjusted with changes in the setting of the audio gain control \( R_e \).

The remainder of the circuit is conventional in all respects and the values indicated in the parts list will be found to be generally satisfactory.

The writer wishes to express his appreciation to Mr. R. C. Merryman, W3FBB, for his invaluable assistance in the construction and testing of the model illustrated.

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**Fig. 1. Schematic diagram of stabilized modulated oscillator. Section enclosed within dotted lines is conventional Hartley oscillator circuit.**

**Fig. 2. Schematic diagram of a practical transmitter which incorporates a stabilized modulated oscillator replacing conventional crystal control.**

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January, 1947
This is an ideal location for a store from the standpoint of pedestrian and car borne traffic. A more spectacular store front, improved lighting and the use of signs could increase sales.

In selecting the location for your store avoid premises where the customer must climb stairs or step down. This factor is a great deterrent to business, inconsequential though it may seem.

A transfer point is a good selling location, particularly for "impulse items." To make this a good service location, pickup and delivery of the radios to be repaired must be provided.

Avoid dead-end streets in residential areas unless you are a dynamic merchandiser and can overcome the many obstacles which this type of location will put in the way of your success.
The author discusses several important factors which must be taken into consideration when you select the new location for your radio business.

By SAMUEL C. MILBOURNE

LET us suppose, for a minute, that you are either going to open a radio service business or are going to move your existing shop to another location. By what signs can you recognize the "perfect" site for your shop? How can you be sure to choose the most profitable location?

First, let us understand that—as in many other things—what is one man's jewel becomes another man's millstone. If, for instance, you were to engage in a "wholesale" repair business, that is, do work exclusively for other radio dealers and servicemen, then there absolutely need be no need for a "fancy" store front on or near a main street. A loft, or other cheap but commodious floor space, centrally located with respect to your dealers would be your answer.

Second, if you do not do sufficient radio service work to support even a small store on a side street, your logical step is to do your radio service work in the basement or in a spare room of your home until you can build up a clientele. Many servicemen make a satisfactory living operating from their homes, and with a minimum of expense.

However, there comes a time when space becomes cramped, business becomes greater, and more advantageous quarters become a necessity.

The proper operation of a store involves certain responsibilities that will take a definite part of your time which, heretofore, may have been spent solely on radio servicing. The store must be kept neat, the windows must be dressed periodically, there must be someone in the store during the complete business day (even when you go out on a call), and there will be a constant flow of floor traffic (for that is the purpose of a store) which will interrupt your actual bench work. If you can not handle these problems, don't open a shop.

Let us assume that the above conditions have been met and that you are going to sally forth in quest of a shop location. How do you go about it?

First, you must be familiar with your town or city. You should know its busy streets and byways. This should be no problem to a wide-awake radio serviceman who specializes in serving his city. On your calls, keep your eyes open for empty stores. Copy the real estate agent's name and address on a card, and have him as to the rent and facilities of the site. By all means do not take the first or second store which you see. If you do, you will almost surely get less than you really want and should have. First get a solid basis and understanding for comparing store values in your town. Compare items such as (1) rent, (2) floor size, (3) type and condition of building, (4) type and condition of store front and windows, (5) shape and condition of interior, (6) location and condition of any store fixtures, and (7) the approximate cost of fixing it up for your use.

If you are operating in a large city, and you are to confine yourself to one neighborhood, give due consideration to the type shop as it relates to the district you wish to serve, that is, try to locate near the center of your customer area.

Keep a list of these store locations as they come up, and you will soon see at least one case where all identical stores (as far as store values which we have so far given) will have a variation in rent between them as much as 300% to 500%. While there is always the chance of a "bargain," store prices are far too high elsewhere—"you get only what you pay for." It is the smart serviceman who can size up a store location and see additional points of superiority which make that particular spot more advantageous to him than to some one else in another line of business.

Here are some of the things to look for in choosing a store for your radio business.

1. Proximity to other stores, particularly drug, grocery, meat, delicatessen, frozen food, hardware and department stores; banks, public buildings, and other service institutions; gas, electric, water and telephone offices where people pay their bills; restaurants, theaters, lunchrooms, soda fountains and stationery stores; businesses where the customer delivers and picks up his own things—such as self-service laundries, dry cleaners, etc.; chain stores of any type; gas stations; men's and women's establishments such as doctors', dentists' and lawyers' offices, and beauty shops; business establishments such as manufacturing plants which employ large numbers of people.

Note that in each of the above cases, these types of businesses mean a flow of street traffic. It is your object to obtain a location which will catch the maximum amount of this traffic, either (1) passing your shop, (2) entering your shop, or (3) just around the corner from it. The preference of location is in the order just named.

If you are interested in auto-radio repairs, note the proximity of auto dealers, garages, parking lots and auto supply stores.

Another point to consider in auto radio servicing is to plan for sufficient space so that cars can be driven under a roof for ease of servicing and for the customer's comfort.

Many are interested in the farm trade, watch for feed and grain stores, seed stores, farm implement stores and for stores selling farm-size deep freezers.

If you were checking locations for a chain company, among other things you would do would be to actually count the flow of traffic past the site. You might find that the early morning traffic was made up of office and factory workers on their way to work, but that these same people homeward bound in the afternoon used the other side of the street because it was the shady side. People going to work have little time for shopping. Locate on the side of the street where workers walk, homeward bound.

A knowledge of the type of people making up the traffic flow is important. For instance, if you want to sell records, a large percentage of popular records are sold to the "teenagers." Thus, if you locate in the "path" of a school, public library or "Sugar Bowl," you are sure to get the teen-age traffic past your store.

Another point to check is whether or not the store is directly a stop on a street car, bus or subway line. People have to wait for such transportation and while they wait, they 'scan' the neighboring store windows and signs. Being close to such a stop is important if your window display or sign is close enough to be seen clearly.

If the stop is a "transfer" point on a car or bus line, or an express stop on a subway, it is an even better location. Once more, such conditions encourage pedestrian traffic and the more flows past your shop, the more chance there is for repair sales. Remember, however, that the better the location, the higher the rent, and that radio repairs alone will not produce top store rents.

A word about store entrances with relation to attracting customers. Most stores have their floors on a level with the street. However, every now and then, you will run across a store with an entrance or steps that are so close to the street floor level will be above or below the street level. My personal recommendation is to steer clear of all "off-street-level" stores, no matter how "cheap" the rent might be. People just will not walk up or down steps if they can help it—but they will climb down rather than up. Many a small business venture has been tripped by just one step.

There are certain specialty repair services which require special locations. For instance, if you wish to specialize in airborne electronic equipment repair, you should locate at an airport or airfield. Likewise, if...

(Continued on page 332)
A Breadboard 2 Meter Kilowatt Transmitter

By G. H. FLOYD, W2RYT and H. D. WELLS, W8LWD

Tube Div., General Electric Co.

This experimental 2-meter rig, using new h.f. triodes, can be built at relatively low cost by the amateur.

IS THERE some simple and inexpensive way to get on 2 meters? The question assumes importance when one considers how many of us there are who are "planning to go on 2 meters sometimes," but who never quite achieve this end. It is usually not possible to wind a few new coils for your present rig, stick up another piece of wire as an antenna and go on any of the high-frequency bands.

Here, however, is a simple and inexpensive way to get on 2-meters—a bread-board 2-meter kilowatt.

The desirability of a simple rig immediately ruled out both a crystal-controlled or an m.o.p.a. transmitter. This leaves only a modulated oscillator. The authors, although they agree that a modulated oscillator is not too desirable, believe that it is better to be on a band with a properly adjusted modulated oscillator than not to be on at all.

The question of what type of modulated oscillator to use provoked much thought. From the standpoint of efficiency a resonant-line oscillator is to be preferred because a high impedance circuit and a relatively high-Q tank circuit can be achieved. Further, these circuits have large physical size in proportion to the wavelength. Because it offered so many advantages the so-called "teeter-totter" high-frequency oscillator circuit was finally selected. This circuit has the advantage over most resonant-line circuits in that two tubes are used, thus giving a completely balanced layout and eliminating the shorting capacitors which would be necessary, as well as the short circuits present, if a one-tube resonant-line oscillator circuit were used.

Reference to the circuit diagram shows two triodes placed at opposite ends of a foreshortened, 300-ohm, half-wavelength line. The filaments are isolated from ground by radio frequency chokes and the addition of a plate choke and grid resistor completes the circuit.

One advantage of the "teeter-totter" oscillator circuit is that there is no feedback adjustment to make as the grid and plate voltages are automatically maintained 180 degrees out-of-phase due to the location of the tubes on the transmission line. Another important advantage is that the ground circuit is not tricky. There are actually three points in the circuit at r.f. ground; the center of the plate and grid lines, and the r.f. electrical center of the filament circuit. There is no difficulty with length of leads in ground circuits and if it is found to be necessary to connect to ground the connection should be made at the "B minus" point.

In order to obtain optimum results with a "teeter-totter" circuit it is necessary to use high-frequency tubes. The new General Electric GL-592 seems to fill the bill very nicely. Although at first glance it might seem strange that a tube of this power capability was selected, it worked in quite nicely with the authors' plans to use the power supply and modulator from the present rigs. A pair of GL-592 tubes was found to be capable of handling an input of 1 kilowatt for 2-meter phone work. Although the pres-
The circuit is so simple that the majority of the details can be seen from the photograph. It is extremely important to maintain mechanical symmetry. This was even carried to the point of using two identical filament transformers. This is perhaps carrying the symmetry idea too far but a ten-volt, ten-amper transformer was a little difficult to find so two ten-volt, five-amper transformers were used.

For purposes of support the tube is mounted with the anode caps down. The anode support proper consists of two thirty-amper fuse clips placed back to back with a one inch angle held between them by means of a machine screw. One of the fuse clips fastens to the half-inch copper tubing of the plate line and the other grips the anode cap of the GL-592. The other end of the 90 degree angle fastens to a three-inch insulator which supports the entire assembly.

The grid line is supported on the grids of the tubes themselves, connections being made to the grid line by a thirty-amper fuse clip which is in turn fastened to a Fahnestock clip which clips over the grid lead. Fahnestock clips are similarly used for filament connections.

Thirty-amper fuse clips are also used to connect the plate choke to the center of the plate line and to connect the grid resistor to the center of the grid line. A six-inch insulating pillar at the rear of the unit acts as a tie point for the filament and grid return circuits. A three-terminal tie strip is fastened at the top of the insulator. The filament leads and the filament center tap run to this point from the transformer tie strip located between the transformers. The grid resistor connects to the filament center-tap at the tie-point mounted on the six-inch insulator.

**Operating Adjustments**

The particular unit shown in the photographs oscillated the first time it was tried. Subsequent testing convinced the authors that only an order from the FCC would stop the oscillations. Very few of the parts were found to be critical, but minor adjustments should be made in order to achieve optimum efficiency.

The filament up to the choke in the plate circuit without any ill effects whatsoever on the operation of the circuit. It was kept in, however, to be on the safe side. The 100-ohm resistor was included in the grid circuit in order to measure the grid current. In use, the grid meter is merely placed in parallel with the 100-ohm resistor. One precaution may be in order at this point. When measuring either grid or plate current do not leave the meters in the circuit any longer than is necessary because the terrific radio-frequency field in the vicinity of this oscillator is liable to burn out the meters. The transmitter and antenna coupling should be adjusted so that the GL-592 tubes draw 0.400 amper at 2500 volts. The grid current (for both tubes) should not exceed 0.100 ampere but should be kept as high as possible. The grid current ran 0.090 amper in the unit described, with 2250-ohms resistance in the grid circuit.

Tests showed that the transmitter produced less frequency-modulation when the grid drive was high than when the tubes were not driven hard. For this reason it is recommended that the grid current be kept above 0.080 amper.

Under normal operating conditions the anode of the GL-592 tube runs a
Fluorescent tube indicates presence of r.f.

bright cherry red. This is a bit unusual for a tube with a carbon anode but the GL-592 has been treated in such a way that no gas is released when the anode is operated at these very high temperatures.

The final circuit adjustment should normally be to test for the presence of r.f. at the center of the grid and plate lines. If there is any r.f. indicated by a neon bulb at these points the fuse clips should be moved one way or the other until the electrical center has been located.

Frequency changing could have been accomplished by shunting the grid and plate of each tube by a disc-type neutralizing capacitor. The authors felt that this would mean needless expense and so decided to use the tuning slugs indicated in the circuit diagram. These tuning slugs are made of copper tubing which is of the proper diameter to give a slide-fit inside the one-half inch diameter grid and plate lines. Each slug is two inches long. If all dimensions are carefully followed it should be possible to tune over the entire 2-meter band by sliding the four tuning slugs in or out of the grid and plate lines. If the frequency is found to be too high with the tuning slugs most of the way out it will be necessary, of course, to make the tuning slugs longer. A change in the antenna coupling will be reflected in a change in oscillator tuning so that it is necessary to readjust the tuning slugs whenever the antenna loading is changed.

Antenna

Transmission lines used on the high-frequency bands are sometimes the cause of very strange results. For that reason the decision was made to forego completely a transmission line and to couple the antenna directly to the tank circuit. The antenna shown is a result of this thinking. When it became apparent that it would be necessary to couple over a great percentage of the plate line the authors decided to come straight out from the coupling loop with a pair of half-wave elements 1 1/4 wavelengths apart. The result is an end-fire array with a gain of 4.3 decibels. The pattern of this antenna when checked with a field-strength meter was found to be very close to the theoretical.

The combination antenna, transmission-line and coupling loop is made up from one piece of \(\frac{3}{16}\)-inch diameter copper tubing. The spacing between adjacent half-waves is ten inches, center-to-center. Total height of the antenna is 42% inches. A rod of one-half inch diameter polystyrene, twelve inches long is drilled out to pass the three-sixteenths inch tubing and is then placed on the antenna system twenty-four inches from the top. The rod is required for mechanical strength and adds no loss as it is placed at a voltage node (point of minimum voltage).

The antenna system is supported on two three-inch insulators and fastened to them by means of a clamp. Antenna loading may be changed by adjusting the position of the bottom portion of the antenna system with respect to the plate line. As the photograph shows it is necessary to bend the two half-wave lines in order to clear the grid line.

In some cases it may be desirable to use an antenna remote from the transmitter. If this is the case, a regular open-wire or coaxial line may be used. The pickup loop should be coupled to the plate line only. The size of the coupling loop will depend on the loading desired.

Results

In a series of tests made with this rig on the air, it was very difficult to tell what effect the beam had as all of the stations contacted were using super-regenerative receivers. On one contact, however, an interesting experiment was made. While W6OJK/2 was in contact with W7BBI/2, George asked the op at W7BBI/2 how much hiss was still present in his receiver. When it was learned that there was no hiss present W7BBI/2 was requested to reduce his antenna coupling until some hiss was present in order that a signal strength comparison could be obtained. After much fussing W7BBI/2 came back and said that he was sorry but with the antenna coupling his receiver decoupled as far as possible, there was still no hiss in his receiver when receiving W6OJK’s carrier.

At first thought it might seem that a modulated oscillator with a kilowatt of power might put out an extremely broad signal. This, however, did not seem to be the case and in one direct comparison against another 20-watt carrier the kilowatt carrier covered five divisions on W7BBI’s receiver as compared to four divisions for a 20-watt carrier which was being received over approximately the same distance.
HERE is a u.h.f. oscillator which can be constructed in an hour without the assistance of a plumber or a machinist. It consists of a very few components, most of which can be made by hand in a few minutes.

Fig. 1 shows the circuit diagram of the 400 to 800 mc. oscillator. The frequency of this oscillator depends on the position of condenser, \( C_1 \), along the line \( L_0 \). This circuit is based on D. B. Sinclair's development described in his article entitled “High Frequency Measurements.” This article originally appeared in the January, 1946, issue of the Radio-Electronic Engineer- ing edition of Radio News.

Fig. 2A shows how the r.f. chokes (RFC) are made. All four are identical and consist of 5 turns of No. 22 wire with 3/16” inside diameter and a winding length of 9/32” or 5/16”.

Fig. 2B describes the construction of the feed-through condenser. It is necessary to use this type of condenser because “postage stamp” type mica condensers frequently introduce too much inductance in the circuits. Of course, commercially manufactured feed-through condensers may be used and the required capacity would be about 50 \( \mu \)fd. As shown in the drawing, the feed-through condenser is made up of the following parts: (A) 6-32 x \( \frac{1}{2} \)” screw, (B) lockwasher, (C) solder lugs, (D) copper washers, 1/16” thick x \( \frac{3}{16} \)” diameter, with a 3/16” hole in center, (E) mica washers, .010” thick x \( \frac{3}{16} \)” diameter, with 3/16” hole in center, (F) spaghetti sleeving 3/16” long to fit over screw, (G) plain washer, (H) 6-32 nut.

As can be seen in the photograph, the r.f. chokes are mounted in a perpendicular position. They project straight down from the tube terminals to the chassis. This is important as leads must be short. The tube socket is only \( \frac{3}{4} \)” above the chassis.

The dimensions and mechanical layout for constructing the chassis are shown in Fig. 4.

A common lead for “A—” and “B—” is soldered to the chassis near the point where the grid resistor is also grounded.

Leads on the ceramic condenser are about 3/8” long and the condenser is soldered across the parallel lines. Pinned wire of size No. 20 is used to make the tuned line, \( L_0 \), which is connected between plate and grid of the tube. The line is 2½” long with a 3/4” spacing between the wires.

Filament voltage can be 6 volts, either a.c. or d.c. 300 volts d.c. should be used on the plate as the circuit will not oscillate dependably if a voltage of much lower value is employed.

First apply filament voltage and allow the tube to heat. Then apply plate voltage and the circuit will oscillate. It is as simple as that. There (Continued on page 116)

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Employing a 955 tube, this oscillator is simple and easy to construct for the experimenter.
FOR some time now it has been generally conceded by progressive radio servicemen that the principle of signal tracing is, in general, the simplest and most direct approach to the problem of diagnosing the defects in radio receivers. The reason for this is that the signal tracing method makes use of the most fundamental factor in any type of electronic system—the signal itself. Guessing at the trouble, on the basis of previous experience with similar difficulties, is unreliable and does not keep pace with the continued development in communication circuits. The point-by-point system of static voltage and current measurement by means of a multirange volt-ohm-milliammeter is very slow and not completely dependable, since any number of defects may exist in the system without in any way altering the operating potentials or d.c. resistance values. The method of signal tracing, by which a signal is applied to the input and traced stage-by-stage through the receiver under operating conditions, offers the advantages of superior speed, universal application, and positive identification of the defects.

The only major objections now raised against the use of signal tracing in the servicing of receivers concern the amount of equipment which must be carried, and the possible adverse psychological effect which may be given to the customer by the radio serviceman who needs a considerable amount of test equipment to diagnose what may be a simple defect in the receiver. The merit of this criticism is evidenced by the continual simplification in the design and construction of signal tracers. In the research laboratory, signal tracing in newly designed equipment is generally performed by the use of the vacuum tube voltmeter, the oscilloscope, and the distortion meter. It would obviously be ridiculous for a radio repairman to carry all this equipment into a customer's living room to diagnose the trouble in a radio receiver. Furthermore, the average repairman does not like to use an oscilloscope, and has no need for a distortion meter. He would prefer to listen to the audio signal for quality and distortion rather than see it on the screen of an oscilloscope or on a distortion meter. Signal tracers for radio receiver servicing therefore have become small, compact, easily portable instruments performing one or more functions to simplify as much as possible the tracing of the signal through every section of the receiver.

The signal tracer described in this article is an improved model which provides an r.f., i.f. and a.f. vacuum tube voltmeter, and at the same time offers an audible check of the signal quality by means of a loudspeaker or earphones, thus permitting maximum flexibility with increased sensitivity. With the use of this signal tracer, a volt-ohm-milliammeter and a spare set of good tubes, the faults in a receiver can be rapidly and completely diagnosed (in the customer's home, if necessary) without the use of any additional equipment. It is, of course, desirable to have available a modulated r.f. signal generator and a tube tester when the receiver is being serviced in the shop, but on occasions when work must be done outside of the shop it is a decided advantage to be able to carry as little equipment as possible.

A number of different signal tracers are in general use at the present time, but most of these possess certain limitations either to their application or to their ease of operation. The signal tracer described here possesses a number of decided advantages over other existing instruments of this type:

a. Most of the available instruments possess either aural or visual indication of the signal, but not both. In those which do give both, a 6E5 "magic-eye" electron-ray indicator tube is generally used as the visual indicating element, thus giving either very approximate readings, or necessitating continual setting of a gain control with the closing of the eye as a reference each time an accurate voltage reading is wanted.

b. The signal tracer described here has a continuous range from 0 to 5000 ohms, including also the a.c. and d.c. measured battery voltage of the receiver itself. Neither the signal tracer described here nor any other instrument is intended to replace a good voltmeter, but it is often more convenient and accurate to use the signal tracer instead of a voltmeter, since it is more responsive to the subtle changes in the signal voltage and thus is more satisfactory for locating faulty components.

c. The signal tracer described here is a battery-operated instrument, and has been designed to be lightweight and small enough to be carried in the pocket of the repairman. It is especially suited for domestic receivers, since it is not possible to carry a voltmeter into the living room, and it is desirable to have an instrument which will carry both r.f. and a.f. signals to the repairman's ear.
or gain reading is required. The present equipment provides both a visual indication of relative signal strength by means of a vacuum tube voltmeter (for stage gain and signal level measurements), and an aural indication of signal characteristics and fidelity by means of a high-gain audio amplifier, with an earphone output for greater sensitivity when required.

b. The sensitivity is sufficiently high to indicate the presence or absence of signal in every section of the receiver.

c. Most early signal tracers made use of the diode type vacuum tube voltmeter circuit requiring additional components making a more cumbersome and complex unit. Many models used a tuned r.f. amplifier which, while quite efficient, takes longer to set up and may require constant adjustment. The circuit used in this instrument makes use of a triode grid leak detector which requires no tuning or adjustment in operation.

d. The input impedance of the grid detection circuit used is so high that there is no loading of the circuit under test up to frequencies above 10 mc.

e. The wide frequency range, which extends from low audio frequencies to 10 mc, makes the instrument useful for measurements on all types of audio circuits, i.f. and r.f. sections of broadcast receivers, audio and i.f. sections of FM receivers, and video amplifiers. This frequency range provides the maximum benefits from the viewpoint of flexibility of operation and simplicity of design, since if the bandwidth were to be extended to accommodate all frequencies which might be required in the future it would be necessary to extend the response to well over 500 mc. to include the high frequency television band in which micro wave television broadcasts are now being transmitted. Such a procedure would obviously be impractical in the design of a test instrument such as this. (If, however, in the future it should become desirable to perform r.f. measurements in FM and low-frequency television receivers, it is a simple matter to construct a v.h.f.-u.h.f. rectifier probe using a 1N34 crystal diode detector whose output would feed into the signal tracer.)

f. The circuit has been designed to provide a maximum of operational flexibility and increased sensitivity, without introducing excess complication by duplicating any functions of any of the other instruments which the serviceman customarily carries along on an outside service call. Thus, there is no provision for the measurement of any d.c. voltages, since they can just as easily be measured by means of the volt-ohm-milliammeter which is invariably present. By designing the instrument to be battery operated, this signal tracer has been made as completely portable as the battery operated volt-ohm-milliammeter.

The schematic circuit diagram of the new signal tracer can be seen in Fig. 4. The circuit consists essentially of a grid leak vacuum tube voltmeter and a single stage of audio amplification. The detector circuit consists of a 1T4 tube connected as a triode, with a .0002 µfd. coupling condenser and a 20 megohm grid resistor. The input impedance of the grid circuit is so high that there is no loading of the circuit under test at any frequencies below 10 mc.

A switch in the plate circuit provides for operation of the tube as either a vacuum tube voltmeter or an audio amplifier stage. The operation of the vacuum tube voltmeter may be described briefly as follows: When there is no signal applied to the grid, current flows in the plate circuit because there is no bias on the grid. When a signal is applied to the grid, rectification takes place and the current flowing through the grid resistor biases the tube, causing the plate current to drop. In order to make the meter give positive current readings for decreases in tube plate current, the meter is connected in reverse (plus terminal to plate, and minus to B+) and a bucking voltage applied across the meter to bring the reading to zero when there is no signal. Meter current is adjusted to zero for no signal by means of the 500 ohm balancing potentiometer. Then, when a signal is applied to the grid, the meter reads up scale in the conventional manner.

It may be mentioned that the calibration is not in volts, but in relative signal strength, and that the meter used in this circuit is the new cobalt magnet type, which is much more rugged for portable use.

With the switch in the "Speaker" position, the 1T4 serves as a stage of audio amplification which drives the 3S4 in a high gain stage operating the speaker. An Anlico V speaker is used because of the greater sensitivity it offers. In addition to the speaker, a phone jack is provided for the use of phones when greater sensitivity is required, especially if a weak signal is being checked. The phone jack is of

(Continued on page 86)
The ELECTROPLEX—a new automatic key

By JULIAN T. DIXON, W-IAJY

One item of equipment which is long overdue in many radiotelegraph stations is a dual-automatic key—one which forms both dots and dashes automatically. The Electroplex is the result of an effort to provide a practical dual-automatic key which might be acceptable for general use by the radio operating fraternity. It is of simple design, yet has a number of features which in combination give the Electroplex definite advantages over previous dual-automatic keys.

This unit is designed to eliminate to a considerable degree the need for precise timing on the part of the operator. It incorporates circuits which selectively form sequences of dots or dashes with each dot, dash, and intervening space being timed much more accurately than is possible with ordinary hand sending. It is controlled by means of a single-pole double-throw switch, thereby minimizing the number of mechanical adjustments required. This simplified control switch assures accurate and easy manipulation at high speed. It is not, however, primarily a high speed key. The model described here has a speed range of from nine to thirty-five words per minute, adjustable by means of a single potentiometer to the desired value. Thus, it is suitable for use by both the beginner and the more advanced operator. In fact, the beginner's problems are simplified appreciably because the key takes over the job of timing each dot and dash correctly. It will be shown how the key completes a correctly timed dot or dash even though the control switch may be opened in the middle of one of these marks.

Design and operation of dual automatic key—one which forms both dots and dashes automatically.

The model illustrated comprises four basic components which will be described in the following order: (1) timing circuit, (2) control circuit, (3) audio frequency monitoring oscillator, (4) power supply.

The Timing Circuit

The timing circuit utilizes a dual triode tube, $V_1$, the respective sections of the tube being designated $V_{ab}$ and $V_{bc}$. This tube and its associated circuit elements are connected in a specialized form of multivibrator circuit designed particularly for this key.

One important characteristic of multivibrator circuits in general is that plate current flows in one and only one of the two tubes at any given time. In a free-running multivibrator, the tubes conduct plate current alternately. They approximate a switch which changes the flow of plate current from one plate load resistor to the other at a frequency which is determined by the circuit design. It will be noted that the coil of relay $R_L$ is part of the plate load of $V_{bc}$. Thus, when $V_{bc}$ conducts, the relay contacts close and when $V_{ab}$ conducts the contacts open.

It will now be seen that when $V_{ab}$ conducts a space is formed and when $V_{bc}$ conducts a mark (either a dot or a dash) is formed. So, in order to transmit a sequence of dashes $V_{bc}$ should be non-conducting three times as long as is $V_{ab}$ during each cycle. This proportion is obtained by making the time constant of the grid circuit of $V_{bc}$ three times as great as the time constant of the $V_{ab}$ grid circuit. These time constants are approximately the product of the grid leak resistance and the capacitance of the corresponding grid coupling condenser. The coupling condensers, $C_1$ and $C_2$, have equal capacitances so that the non-conducting time of each tube is approximately proportional to the magnitude of its grid leak resistance. The grid leak resistance of $V_{ab}$ is the sum of $R_1$, $R_2$, and $R_3$, while the grid leak resistance of $V_{bc}$ is $R_2$ and $R_3$ in series.

The potentiometers $R_1$ and $R_2$ are provided for exact adjustment of the spaces and dashes, respectively, with relation to the dot length which is determined principally by $R_3$. These potentiometers are screwdriver adjustments which need not be changed after the correct settings have been determined by means of a simple alignment procedure to be described later.

The frequency of a multivibrator may be changed conveniently by vary-
ing the positive voltage to which the grid leaks of the tubes are returned. In this circuit, the frequency is almost directly proportional to the positive bias voltage obtained from potentiometer \( R_a \), which is part of a voltage divider connected across the high voltage power supply. Consequently, \( R_a \) functions as the transmission speed control but does not change the relative lengths of the dots, dashes and spaces. This is a front panel control and is mounted just above the control switch lever. It may be provided with a scale calibrated in words-per-minute as will be described in connection with the alignment procedure.

It would be desirable to clip a dash too short by opening the control switch before the final dash of a sequence is completed. This possibility is avoided here by providing negative effect on the circuit operation.

The Control Circuit

Thus far, the timing circuit has been treated as a free-running multivibrator issuing a continuous sequence of marks. The control circuit functions to start and stop the timing circuit and to determine whether dots or dashes are to be transmitted. It operates in response to manipulation of the control switch, or key, which is shown in the neutral position.

When the control switch is in the neutral position as shown, \( V_{in} \) is biased beyond cut-off by the voltage developed across the common cathode resistor \( R_c \). This negative bias is developed by the plate current of \( V_{in} \), which is conducting steadily because its grid leak is returned to the positive bias at \( R_{in} \). It will be noted that the grid leak of \( V_{in} \) is returned to the negative end of \( R_c \) through a very high resistance, \( R_c \).

Now, suppose that it is desired to transmit dashes. The control switch is moved to the dash contact, thereby connecting the positive bias from \( R_{in} \) to the grid leak of \( V_{in} \). The initial voltage surge is coupled through \( C_i \) directly to the grid \( V_{in} \), driving the grid voltage up to zero immediately and causing plate current to begin flowing through this tube. Simultaneously, \( V_{in} \) is cut off because, as previously explained, only one of the tubes can conduct at any given time. Thereafter, the circuit operates as a free-running multivibrator, forming a sequence of dashes which continues as long as the control switch is held in the dash position.

The duo-diode \( V_d \) operates as an electronic switch. When the control switch is moved to the dot contact, the multivibrator begins operation as previously explained because one section of \( V_d \) conducts current from \( R_{in} \) to the grid leak of \( V_{in} \). The other section of \( V_d \) simultaneously shunts \( R_{in} \) and \( R_{in} \), thereby reducing the time constant of the \( V_{in} \) grid circuit to one-third of its former value and making it equal to the \( V_{in} \) grid circuit time constant. These two circuit changes are accomplished with only a single circuit through the control switch. The current keyed by the switch contacts is very small, about one-half milliamperes or less according to the setting of the speed control.

The internal resistance of the diodes is about 1000 ohms, very low relative to the resistances which they shunt, and is considered to have negligible effect on the circuit operation.

Condenser \( C_i \) prevents a dot from being changed to a dash in the event the control switch is opened in the middle of a dot. In that event, \( C_i \) shunts sufficient current around \( R_{in} \) and \( R_{in} \) to be considered a momentary short circuit for sufficient time to permit the formation of a correctly timed dot.

(Continued on page 148)
New Parasitic Beam Design

Design characteristics of a 4-element, close-spaced antenna array featuring novel adjustable element length. Data applies to arrays for 28 mc. and up.

The following article describes a four-element, ten-meter, close-spaced array based upon the Plumber's Delight, but having a distinctive feature in the way of adjusting element lengths not heretofore disclosed to the best of the writer's knowledge.

While the design principles are not limited to any practical number of elements or element spacings, from a mechanical standpoint they can be best applied to arrays for 28 megacycles and higher, due to the relatively short element lengths required at these frequencies.

The novel mechanical design arises from the method of staggering quarter-wave sections of each element along the central carrying tube, as shown in Figs. 1 and 3, thereby permitting simple adjustment of element length from the center of each half-wave section and eliminating the need for telescopic sections. The protrusion of the short length of the butt end of each quarter-wave section does not deleteriously affect the gain or pattern of the array. The beam is made entirely from aluminum, with the exception of one small piece of insulation in the "T" matching section, later to be described. The metal frame, elements, matching section, and feed line are all electrically connected, permitting a single, permanent ground connection to afford protection from lightning and static discharge.

The central carrying structure, or "frame," for the particular ten-meter beam illustrated is made from a 12 foot length of 2 inch o.d. aluminum tube with a wall thickness of one sixteenth inch. An inspection of Fig. 4 shows how the tube is drilled at the spacings indicated in Fig. 1. A "stagger" distance of 1.5 inches was used in this particular embodiment, with 0.5 inch diameter thin-wall elements. The stagger distance should be minimized as much as possible, becoming progressively critical at higher and higher frequencies. The frame holes should provide a snug fit for the butt ends of the elements, yet permit them to slide when the clamping bolts are loosened. Small holes through the bottom of the frame, indicated in Fig. 4, are drilled to permit the insertion of the so-called "J" bolts. These bolts may be formed from eye bolts, "U" bolts or bent up from straight bolts. Tightening the wing nuts securely locks the elements in place, whereas loosening them slightly permits simple adjustment of the length of each quarter-wave section.

The quarter-wave sections may be scribed or otherwise ruled off at their butt ends to facilitate reading the over-all length. In the illustrated beam, short pieces of friction tape were wound around each element near the butt end at a predetermined, measured length from the tip. Thus, by measuring the short distance from the frame to the tape, it is possible to balance the length of each section easily as well as to mentally calculate the over-all length rapidly, without using a long rule or tape to measure the tip-to-tip length. All adjustments and measurements may be made at the center of each half-wave section, greatly facilitating installation and tuning.

Fig. 5 indicates a possible method for mounting the frame at its mechanical balance point on a short length of grooved 2 x 4 with "U" bolts. A pipe flange is screwed to the underside of the 2 x 4 to take a short 12 inch length of pipe, the i.d. of which just will slip over the o.d. of the supporting pipe, providing a bearing for rotation. In the illustrated arrangement, a ½ inch galvanized water pipe is used as the supporting pipe, for inasmuch as the array is close to the chimney bracket and the supporting pipe is short, greater rigidity is not required. Many other ways to sup-
In the illustrated mounting the tube frame was grounded to the pipe flange by a short length of copper braid, inasmuch as the supporting pipe and chimney bracket are permanently grounded to a vent pipe in the roof of the house for lightning protection. A potential method for rotating the array is to bring the base end of the supporting pipe through the roof. A section of small o.d. tube may be inserted inside the supporting pipe, mechanically secured to the 2 x 4 and provided at its lower projecting extremity with a wheel or lever for rotation.

For this type of beam the "T" match, delta match or folded dipole feed is most easily adaptable. However, by drilling oversize the frame holes which carry the driven element, insulated bushings may be inserted at this voltage node to insulate each quarter wave of the antenna section from the frame so that other types of feed may be used.

The "T" match shown in Figs. 2 and 6 was selected for this particular application and the "T" section is made up from two 33 inch lengths of 1/2 inch o.d. thin-wall aluminum tube, the same diameter as the elements. A small block of 1/2 inch thick bakelite serves to mechanically connect and electrically insulate the inner ends of the "T." The block is so dimensioned that the stagger distance of 1.3 inches is maintained in the "T" section and is supported from the tube frame for rigidity. The shorting straps, which are adjustable along the length of the elements and "T" section, are formed from one sixteenth inch thick aluminum sheet, 1 inch wide. They are provided at each end with a hole for the passage of a bolt and wing nut to tightly clamp the tubing. By loosening the two wing nuts on each shorting strap, each strap may be slid in or out along the length of the element to minimize standing waves on the feed line, after the beam has been tuned by any one of several tuning procedures outlined in the various antenna handbooks. 300 ohm twin-lead type feeders are used with the illustrated beam and connected as shown in Fig. 6.

Before final installation of the illustrated "T" section made from aluminum tube and aluminum shorting straps, a temporary "T" section using No. 8 copper wire was used with excellent results. If a wire "T" section is used the vertical spacing may remain 4 inches and the distance "T" determined by noting the standing wave ratio.

A convenient, qualitative check for standing waves on the twin-lead type line may be made by running a neon bulb along the line for a distance of some ten feet, on ten meters. If the bulb brilliancy remains reasonably uniform, the line is reasonably flat. If the brilliancy varies, the distance "T" should be readjusted. The total distance "T" for the separation of the shorting straps will be somewhere between 40 and 60 inches. While the illustrated beam has been adjusted for maximum forward gain and minimum standing wave ratio at 29 megacycles, it has been used without readjustment from 28.1 to 29.4 megacycles. At these frequency extremities the standing wave ratio becomes appreciable and coupling to the final tank must be altered. However, with 600 watts input to a BC610E transmitter the 300 ohm twin-lead does not break down.

The staggered element design is not limited to the particular element or frame sizes shown. In the illustrated array the 1/2 inch thin-wall aluminum elements seemed rather light and flexible. Some lengths of thick-wall aluminum pipe were found in a war surplus stock, the o.d. of which would drive fit the i.d. of the 1/2 inch elements. Therefore, 2 1/2 foot lengths of the pipe were driven into the butt end of each of the quarter-wave elements.

In working with arrays using a metal center structure of appreciable diameter, the writer has noticed that the popular formulas for calculating the tip-to-tip element lengths seemed to give elements which were too short according to maximum forward gain measurements. It has been determined roughly that by adding the width of the frame to the calculated lengths such an effect is obviated.

Accordingly, it is to be noted in Fig. 1 that the dimensions for D 1, D 2, D 3 and D 4, calculated from Table 1, are measured from the outer wall of the 2 inch tube frame to the element tip. The formulas give the dimensions for each quarter-wave section of each element, which is the measured distance from opposing sides of the tube frame to the tip of each corresponding quarter-wave element, or the distance which each quarter-wave element projects from the side of the frame. The total over-all cut length of the various quarter-wave sections, to permit adjustment from 28 to 30 megacycles, is:

\[
D 1 + D 2 = 8' 2'' \\
A = 8' 6 1/4''
\]

It will be obvious from this that this beam requires for the elements, 4 lengths of tubing 8' 8'' long, 2 lengths 9' 0 3/4'' long and 2 lengths 9' 6'' long; for the frame, 1 length of larger o.d. tubing 12' long; and for the "T" section.

(Continued on page 48)

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Fig. 2. Photograph shows close-up view of "T" matching section.

Fig. 3. 16 meter antenna constructed by author. Main support is made of 1/2" galvanized pipe.

January, 1947
ALTHOUGH the recent maritime strike is hardly over and there is talk of another, the American Merchant Marine Institute President F. J. Taylor, recently predicted uninterrupted maritime activity for some time to come. . . . It was pointed out that with recent wage increases in all groups of personnel there would be no reason for another stoppage in the maritime shipping field.

During the recent strike there was a strong tendency to transfer cargo originally scheduled for American vessels to foreign flag ships in order to eliminate delays due to the labor troubles, it should be recognized by the unions that such action by concerns shipping goods to foreign ports will take place more and more and American shipping must operate continuously if it is to compete with such foreign vessels operating steadily out of American ports . . . that these foreign firms are really out for the trade can be seen in some of the recent arrivals of new foreign ships, a recent arrival, the Houffalize (Belgian), an 18½ knot vessel of 11,000 tons with the usual accommodations for 12 passengers. . . . The vessel is a triple screw, diesel powered . . . this is the second of three such ships to be operated by the Belgian Line. The first of the three was the Stavelot which made her maiden voyage last spring.

Various other foreign firms are either building new ships or, in some cases, purchasing American built vessels and converting them for their own runs and services.

A C. WELLS reported back in New York after a vacation. . . . M. C. Wilson arrived in port recently and after being around for some time contracted pneumonia and was hospitalized for some weeks—MC will be up and around shortly we hope.

Alan Van Siclen recently relieved aboard his Mariners Spice and started for the West Coast—Alan has ambition for a run down the west coast from Frisco to the Canal. . . . Dave Grossert reported back in the big town and shipping out recently. Harold Koch back at Charleston after a vacation home in the Mid-west. . . . Ed Stetson down to Philadelphia for several days, says he likes Jersey City better. . . . Joe Malony unreported the past month. . . . D. K. Crosby around town for a while to say "hello" to the old gang. C. E. Williams off a while ago to do a little fishing and hunting—and ran afoul of one of those black kitties with the white stripe! CE came off a close second.

LATEST reports from the Maritime Commission reveal that about fifty-one per-cent of the world’s merchant shipping tonnage is under the American flag compared with only fourteen per-cent in pre-war days of 1939. There is over 50 million tons under the U. S. flag and nearly five million more under various foreign flags is owned by United States shipping outfits. England, which is constructing most of the new tonnage now being built, shows a decline from the 1939 figure of 12,798 to 12,445 in 1946. However, world tonnage increased from 30,601,000 to 99,220,000 tons.

Wartime construction of about 2000 Liberties accounted for this trend. Only other major maritime nation to show an increase in addition to the United States was Soviet Russia whose merchant fleet increased from 2 per-cent to three per-cent of the world’s merchant shipping tonnage.

GENERAL ELECTRIC recently announced the development of a new and lighter radar unit for aviation, designed to eliminate some of the hazards of flying in darkness, fog, or storms—the unit has also been considerably simplified in operation over the 150 pound APS-10 radar built by GE for the Air Forces during the war.

TIE Maritime Commission did announce recently that 1685 vessels were now in Merchant Marine Reserve Fleet anchorages throughout the country as of Oct. 15th. . . . During the period Sept. 15th to Oct. 15th 46 vessels were withdrawn for sale, service or scrapping, it was announced.

Among the new shipping interests is the announcement of the completion of reconversion of the “America”—largest of the U. S. built ships which has been completely overhauled since her ‘West Point” days and is said to be one of the finest vessels afloat for the North Atlantic passenger trade—the vessel left Newport News recently (where she was built) for New York to shortly engage in her prewar trans-Atlantic trade.

SALES reported in progress are 50 Liberties to Italy, Holland also reported after quite a number of these craft—Holland-American Line looking for four Victories . . . France reported after about 75 vessels. . . . Matson has shifted four ships to Panama registry recently.

RMCA’s new radar unit reported ready for installations aboard the merchant fleet. Raytheon recently fitted out the Drottningholm with new radar gear—a new design commercial unit for marine use.

TEAMSHIP companies still in a struggle with CAB trying to get charters for over-ocean flying—CAB still interprets the law in a manner which prohibits steamship lines from operating airlines, American Export the only shipping line ever to get into the air business was forced to get rid of its airline by CAB.

Waterman, Matson, United Fruit, Grace and American South African are among those seeking permission for airlines in conjunction with their sea routes.

CONGRATS to Lt. Col. F. J. Shanon, who received the air medal for his part in the flight of the ‘Dreamboat’ from Hawaii to Cairo. . . . Frank in civilian life is connected with WCAU. Fred Pratt still out of town and has not been seen for some time . . . S. G. Hopkins and E. H. Robinson, recently cited by WSA, just before the end of that unit, for their part in wartime aboard their vessels.

YOU heard wrong. I didn’t say I had radio tubes for sale!”

By CARL COLEMAN

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www.americanradiohistory.com
Crystal Diode Applications

By J. C. HOADLEY

A very useful characteristic of this diode is its frequency response. It is flat from zero to 100 megacycles. This makes it ideal for use as a meter rectifier, among other things. The usual a.c. voltmeter using a copper oxide rectifier has relatively poor frequency response, falling off above several thousand cycles-per-second. It is inexpensive to convert your a.c. voltmeter to one whose frequency response is flat as far up the frequency range as the loading and other conditions will allow.

Keep in mind that not over thirty odd r.m.s. volts should be applied to one crystal. This can be overcome by series connection of two or more crystals. As the high frequency voltages which are usually measured are seldom over 100 volts, and are usually much less, this is not as serious a restriction as would first be supposed.

Let us consider some applications of this versatile little diode. The first one to come to mind is its use as a detector. From the beginning of radio, crystals have been used for detectors. They have fallen into disuse in recent years because of the critical adjustment of catwhiskers, etc. This problem has been solved, however, and the 1N34 is permanently adjusted.

In Fig. 2 is shown a detector circuit for use in a superheterodyne or tuned radio frequency receiver; or, if preferred, the circuit in Fig. 4 may be used as it has a higher output voltage. The sizes of $R_s$ and $C$, in Fig. 2 depend on the audio response required. It functions as a filter to remove the radio frequency component without attenuating the higher audio frequencies. We will probably want automatic volume control.

Fig. 3 shows the connection for a detector and a.v.c. rectifier. Notice that the diodes are reversed, as a negative voltage is needed for a.v.c. which determines the polarity of the a.v.c. diode. We then connect the detector diode with the opposite polarity to even up the load on the last r.f. or i.f. stage. Of course these diodes can be used to replace the diode tubes in an FM discriminator.

For the serviceman, one of these small diodes, a condenser and resistor made into a miniature probe and connected directly to a pair of earphones, makes a convenient signal tracer which may be slipped into the pocket and will never require new batteries or any attention.

The photograph in Fig. 1 shows a neat way to construct a crystal probe. First, saw the metal shell from a medium size metal tube such as the 6SJ7 or 6SK7 and cut an insulating disc that fits snugly into the open end. Drill and tap several holes for 2-56.

Fig. 2. Detector circuit designed around the IN34 crystal diode which may be incorporated in either superheterodyne or TRF receivers.

Fig. 3. Two crystal diodes replace a vacuum tube in this detector and a.v.c. circuit.

January, 1947
The inherent tendency of mixer and converter tubes to give poorer performance at the high frequencies is important now that television, FM and u.h.f. services are becoming widely used. As the operating frequency of receivers is increased, it becomes more and more difficult to obtain satisfactory, efficient frequency conversion.

In ordinary converter tubes, poor oscillator action, together with the undesirable space-charge coupling and transit-time effects limit the use to frequencies of about 30 mc. (10 meters) or so. The more recent improved forms of converter tubes provide satisfactory operation up to higher frequencies; for example, the 6SB7Y improved pentagrid converter tube provides stable, satisfactory frequency conversion in the FM broadcast band (88 to 108 mc.). However, it is generally true that a separate oscillator can be built with better high-frequency characteristics than can a built-in oscillator. Also, because the method used to introduce the oscillator voltage into the mixing part of the system can generally be chosen to better advantage with a separate oscillator than with a built-in oscillator, a frequency converter employing a mixer and separate oscillator tube can generally be designed to provide better high-frequency operation than is obtained with a converter tube. In general, also, mixer tubes are usable at higher frequencies than converter tubes, as the mixer may be used with a specially designed oscillator tube suitable for high-frequency operation (for example the macro type 6F4 triode oscillator can be used to generate frequencies up to approximately 1200 mc.). Triode-heptodes and triode-hexode converter tubes may be used to fairly high frequencies also.

In the u.h.f. region, the oscillator sections of ordinary converter tubes cease to function altogether. Consequently ordinary converter tubes must be replaced by special types of mixer tubes (diodes), and vacuum-tube oscillators designed specifically for these frequencies. These too, fail to function as the frequency is increased beyond certain values. Above these, other types of frequency converters must be employed, as we shall presently see.

**Use of Diodes as Mixers at U.H.F.**

A simple diode tube (2-element tube) can serve as the non-linear element in a single-electrode input type mixer. During the past few years diode tubes have become appreciated for the advantages they possess for operation in the region of ultra-high signal frequencies where ordinary rectifiers, oscillators, and vacuum-tube converters have generally been poor performers. However, such a circuit is not very satisfactory, as the voltage ratio between the output and input frequencies is too small (hence the name "diode mixer"). For example, in the 88 to 108 mc. FM service, line frequency (60 cycles) is used as the oscillator frequency; the mixer tube voltage ratio is then only one to 18,000.

A better arrangement employs the use of a separate oscillator as shown in the diagram. In the region of 88 to 108 mc., the oscillator frequency is generally of the order of 18,000 cycles, and the mixer tube voltage ratio is 60 to 1. This gives a much higher output-to-input ratio (in the order of 60) than in the grounded-grid arrangement and is a much better mixer. The use of a separate oscillator has the added advantage that the oscillator frequency can be varied at will, whereas the diode mixer tube frequency is generally limited to a few thousand cycles by frequency stability requirements.
multi-electrode types of mixer and converter tubes cease to operate satisfactorily. Accordingly, they have become popular for use in u.h.f. superheterodyne receivers.

The basic diode mixer stage consists of an input circuit tuned to the signal frequency, an output circuit tuned to the i.f., a source of local-oscillator voltage, and a source of d.c. bias (from a bias battery or a by-passed voltage-dropping resistor). The basic schematic circuit diagram of such an arrangement is illustrated in Fig. 1. In u.h.f. receivers, the signal and oscillator tuning elements may take the form of resonant lines, or cavity resonators. The oscillator voltage may be injected by means of a small coupling loop inserted in the resonant cavity. The oscillator voltage needs to be selected within a range that results in good over-all sensitivity and low noise.

**Operation of Diode as a Mixer**

Although the diode is the simplest type of vacuum tube, its behavior as a single-electrode input type mixer has not been clearly understood until fairly recently. One reason for this is that the frequency-conversion process is more complex than in conventional types of mixers in that it is bilateral, i.e., the diode mixer converts in both directions. It converts the applied signal-frequency and oscillator-frequency input voltages to an i.f. output; since this i.f. output and the oscillator-frequency voltage appear in the same circuit (see Fig. 1), it will reconvert them back to a signal-frequency current in the input. As the degree to which this occurs depends upon the impedance of the respective circuit elements to the two frequencies, the effect can be minimized by proper design.

Because no amplification is produced by a diode tube (since it does not possess a grid), no conversion gain is obtained in a diode mixer. Actually, there is a conversion loss, due to losses in the various circuit elements associated with the tube. If the conversion loss is to be held small, the diode must be operated so as to obtain the highest ratio of conversion conductance to average conductance. The upper limit of this ratio is unity, and this is attained only when the mixer-stage impedance is infinite. Thus, circuit losses prevent the attainment of the condition of zero conversion loss in practice, so the diode mixer normally operates with some conversion loss (although it may be kept fairly low by suitable design). This is one of the disadvantages of this type of mixer. However, conventional types of mixer tubes cannot be operated in the u.h.f. region at all, so the diode mixer with its conversion loss is better than no mixer at all.

The diode should be operated with fairly high bias voltage, properly bypassed, and correspondingly high oscillator voltage injection. Under these conditions of operation the output is essentially proportional to the input signal voltage, and small variations in oscillator voltage do not appreciably affect the conversion gain, percentage-wise.

Another disadvantage of the diode mixer is that the current it draws places a load on the tuned signal-input circuit at frequencies lower than 30 mc. (approximately), which tends to cause broad tuning. On the other hand, at extremely high frequencies where the input impedance of the conventional types of mixers is very low due to electron transit time effects, the diode mixer is based on the tuned circuit. This is one of its important advantages in u.h.f. receivers.

The damping effects of the diode on the signal input circuit can be decreased by tapping the diode down on the signal-tuning coil (as shown in Fig. 1) instead of connecting across the entire inductance. The signal voltage reduction caused by the resulting step-down transformer effect is offset by the increased tuned circuit Q resulting from the decreased loading.

The diode mixer, in common with all single-electrode input type mixers, has a very high oscillator-harmonic response. This is fortunate, for it permits operation of the local oscillator at a comparatively low fundamental frequency (where its stability is good, and its output high), a harmonic frequency of the oscillator being used for the mixing. As a result, the frequency drift of the receiver (which is dependent mainly on the frequency stability of the oscillator) is greatly reduced.

The elements of diode tubes used as u.h.f. mixers must be small, and the cathode and plate should be mounted close together to minimize electron transit-time effects. Special high-frequency diodes are now available for use in receivers designed for operation at frequencies up to the vicinity of 2000 mc. (15 cm.).

**Crystal Rectifiers for Use as Mixers at U.H.F. and S.M.F.**

Improved forms of contact rectifiers (such as the new germanium and silicon types) are widely used as the (Continued on page 151)

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<td>Modified Pentagrid Converter (647, 6765, etc.)</td>
<td>Osc. and Mixer Electrodes in Same Electron Stream</td>
<td>Figs. 1, 2, 3, Part 49</td>
</tr>
<tr>
<td>Mixer</td>
<td>Double</td>
<td>Electron</td>
<td>Sliding Q-point</td>
<td>Pentagrid Mixer (6L7, etc.)</td>
<td>Separate Osc. and Mixer Tubes</td>
<td>Figs. 3, Part 49</td>
</tr>
<tr>
<td>Converter</td>
<td>Double</td>
<td>Electron</td>
<td>Sliding Q-point</td>
<td>Triode-Paradise (1257 etc.)</td>
<td>Osc. as I.F. Electrodes in Same Electron Stream</td>
<td>Figs. 3, Part 49</td>
</tr>
<tr>
<td>Converter</td>
<td>Double</td>
<td>Electron</td>
<td>Sliding Q-point</td>
<td>Triode-Paradise (613L, etc.)</td>
<td>Osc. and Mixer Electrodes in Separate Electron Streams</td>
<td>Figs. 5A, 10, Part 49</td>
</tr>
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**Fig. 2.** (A) Sectional view of the Sylvania 1N34 germanium fixed crystal rectifier showing component parts. (B) The Sylvania 1N218 silicon type crystal rectifier for mixer use at higher frequencies.
During the war it became necessary for manufacturers of electrical equipment to design and construct their own test equipment. Two things dictated this: Procurement; and the fact that no appropriate test equipment was available. Many military contracts in the electronic field had specifications that were so tight that nothing less than precision laboratory equipment could be considered satisfactory for production testing. There were a limited number of manufacturers capable of producing precision test equipment.

Precision test equipment which was available in many instances proved unsatisfactory for production use. The mechanical construction of this equipment was, in some instances, inadequate to withstand production usage. Another difficulty experienced was instability. Some laboratory standards require precise adjustment just before measurements are made, and such procedure is unsatisfactory for production use.

This article covers the operation and construction of an audio oscillator which was designed and used to supplement precision test equipment. It will be possible for a technician to construct this test equipment from the information given and produce a piece of equipment that is equal to precision laboratory equipment.

There are many uses for an audio oscillator if the oscillator is stable, accurate in calibration and free from distortion (less than 1%). The oscillator described in this article incorporates the above features. Some of the uses for such a piece of equipment are: Frequency calibration, fidelity measurements, and distortion measurements. For frequency measurements, the calibration must be accurate and remain that way. Fidelity measurements require low distortion and a constant output. Distortion measurements require a harmonic-free voltage source. A voltage source with harmonic content will give an indication of excess distortion, since the distortion meter will be indicating not only the distortion of the amplifier but also the distortion of the voltage source.

Theoretical Operation

To successfully construct a piece of precision test equipment, it is helpful to understand the theoretical operation. Understanding the operation of the equipment puts the builder in a position to make slight final adjustments. The heart of this RC oscillator is, of course, the first two tubes which comprise the oscillator. A simple straightforward two-stage audio amplifier is shown in Fig. 1A. Note the absence of cathode and screen condensers. These condensers are omitted to reduce phase shift. Adding the condensers would increase the gain of the amplifier, but in the case of an RC oscillator, this is not necessary. Referring to Fig. 1B, we simply add RC networks composed of C.R. and C.R. to the grid circuit of the 6S7T. The cathode resistor becomes a 3 watt Mazda lamp connected to the feedback circuit by $R_e$ with the addition of $C_1$ coupling condenser. The condenser $C_1$ causes the circuit to oscillate by feeding back to the grid of the 6S7T. The resistor-condenser combinations of $C.R.$ and $C.R.$ determine the time element necessary for such a cycle to take place, which in turn determines the frequency of the oscillator. $R_e$.
The action of this adjustment is to feed sufficient negative feedback to the cathode of the 6SJ7 to reduce the gain to approximately 1. For minimum distortion output, the resistors and condensers of the RC network should be closely matched. A mismatch of 10% will cause harmonic distortion in the order of 5%. The coupling condenser C3 must be larger than normally used in a resistance-coupled amplifier, since a small capacitor would cause phase shift. A 5 µfd. condenser should be considered minimum capacity. The feedback condenser C4 must have a capacity of at least 5 µfd. due to the low load resistance created by the negative feedback circuit. If the oscillator is to be used for low frequencies, heavy condensers reduce the possibility of phase shift. If the oscillator is used at high frequencies (above 20,000 cycles), the capacity of the grid to ground of circuit components, wiring, and tube capacities becomes important in that this causes phase shift.

The use of a bath-tub type condenser for C4 is undesirable, since the capacity of the condenser to the can will cause difficulties at high frequency. If phase shift is encountered at high frequencies, it can be corrected by using small capacities from the screens of the tubes to ground. The value of these capacities will be determined by experimentation. If a variable frequency oscillator is desired, simply substitute a variable condenser for C4 and C3, and adjust the values of C2 and C3 so the frequency spectrum desired is covered.

It is common practice to use a four-gang variable condenser with two sections tied together for the variable control. If desirable, the condensers C2 and C3 can be fixed and a dual potentiometer used for resistors R1 and R2 to vary the frequency. The use of potentiometers for the purpose is rare, since linearity is not certain. If a variable condenser is used, it is necessary to insulate the rotor from the chassis and compensate for the additional capacity to ground by shorting the same amount of capacity across the section that is above ground. By using a variable with a capacity of 450 µfd. per section and

(Continued on page 74)

Panel view of oscilator shows position of various operating controls.
Ring Oscillators for U.H.F. Transmission

By TOM GOOTÉE

G ENERATION of u.h.f. oscillations above 300 megacycles is an impossible task for conventional types of vacuum tubes, because of the effects of interelectrode capacitance and electron transit time, and the effects of distributed inductance and capacitance in tube leads. Special types of high-frequency triodes—developed within recent years—have overcome some of these limitations to a degree, and many of the tubes can function as negative-grid oscillators at frequencies well beyond 1000 megacycles.

But these special triodes cannot carry large amounts of current, and therefore their output power is relatively low for most u.h.f. requirements. And the old bugaboo: interelectrode capacitance, though of lower magnitude, is still present. And it is still objectionable, since it limits the highest operating frequency of a vacuum tube.

The only solution to the problem of generating very high power with u.h.f. triodes is by arranging an even number of them in a wholly new type of u.h.f. oscillating circuit, known as a ring oscillator.

Any type of special u.h.f. triodes may be used in this arrangement, their combination providing not only a greater power output but also an extension of the upper limit of frequency operation in the u.h.f. band. Thus, an even number of four or more triodes will oscillate at higher operating frequencies and with greater power output than would be possible with one or two vacuum tubes of the same type.

Basically, the circuit is a special type of tuned-plate, tuned-grid oscillator.

The development of the ring oscillator is closely allied with the fundamental feedback circuit.

Basic Circuits

The circuit for the basic tuned-plate tuned-grid oscillator (Fig. 1A) uses a single vacuum tube and a resonant coil-and-condenser tank circuit in both grid and plate circuits.

Action of the oscillator is predicated on the feedback of energy from plate to grid circuits by means of the plate-to-grid interelectrode capacitance within the tube itself.

In operation, alternating voltage fed back to the grid of the triode is 180 degrees out-of-phase with the alternating voltage in the plate circuit, and the grid voltage is of sufficient amplitude to develop the output power required to maintain this voltage.

Frequency of oscillations is slightly lower than the resonant frequency of the plate and grid tank circuits. The two circuits need not be in exact resonance with each other, since frequency of oscillations is determined primarily by constants of the plate circuit. The grid tank circuit controls the degree of excitation.

At the operating frequency, both tank circuits offer inductive reactance.

A wartime development that contributes to the efficient operation of tubes at high frequencies, thus permitting high power outputs to be more readily accomplished.
to the flow of current. But to sustain oscillations, reactance of the plate-to-grid interelectrode capacitance must be greater than the inductive reactance of the grid tank circuit.

Grid current in a tuned-plate, tuned-grid oscillator effectively leads the plate voltage by more than 90 degrees, so the voltage fed back to the grid of the tube is exactly in phase with the plate current. This satisfies the oscillator requirement of a negative resistance of magnitude sufficient to compensate for all losses in the circuit.

Fixed bias (such as a battery) is seldom used in feedback oscillators. Invariably used is resistance bias, so the circuit will be self-starting and stable operation will be assured.

To obtain an output power greater than that for a single triode, two or more tubes may be connected in parallel. However, this serves no practical advantage, because all tube interelectrode capacitances are also paralleled. This increases the minimum circuit capacitance, decreases the tuning range, and causes the development of parasitic oscillations.

For these reasons, parallel-connected oscillators are not useful for generating high frequencies.

To obtain increased output and also greater frequency stability, a double-ended arrangement of the tuned-plate, tuned-grid circuit may be used. In this arrangement (Fig. 1B), two triodes of the same type are connected in push-pull.

Operation of this circuit also depends upon the interelectrode capacitance of each tube. Oscillations are sustained when a sufficient portion of the voltage in the plate circuit is fed back to the grid circuit.

The two triodes are balanced against ground, and each tube handles an alternation opposite in original polarity to that handled by the other tube—so that both alternations are utilized. In this way, even-order harmonics are effectively cancelled out in the plate circuit.

Oscillations normally tend to increase in amplitude until the energy lost in the grid and plate tanks is exactly equal to the energy supplied the tank circuits by the two triodes. Maximum amplitude of oscillations is called the saturation amplitude, since the two tubes are driven into the current-saturation region of their characteristic curves.

Since interelectrode capacitances of the two tubes are effectively in series, theoretically their combined value would be one-half that for a single triode—considerably extending the highest frequency at which the oscillator may be operated.

However, at ultra-high frequencies, the distributed inductance of the tubes leads which are also in series tends to overcome the advantage of decreasing input capacitance.

Resonant Lines

Effects of distributed inductance and capacitance in circuit components directly associated with the oscillator can be minimized by using extremely short leads and resonant lines.

Use of resonant or Lecher lines also contributes to extreme frequency stability and increased power output of the tuned-plate, tuned-grid oscillator. This takes place because both output power and frequency stability are functions of the "Q" of the oscillator's resonant tank circuits. "Q" is a factor-of-merit, determining the sharpness of resonance of a tuned circuit.

Considering the basic push-pull circuit (Fig. 1B), to obtain a high "Q" required for efficient u.h.f. operation, the r.f. resistance must be low. This would require use of a very large conductor, since u.h.f. current flows only in the outer surface. Also essential is a large inductance, compared to the capacitance of the tank circuit. But this is practically impossible, since interelectrode capacitances of the tube are limiting factors. Therefore, the "Q" of a coil-and-condenser tank circuit, even at best, leaves much to be desired for ultra-high frequency operation.

Quarter-wave resonant lines have very high values of "Q", and therefore are ideal as tuned tank circuits for ultra-high frequency operation. High values of "Q"—between 5000 and 10,000—are made possible by the construction of the resonant or Lecher lines, which minimize skin effect. As the operating frequency is increased, the length of the resonant line decreases faster than the skin effect increases. Thus, the value of "Q" increases with frequency of operation.

The basic push-pull circuit (See Fig. 1B) has been redrawn in Fig. 2, showing the substitution of tuned resonant lines for the previous coil-and-condenser tank circuits.

The circuit operates in much the same manner as the basic push-pull tuned-plate, tuned-grid oscillator. Differences are mainly physical or mechanical ones.

Grid and plate terminals of the two triodes are generally connected directly across the open end of their respective resonant lines. Since the high-"Q" circuit is also a high impedance device, direct connections permit the oscillator tubes to work into maximum impedance, thus delivering optimum power output.

The only disadvantage of resonant lines is the shunt-loading effect of the triodes, which loads down the line and diminishes slightly the value of "Q." Resultant operation is something of a compromise; high power output with relatively moderate stability.

Tuning of resonant lines is accomplished by "shorting bars," which resonate the lines at a given operating frequency.

The u.h.f. energy can be coupled out of the push-pull resonant-line oscillator (Fig. 2) by inductive, capacitive, or direct connection.

Inductive coupling to the grid circuit—by means of a one-turn loop—is critical, because coupling may seriously reduce the "Q" of the grid resonant circuit to such an extent that frequency control is influenced.

Inductive coupling to the plate circuit results in an extremely high potential between the plate line and the one-turn coupling loop. This potential

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Fig. 1. Basic (A) and push-pull (B) tuned-grid, tuned-plate oscillators.

Fig. 2. Ultra-high frequency push-pull tuned-grid, tuned-plate oscillator.

Fig. 3. Schematic diagram of u.h.f. tuned-grid, tuned-plate ring oscillator.

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is the sum of the d.c. and r.f. voltages. For this reason, precautions must be taken to prevent possible arcing. The degree of inductive coupling is often so limited that in some cases optimum coupling (maximum transfer of energy) cannot be obtained.

Capacitive coupling is seldom used unless in conjunction with inductive coupling.

It is possible to couple into a parallel line by tapping directly to one or both resonant lines, however, this should be done only to those lines carrying no d.c. voltage—such as the cathode or filament Lecher lines. Use of d.c. blocking condensers is discouraged.

These are general considerations of the simple push-pull resonant-line oscillator (Fig. 2).

The circuit has good stability of frequency.

Although it supplies a power output somewhat higher than any of the oscillators previously described, it is desirable in many u.h.f. applications to transmit signals of much higher power—while retaining good frequency stability.

The output power of the push-pull resonant-line oscillator (Fig. 2) is limited by the plate dissipation of the triodes and by the magnitude of plate current that can flow in the plate circuit.

Increasing the temperature of the filaments may permit greater emission, but this greatly shortens the life of the u.h.f. triodes, and is therefore undesirable.

A combination of four tubes arranged in push-pull parallel would increase the current-carrying capacity of the oscillator. However, the combined interelectrode capacitance would also be increased by such an arrangement, and parasitic oscillations would be prevalent. So, despite a higher output power, the upper limit of frequency operation would be limited and general efficiency of the circuit would be only fair. For this reason, use of the parallel push-pull oscillator for ultra-high frequency work should be avoided.

Solution of the problem of generating high power of stabilized frequency—with u.h.f. triodes—is a development of the simple push-pull resonant-line oscillator. This new circuit is known as a ring oscillator, and consists of any even number of four or more of the same triode types arranged concentrically and tuned with resonant lines.

**Basic Ring Oscillator**

The simplest type of ring oscillator consists of four tubes, arranged as shown in Fig. 3. Fundamentally it functions much as any tuned-plate, tuned-grid oscillator—using resonant or Lecher lines.

Leads between plates and grids of adjoining tubes connect to quarter-wave resonant lines. A common transmission-line tank serves each pair of grids and each pair of plates.

Standing wave transmission voltage established on sections of the tuned Lecher lines causes the instantaneous voltage on one plate to be 180 degrees out-of-phase with the connecting plate.

This voltage relationship plus some interelectrode coupling inherent between plate and grid circuits plus feedback of alternating voltage through the interelectrode capacitance of each tube combine to produce the necessary conditions for sustained oscillations.

Quarter-wave grid and plate lines are tuned to resonance by adjusting the position of the shorting bars. At resonance these shorting bars will be at zero r.f. potential.

Half-wave Lecher or coaxial lines are used in the cathode or filament circuit. When tuned to resonance, there will be zero r.f. potential both at the filament and at the shorting bar of each line.

In practice, electrical length of the resonant lines varies considerably from the physical length—because of capacitance effects between the various leads and r.f. ground potential, and between the tube elements and ground. This additional capacitive reactance in the circuit results in resonant lines of physical length considerably shorter than the effective electrical length.

Operating frequency of the ring oscillator is varied by adjusting the length of the resonant lines of all three tube circuits—grid, plate, and filament or cathode. The plate and grid resonant lines have the greatest effect on the oscillator frequency.

The u.h.f. energy can best be coupled out of the four tube ring oscillator by a single-turn coil placed between, in the same plane, and in close proximity to the two shorting bars of the plate circuit.

Since polarity of the plate resonant lines is in the same direction, current flows in the same direction in each line, and since the resonant lines are a quarter-wave in length and shorted at one end, current will be maximum at the two shorting bars and flowing in the same relative direction. This permits easy coupling by induction. The one-turn coil functions much as the secondary of an air-core transformer, feeding energy directly to the u.h.f. antenna by any kind of low-loss transmission line.

Frequency stability of this type of oscillator is good and is generally independent of the type of u.h.f. triodes employed in the ring circuit.

The arrangement of four tubes provides a power output double that for two triodes (of the same type) back ranged in a simple push-pull resonant-line circuit.

Since the tubes are effectively in series, the effect of interelectrode capacitance is diminished—permitting operation of the ring oscillator at a higher ultra high frequency than (Continued on page 118)

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![Fig. 4. Wiring diagram of 24-tube u.h.f. ring oscillator.](image-url)
Be Sure of Quality BEFORE YOU SELL

A dealer's reputation is always at stake. High-quality home performance of all products will assure satisfied customers.

As you read this, the first slow trickle of radios and appliances reaching your store is starting to increase to a stream. Soon the stream will widen to a river and soon after that we may expect flood tide. What will your position be when the flood is on us? If you use care and caution in building your dikes you will weather the flood and be strong. If you get careless and try just to ride the crest of the wave, you will be weak.

There are a few, and I feel a very few, dealers who have gone into the radio and appliance business with the fond hope of making a quick killing, taking the cream off the business, and then getting out. The words of advice and caution that follow are not for these. They are for the good, reliable dealers who have been in business for years and intend to remain in business. They are also for the veteran and many other reliable persons who have set up a radio and appliance business with the thought of continuing in business by being an asset to the community.

Let us first see what makes a good radio and appliance dealer. I think the following are the two most important factors, although there are many others:

1. A Good Product
2. Good Service

This brings us to the point of "What is a good product?" In my thoughts a good product is, "A piece of merchandise that, for the lowest possible price, will do, in the best possible manner, the job for which it is intended."

By M. KENNETH BRODY*

It must require a minimum of attention and service. When service is necessary, it must be easy to work on and the manufacturer or jobber must have adequate parts stocks available.

"Good Service" is much more than repairing a defective product when it needs repairing. "Good Service" starts before the customer enters your store and extends the life of the product you sell to him. "Good Service" gets your customer; "Good Service" keeps him sold; "Good Service" makes him a repeat customer and "Good Service" makes customers out of his friends.

As I said before, "Good Service" starts before the customer enters your store. When you send a circular, for example, on a new refrigerator to a person who has one that is ten years old, you are attempting to improve his living conditions and save him money on operation costs. This starts your "Good Service." When he comes in to buy, you make sure that he buys something he really needs; for example: when a man comes in to buy a water heater, sell him the correct size.

* Former Technical Director, McCall's Test Rooms, McCall's Magazine. Chairman, Committee of Domestic and Commercial Applications, American Institute of Electrical Engineers.

January, 1947
Putting the new SMALL METER to work

By RUFUS P. TURNER, W1AY
Consulting Eng., RADIO NEWS

These meters make possible, for the first time, real pocket test instruments and complete sub-miniature radio transmitters.

In comparatively recent months, an Eastern instrument manufacturer has made available to the public an interesting line of miniature panel-mounting meters developed during the war. Of the movable coil type, these instruments, in the round case style, are only 1 inch in diameter (the same size as that of a man's round-face wrist watch) and are available in all standard d.c. ranges from 0-100 microamperes to 0-10 milliamperes. Rectifier-type a.c. instruments are available in 1¼-inch cases. Although the meter scales are small, they are perfectly readable without magnification.

These meters are fast and rugged and excellently damped, despite their small size, and are sealed against dust and moisture. Provided with powerful Alnico No. 5 magnets, soft iron pole pieces, and steel pivots in sapphire bearings, they conform to AWS specifications. The accuracy of all scale points is plus or minus 2% of full-scale deflection.

The new sub-miniature meters are of particular interest to radio amateurs, experimenters, and servicemen who plan to build pocket-size test instruments and midget communications gear. Heretofore, it has been possible to build equipment much smaller in size than available meters. In fact, a well-known paradox has been the "vest-pocket" transmitters and field strength meters that were as big as the then smallest available milliammeters. There really was little point in reducing dimensions of the instruments so drastically when provision had to be made for a space-hogging meter.

Sub-miniature test instruments and radio gear are more than mere curiosities. A reliable vest-pocket test meter is a distinct asset to the stairs-climbing serviceman already bugged down with a tool kit and other heavy paraphernalia. And the traveling radio ham has strong praise for a practical camera-sized transmitter or transceiver, complete with tuning meter, which will not noticeably increase his baggage burden as he approaches some distant hotel. Likewise, the ham at home appreciates the opportunity of keeping his monitors, frequency meters, and field strength meters small—for easy portability and minimum storage space.

Applications

It would not be practical in a single article to give examples of all amateur and service applications of the new miniature meters. Only two applications actually are illustrated here, but these should arouse interest and stimulate further development in this direction.

Radio service applications might include pocket voltmeters, milliammeters, ohmmeters, and multimeters, v.t. voltmeters, wattmeters, impedance meters, null indicators for bridges, decibel meters, continuity testers, first-step tube testers, microfarad meters, inductance checkers, battery checkers, and the like.

Amateur radio applications might include field strength meters, radio-phone monitors, per-cent modulation meters, external or internal S-meters or tuning indicators for receivers, neutralizing indicators, volume level indicators, milliammeters on midget transmitter panels, indicating meters in absorption wavemeters—especially u.h.f., etc.

Figs. 1 and 2 show a real vest-pocket, multi-range d.c. voltmeter. The basis of this 1000 ohms-per-volt instrument is an MB Model 100, 0-1 d.c. milliammeter having an internal resistance of approximately 20 ohms.

1 The MB Manufacturing Co., Inc., 331 East St., New Haven 11, Conn.

Fig. 1. Front and rear views of vest-pocket multirange d.c. voltmeter, using a 1-inch 0-1 d.c. milliam- meter. Ranges provided are 0-1, 0-10, 0-100, and 0-1000 d.c. volts and 0-1 d.c. milliamperes. Circuit schematic is given in Fig. 2. Size of the complete instrument is 2½" by 1-11/16" and ¾" deep.
Ranges provided are 0-1, 0-10, 0-100, and 0-1000 volts d.c. and 0-1 milliamperes d.c. Individual builders may provide other ranges and may include a.c. voltages and additional milliamperes ranges as well.

The instrument panel, as shown in the photographs, is ⅜-inch-thick wire-brushed aluminum 2¼" high and 1¾" wide. The mounting box is ¾ inch deep. This voltmeter is in the featherweight class.

Multiplier resistors (see Fig. 2) are small-sized 1-watt carbon units, hand-picked for exact resistance values. The free-point contact terminals are standard sized, insulated banana jacks which accommodate the banana plugs on standard meter test leads.

The instrument size could have been reduced still further if smaller contact jacks had been obtainable. Also, a subminiature rotary switch would have permitted internal switching of the meter ranges. These are needed components which undoubtedly will be manufactured when widespread use of the small meters justify their production.

The test meter, taking up not quite as much room as the package of cigarettes alongside which it is shown in Fig. 1, fits into the serviceman’s pocket with equal ease.

Figs. 3 and 4 show a universal field strength meter, using an MB Model 100, 0-200 d.c. microammeter, having an internal resistance of approximately 510 ohms. This instrument, built by A. R. Pierce, Jr., W1AWD, has been used already for adjusting beam antenna elements, neutralizing transmitters, watching for carrier shift in a 'phone transmitter, detecting stray r.f. energy in the shack and on power lines, and checking polarization of transmitted signals in the neighborhood of the transmitter.

As will be seen from Fig. 4, the instrument consists of a detector and indicator connected to the center of a small doublet antenna. The aperiodic detector is a Sylvania 1N34 crystal diode. The antenna is a rigid dipole composed of two 24-inch lengths of ⅜-inch-diameter brass rod. Although the antenna appears to be a half-wave at 233.7 megacycles, the field strength meter has been employed successfully at wavelengths as high as 80 meters. Either or both antenna rods may be removed by unscrewing from a small brass mounting block on the instrument panel.

The entire instrument, with its pickup antenna, may be rotated easily in any plane when waves of various polarizations are encountered. In a recent test, as the operator walked by a large nearby metal body while reading the field strength meter, rotation of the antenna from vertical to horizontal meant the difference between no indication at all and better than full-scale deflection of the microammeter.

In certain applications involving close proximity of the field strength meter and transmitter, as when watching for carrier shift on a radio-phone signal with the transmitter across the room, the dipole antenna will pick up excessive r.f. energy and the meter pointer will be driven vigorously against the pin. Pickup may be reduced in such a case by unscrewing and removing one of the antenna rods, as shown in Fig. 3.

If an individual builder desires, he may include in the midget field strength meter a tuning circuit, comprised of a midget variable capacitor and miniature plug-in coils. Tuning capacitors now are available in very small over-all sizes, and plug-in coils may be wound on tiny forms. Fig. 5 is a suggested circuit diagram for a tunable instrument.

If the dial of the tuning capacitor is graduated in megacycles, the instrument will be invaluable as a direct-reading absorption wavemeter, as well as a field strength meter, modulation checker, and neutralizing indicator.

**On the Way**

With sub-miniature batteries and tubes now available, the possibilities offered by the new miniature microammeters for construction of a single-packaged pocket v.t. voltmeter are not easily ignored. The author now is at work on such an electronic voltmeter. There is every indication that the developmental work soon will be completed, and it is planned to describe the instrument in this magazine.

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**Fig. 5.** Suggested circuit for a tuned field-strength meter.
Home Constructed V.T.V.M.

By J. H. CARLISLE

THERE have been published in all leading magazines, from time to time, vacuum tube voltmeters of every size, shape and description. We propose to describe a simple vacuum tube voltmeter which requires essentially, one tube, exclusive of the power supply rectifier, and in which the builder may use anything from a 0 to 50 microamperemeter to a 0 to 1 milliammeter.

In the model described, a VR150 tube is included in the capacity of the plate circuit. If this, however, is a refinement which is not essential to its operation. The circuit is shown in Fig. 2, and consists of a bridge with a tube as one arm. The tube is operated practically as a cathode follower and is highly degenerative. This high order of degeneration is instrumental in providing the great stability of the circuit. If you wish to look at the circuit another way, it consists of a cathode follower and the voltage is read across its cathode by means of a meter whose other side is connected to the proper voltage to buck out the initial reading on the meter caused by the no signal current in the tube and thus allows the needle to be set to zero.

One of the greatest advantages of using the cathode follower is the fact that it loads a circuit under test very slightly. There are two causes of loading when a tube's grid is connected to a circuit — capacity and grid current. In a cathode follower, the input capacity is degenerated to a value approximately equal to the measured input capacity of the tube, instead of being equal to the input capacity of the tube times mu, as it would be in the conventional circuit with the load in the plate circuit of the tube. Grid current can be prevented by inserting sufficient series resistance in the grid circuit to keep any current drawn by the grid very low, in the order of a fraction of a microampere. This is the function of the 3 megohm resistor R5 in Fig. 2.

The main objective in a vacuum tube voltmeter is to provide a voltmeter which loads the voltage to be investigated as slightly as possible. i.e., it draws as low a current from the investigated source as is feasible. There is a limit, however, to the value of resistors which are readily available to time series and consists of a cathode follower, exclusive of the plate circuit, and consists of 10 megohms as the total input resistance for the instrument (the effective a.c. impedance is 6.3 megohms). This gives a one-million-ohms-per-volt instrument on the 10 volt scale which means for full scale deflection on a 10 volt scale it will draw one microampere. On the 50 v. scale it draws 5 microamperes. These currents may not be considered appreciable for any measurements encountered in service work or general experimenting.

The 6SN7 has been chosen as an appropriate tube for our circuit, first because it contains two complete triode sections; second, because it is easily obtainable; third, because its plate characteristics are nearly straight lines. The first section of the 6SN7, VN, is connected as a diode to act as a rectifier so that the meter can be made to read a.c. voltages. It is highly desirable in order to reduce confusion, to have the voltmeter read either a.c. or d.c. on the same scale, so the diode is connected, as shown in Fig. 2, to read a peak value of a.c. voltage and then a resistor is inserted to act as a voltage divider with the 10 megohm divider on the a.c. voltmeter circuit. In this way the meter will read the r.m.s. value instead of peak. This is also the reason a scale of lower than 0 to 10 volts was not included, as the diode imparts a serious enough nonlinearity to require a separate scale for any a.c. scale lower than 0 to 10. The layout and construction are apparent from the photographs (Figs. 1, 3, and 4).

The VR150 tube holds the plate voltage on Vn constant with line voltage changes, although, due to its high order of degeneration, Vn plate current does not change more than a few per-cent with a considerable change in plate voltage. It is suggested that if the VR150 is not used, it should be replaced with a 10 watt resistor of such value as to provide 150 volts on the plate of Vn.

The author used a 0 to 50 microammeter as the indicating device on his model. However, it was found that a 0 to 100 or 0 to 200 microammeter could be used while maintaining the extremely good linearity. The instrument, as shown with 50 microammeter meter, was so linear that a scale was drawn and divided with a compass. When checked with known voltages, there was no departure from linearity greater than the width of a line forming the divisions on the scale.

A 0 to 0.5 milliammeter can be used.

Fig. 1. Front panel view of completed test instrument. The meter can have a movement anywhere from 50 microamperes to 1 milliamper.

Design and construction of an extremely simple vacuum tube voltmeter. It can be built by the novice with a small cash outlay.
with a slight nonlinearity. When a 0 to 1 milliammeter is used the departure from linearity is serious enough to require the scale to be hand calibrated. This is not as difficult as it sounds. All the equipment that is needed for such a calibration is two flashlight cells and one 45 v. "B" battery. With these voltage sources, and a few resistors of known value, all the scales can be calibrated. The nonlinearity will be precisely the same for all ranges, so only one range must be calibrated as the others may then be drawn in.

It is suggested that the 10 v. scale be chosen for the calibration and then 6 flashlight cells connected in series will give sufficient points to construct the scale, i.e. 15 v., 3 v., 45 v., 6 v., 7.5 v., 9 v. (actual voltage of a new cell is somewhat higher than 1.5 v., on the order of 1.55 v.).

If the more sensitive meters are used, the scale can be constructed directly with a camera. The author constructed his scale on a piece of 8" x 10" paper. This enlarged scale was then photographed and a print made from the resulting negative which was precisely the right size to fit the 3" meter used in the model. This photographic reduction minimizes the imperfections in the drawn original and results in a scale which looks as if it had been printed. A box camera may be pressed into use in lieu of a focussable model, and a 3.5 portrait attachment used in front of the lens. The picture can be made from a distance of about two feet which will result in a very acceptable scale. Of course, the scale may be drawn directly on a piece of paper or cardboard and glued directly over the existing meter scale, or a meter may be purchased with the scales on it. The reproduction (Fig. 5) of a scale for a 3" meter may be traced or cut out and pasted on the meter face.

The ranges chosen by the author are 0 to 10 v., 0 to 50 v., 0 to 100 v., 0 to 500 v., 0 to 1000 v. Any number of intermediate values can be used by providing the proper taps on the voltage divider. It is not recommended that the 1000 v. a.c. scale be used, as 1000 v. is too high a voltage to apply to the 6SN7 diode connected rectifier.

The resistors in the divider should be as accurate as possible. If you can obtain 1% precision resistors, they should be used; if not, 5% metalized 1-watt resistors will do. If greater accuracy than 5% is desired, the values may be obtained by a series or parallel connection of two or more resistors to make up each of the six resistors in the divider. If an accurate ohmmeter is available, the resistors may be pruned after the instrument is built, by applying known voltages and adjusting the resistor until the scale reads properly. The calibration pot should be set on the 10 v. scale so that a known voltage of 3 volts reads 3 v. on the 10 v. scale. After each change in the divider, the 10 v. scale should be checked to be sure its calibration has not been affected. If it has, readjustment of the calibration pot is necessary. The zero adjusting pot which is located on the front (Continued on page 84)

Fig. 2. Circuit diagram of v.i.v.m. The a.c. input impedance is 6.3 megohms while the d.c. input impedance is rated at 10 megohms.

Fig. 3. Under chassis view of completed test instrument.

Fig. 4. Rear view shows neatness of above chassis layout.

January, 1947
SHORT-WAVE enthusiasts the world around can look forward to 1947 with few misgivings. I believe they can face the New Year with hope of better reception to come. Short-wave radio is rapidly coming of age. The results of wartime research and invention should be more evident in both broadcasting and receiving equipment in the years immediately ahead. Too, we can expect expanded facilities and schedules as well as better programming. Many new stations—from New Zealand to Northern Europe to Central Africa and back to Java—will, in all probability, take to the airwaves this year.

Broadcasting experiences during World War II have clearly demonstrated the effectiveness of short-wave radio and that it should prove an ideal medium in helping to achieve and maintain better understanding between the nations of the world. In no other way can the spoken word reach so many people in so short a time. In no other way can one tell one's story so quickly either to or from the more remote places on the globe. I, for one, feel strongly that international short-wave radio will assume its rightful place and responsibility in the era just beginning.

Since war's end there have been many complaints regarding the poor quality of receivers in general—and of the component parts thereof, including tubes, in particular—but as production increases and demand tends to lessen, in all likelihood, manufacturers will put more stress on "quality" as well as "quantity" production.

Last, but not least, scientists predict that during a part of 1947 we should have some respite, perhaps brief, however, from sunspot activity that was so annoying to short-wave listeners during the past year.

All in all, we can anticipate brighter listening days (and nights!) ahead for us all.

**Uruguay's CXA19**

Through the courtesy of John Znaidukas, Philadelphia, this month we present information regarding short-wave station CXA19, located in Montevideo, Uruguay, South America:

CXA19 operates with a power of 5000 watts, is listed on 11.835, but in a letter to Mr. Znaidukas, an official of the station indicated the current frequency as 11.705. "El Espectador," as the station is known, has been experiencing quite a bit of interference lately and has been sending out requests for information on said interference, in order that data may be submitted to the Government of Uruguay in the hope of receiving a new allocation of frequency.

Schedule is 6 a.m. to around 10:05 p.m. sign-off daily. Apparently, all transmissions are in Spanish.

This station uses a full-wave horizontal antenna, beamed to the United States and to Europe; the transmitter was made locally, having been designed by the technical staff of CXA19 and then was constructed in the station's own workshop. The transmitter was assembled as two units—one-kilowatt plate modulated exciter and a five-kilowatt radio frequency linear amplifier, which is equipped with two Marconi CAT9 tubes.

Mr. Znaidukas received his verification and some photographs from CXA19 two months after mailing in his reception report. The letter was signed by Sr. Jorge Cobilo, el Gerente General. Address is "El Espectador," Difusoras del Uruguay, La Cadena Uruguaya de Radiodifusión, 1398, La Sociedad Anoima, Montevideo, Uruguay.

In reporting to this station, it is suggested that full information be furnished regarding any interference noted.

**Sunspots to Continue**

According to Dr. John Q. Stewart, Princeton University astronomer, sunspots, some of them as big as the earth, will continue to disrupt radio, wireless, and telegraph facilities for at least another year. Even then the world will get only a comparatively brief respite from this solar phenomenon. One spot cycle is just completed and then another one starts. It usually takes about 11 years for the maximum to be reached.

Dr. Stewart, professor of astronomical physics, and George S. Baldwin, Jr., a Princeton undergraduate, recently devised a formula on which they based the prediction that the present cycle of sunspots would reach its maximum by about the end of 1947.

Of interest to ISW listeners will be this comment by a BBC engineer in a recent issue of "London Calling":

"Sunspot activity continues to increase very rapidly, and the effect of this upon the ionosphere seems likely soon to have definite repercussions upon short-wave transmission and re-

* Compiled by KENNETH R. BOORD

* View of power amplifier, showing the two Marconi CAT 9 tubes and line plate circuit, at station CXA19, Montevideo, Uruguay, South America. The station is currently operating on 11.835, 6 a.m.-15:05 p.m., EST.

* Sunspots to Continue

Unless otherwise indicated, all time herein is in Eastern Standard Time, 5 hours behind GMT.

RADIO NEWS
NEW IRC RESISTOR KIT
CONTAINS COMPLETE VARIETY OF STOCK
NEEDED FOR YOUR DAY TO DAY WORK!

YOU ASKED US FOR IT! HERE IT IS! THE IRC BASIC KIT—a wide-variety stock of most-needed resistor sizes and types that equips you to do just about any job you'll encounter in your day to day work. This unusually handy and convenient assortment of items was carefully selected through an exhaustive study of orders and a survey of IRC distributors and dealers.

The IRC Basic Kit is a practical planned time-saver, particularly suited to the needs of servicemen, schools, colleges, research labs and Industrial Maintenance Departments. The Resistor Assortments are so arranged that in most cases even a shortage of stock in any one range may be compensated for by using two other ranges in series or parallel. The power wire wound resistors included are useful in replacing many power resistors used in old-time receivers and as ballast resistors in some of the more modern AC-DC receivers. Additional adjustable bands are included in the Kit for use in making up bleeder sections.

INTERNATIONAL RESISTANCE CO.
401 N. BROAD ST., PHILADELPHIA 8, PA.

January, 1947

www.americanradiohistory.com
ALNICO V S-P. M. SPEAKER
New Alnico V magnet for maximum sensitivity and performance with minimum distortion. Massive 8 oz. magnet, 3½" deep. $1.98

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WELLS-GARDNER BC-348-N Communications Receiver, 4 kc-5000 kc. 2 stage RF, 3 stage IF. Tuned Oscillator, Crystal IF. Filter, Muf. 250 V A C. Complete with tubes and 2 U. D. C. input dynamic power supplies. Supplied with complete instructions and diagrams for converting to 110 V A C. 60 cy. operation. BC-348-N $53.95

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www.americanradiohistory.com

WIRE STRIPPER

Wire stripper instantly! Fastens to operator's belt. Wire stripped to any length. Strips wire from 22 to 0 gauge. Will strip penny size wire. $1.25

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2½" Range mounting type. Black enameled finish. Bakelite case. Suits 2 1/16" x 21/8" ships wt. 1 lb. $18.57

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Mail the Coupon Below Now!

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RADIO NEWS

ception. The present sunspot cycle, in fact—judging by the course of events since its minimum in April, 1944—prizes either to give rise to solar activity of exceptional magnitude, or else to reach its maximum in an unusually short time. Already, only two years or so after the minimum, the activity has reached levels comparable to those of about 1930 before it, and this rapid increase shows no sign of abatement. " (This statement was made prior to the increased sunspot activity experienced widely during September, particularly during the latter half of the month.)

The BBC engineer continued, "Concurrent with the increase in solar activity, and owing, of course, to its effects, there has been a rapid increase in the electrification or 'ionization' of the upper atmosphere. And as it is the degree of ionization of this region—the 'ionosphere'—that determines the frequencies suitable for short-wave communication at any particular time of day, this increase of ionization must be taken carefully into account when selecting the frequencies to be used.

"During the northern hemisphere summer months, however, there is a seasonal effect in the ionization which, so far as the daylight hours are concerned, will be apparent. In short—in September of next year, the BBC may expect some extensive changes in the frequencies they receive best.

"When the ionization is high, the higher frequencies (shortest wavelengths) become the greatest utility; when it is low the reverse applies. So, from September onwards the tendency will be to make greater use of the higher frequencies for transmissions over day-light paths, and this situation will presumably hold good throughout the northern winter. So far as the nighttime frequencies are concerned, these will probably decrease somewhat from September towards the midwinter period, but even so they will often be considerably higher (wavelengths will be shorter) than those that were in use during the same months of last year. All of these measures are not only desirable, of course, but really necessary if the most efficient broadcasting service is to be provided.

"The increased ionization will make the service more certain in the case of higher or lower waves—band not hitherto employed for the purpose—namely, the 28 mcs. (11 meter) broadcasting band. It is more than probable that this band will be suitable for service (of the BBC) to India and the Far East during the present winter, and Central America, as well as continuing to be used to service to Africa. It may well be heard in other countries, too, and its use may be found advantageous at some time during the winter for service to North America."
WE'RE GLAD THAT BIRCH TREES SWAY

The telephone wire which runs from the pole in the street to your house is your vital link with the Bell System. More than 17,000,000 such wires are in use.

The wire becomes coated with ice; it is ripped by gales, baked by sun, tugged at by small boys' kite strings. Yet Bell Laboratories research on every material that goes into a drop-wire—metals, rubbers, cottons, chemicals—keeps it strong, cheap, and ready to face all weathers.

Now a new drop-wire has been developed by the Laboratories which lasts even longer and will give even better service.

It has met many tests, over 6 or 7 years, in the laboratory and in field experiments. It has been strung through birch thickets—rubbed, winters and summers, against trees, and blown to and fro by winds. In such tests its tough cover lasts twice as long as that of previous wires.

House by house, country-wide, the new wire is going into use. Wire is only one of millions of parts in the Bell System. All are constantly under study by Bell Telephone Laboratories, the largest industrial laboratory in the world, to improve your telephone service.

BELL TELEPHONE LABORATORIES

EXPLORING, INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

January, 1947
**COMPACT POWER PACK**

For little more than the cost of one set of regular dry batteries, you can obtain a new, modern, vibrator pack that will save you space, weight, and money! Ruggedly made for Navy radio equipment, this pack gives excellent service under the toughest field conditions.

- **Only 1 1/2" x 3 1/2" x 4"** high (6 1/2/2 high with battery!)
- **Weights 3 lb. 10 oz., complete!**
- **Delivers: 135 volts at 20 ma. in continuous Military duty or 30 ma. or more, in intermittent Amateur or CB conditions.**

Complete Power Pack including clip-in Willard storage battery. Unbreakable plastic Non-Spill Case (even if turned upside down!) Shipped bone-dry, fully charged, ready to put into immediate service or to store for years. Can give several hours of continuous operation at full load and then be Recharged for only a few pennies by any 135-amp charger—our special trickle charger.

**$5.50**

**BATTERY CHARGER**

Nistadmer Selenium rectifier type, to trickle charge these or any other full battery. Works at 2 Amperes 110 Volt AC.

**$2.97**

If recharging facilities are unavailable we can supply these packs with clip-in Willard 6 volt lead acid Primary batteries. 25 watt hour capacity. (Limited shelf life. Can store for years! Excellent for export.) 1 1/2" x 3 1/2" x 3 1/2". 20 oz. complete! Good! Complete pack with TWO Primary batteries. **$5.75**

**REPLACEMENT PRIMARY BATTERIES.** These batteries are also a fine source of 6 Volts DC for many other applications. Each... **95¢**

Export packed case of twenty $14.75

**KW Modulation Transformer**

Here's an FB HISS value in a hard-to-get item! RCA commercial quality. Consistently rated at 550 Watts of audio, will modulate up to a kilowatt final.

Primary matches any Class B modulators up to 10,000 ohm plate to plate. Impedance ratio 1:1. 250 watt, electrically 65 ma. Tertiary winding to modulate screens or suppressors carries 80 ma.

Mycelx terminal board with three adjustable protective flash-over gaps insures against breakdowns. Open frame output antenna. 1/10,000 at 5 amp; 38.5 lbs. 9 1/2" x 7 1/2" x 7 3/4" high. **$24.75**

**Antenna Tuning Unit**

Signal Corps BC-839-A (Hallerstein AT-3) will efficiently couple up to KW transmitter to any short or long wire antenna working against ground. Full range of 1.5 to 18 Mc.

You've seen the "quickie" at $76.00 Harrison sells them NOW, brand new, complete with RP meter, cabinet, and both plug-in vacuum condensers, for only **$29.95**

**ALL STANDARD LINES**

We are Factory Authorized Distributors for the top quality manufacturers and we now have in stock lots more new, latest improved production Ham gear! Visit our stores today, for everything you need. We promise you fresh clean material—quickly at the lowest prices. And above all, our sincere desire to be of friendly, helpful service.

MAIL ORDERS? Certainly! Just list everything you want (items in this ad, or any ad, magazine, or catalog) and include remittance.

Vv 73 de
Bill Harrison, W2AVA

(Incidentally, the 81-mc. band is heard well in the Eastern U.S. mornings on several BCB frequencies now in use.)

The BBC is doing a splendid job in giving advance notice to its listeners with regard to the possibilities of increased sunspot activity, with recommendations as to the frequencies expected to be the most advantageous in a particular area during the disturbances.

**Nanking Assignments**

According to a supplement to the Bern List, these new Teletype and frequencies have been assigned for the projected short-wave station at Nanking, China, to be operated by the Central Broadcasting Administration:


Most of these appear to be ex-Japanese frequencies. (Legge)

**Report from India**

Those interested in the "other half of the world," will be especially concerned with these comments on reception in India, as just received from Anwer Lalljee, Bombay:

"During August, due to the moon, reception conditions were not too good, although the 16- and 13-meter bands were rather good, the latter being 'freakish' at times, in fact. Generally, reception on that band was best from about 6 a.m. to 12 noon, after which it deteriorated and faded completely around 2 p.m. Radio Australia has been heard as early as 10:30 p.m. at R-3 and as late as 4:45 p.m. at R-6 and R-7; similarly, WLWS, Cincinnati, has been coming through regularly from 10 a.m. to 4 p.m. at R-7 to R-8, some time in the past week had similar experience with the BBC on this (13-meter) band, it is coming in R-7 to R-8."

Mr. Lalljee lists as Best Bets in his area, Radio SEAC, Colombo, Ceylon; BBC, London (Forces Program and Eastern Service); Leopoldville, Belgian Congo; KRHO, Honolulu; AIR, Delhi (Home and External Services); CKNC, Montreal; WLWS, Cincinnati; PCJ, Hilversum, Holland; Radio Brazzaville, French Equatorial Africa; WCWO, Scottsdale: Radio Australia; and WNRA, WNB, New York City.

**RE 41-Meter Band**

"The use for broadcasting of frequencies in the 7 megacycles-per-second (41-meter) band has been questioned in letters to the BBC by amateur radio experimenters in North and South America. The important point, as this band was allotted exclusively to amateurs, broadcasters had no right to use frequencies within it."

(Continued on page 124)
NEW CHOKES

The enlarged line of chokes now offered by National includes many new sizes and types and provides units suited to specialized as well as standard applications. Many popular new chokes are illustrated above, including the R-33G which is hermetically sealed in glass. Other models cover current ratings from 33 to 800 milliamperes in a variety of mountings carefully planned for your convenience. These as well as old favorites like the R-100 are listed in the latest National Catalogue.

NATIONAL COMPANY, INC., MALDEN, MASS.
Our young men come to us from every walk of life—from the farm—from the city—rich and poor—many ex-GI’s. They represent every race and creed but they do have ONE thing in common.

They’re all new to Radio, BY Radio and FOR Radio. They’ve grown up with a “cat’s whisker” and a set of headphones as playthings. The only lullabies they remember are the ones they heard over Dad’s Battery Set, with all the knobs, dials, and switches, when radio itself was an infant. These young men have never known a world without radio, and they never want to. Radio has molded their minds, provided them with an absorbing hobby and given them the means of earning a good living.

SKILLED MEN FOR RADIO

Now, with their training at National Schools behind them, they are prepared to contribute their skill, talent and creative ideas to an industry which is literally a part of them.

We feel fortunate indeed to have had the privilege of awakening the dormant abilities of many men now holding prominent positions in Broadcasting, Communications, Radio Sales and Service, Television and Electronics. And we look forward with pleasure to an ever-broadening educational program, designed to train still more men to fill the thousands of specialized positions radio will require in the future.

During the four decades since we first began to build men for Industry, we have kept accurate student records and compiled unusually complete performance charts. Thus we have acquired a keen insight into the most effective ways to inspire radio-minded men to APPLY their training, and to use their creative abilities to the best advantage of themselves and their employers.

REPORT TO INDUSTRY—FREE!

You’ll be impressed by our methods and observations, as they apply to YOUR personnel problems. You’ll welcome an opportunity to learn how we inspire our students to ACTION, how we develop in them those vital traits of character which make them an asset to any employer.

We know you’ll want to send for our “Report to Industry.” Whether you employ one man or hundreds, you will enjoy and profit by this factual, informative presentation.

Send for it today! No obligation.

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RADIO NEWS, JANUARY, 1947
FARNSWORTH MODELS EC-260, EK-262, EK-263, EK-264, EK-265

RADIO NEWS, JANUARY, 1947
DE Tone MODELS 571A, 571B

RADIO NEWS, JANUARY, 1947
GENERAL ELECTRIC MODEL 250
Here, and on following pages, are circuit diagrams and parts lists of many new postwar radio receivers. Radio News will bring to you other circuits as quickly as possible after we receive them from manufacturers.

RADIO NEWS, JANUARY, 1947

PERSONAL RADIO

One of the new features of the 1947 Remler "Scotties" is the "invisible" carrying handle which drops down out of sight when the radio is in use.

This new plastic unit, which is made by Remler Company Ltd. of San Francisco, is completely enclosed and dust proof. The large, easy-to-read dial tunes stations by name. The dial is molded of heavy transparent lucite. The white numerals and colored markers are molded in the underside of the dial and light up against the dark background.

The radio has 5 tubes, including rectifier, and is a.c. operated.

Complete information on the "Scotties" and other radios in the Remler line will be furnished by Remler Company Ltd., 2101 Bryant Street, San Francisco 10, California.

PLUG-IN AMPLIFIERS

A line of "plug-in" amplifiers for broadcast field application has been announced by the RCA Engineering Products Department of Radio Corporation of America.

Revolutionary in design, these amplifiers permit a complete unit to be removed from the rack and another to be installed in its place with no greater effort than that expended in changing an ordinary radio tube.

These new plug-in amplifiers may be removed by pulling a lever near the front of the unit which ejects the unit from its socket and automatically detaches it from the circuit connections.

Another unit may be plugged in for operation while the unit which has been removed may be handled without the danger of blowing a fuse or taking risks with the power supply circuits.

A special shelf assembly for mounting in a standard rack has been developed for use with the plug-in amplifiers. Full information on this piece of broadcast equipment will be furnished by Engineering Products Department of Radio Corporation of America. Address your requests to the RCA Victor Division at Camden, New Jersey.

"PYLON" FM ANTENNA

RCA Engineering Products Department is developing and production of a new cylindrical FM antenna which is said to provide higher gain height-for-height than any previous antenna.

Known as the "Pylon" antenna, the new FM radiator is a single-element, mechanically-rigid, self-supporting structure. This antenna requires no additional means of support or mounting, nor are there any arms, loops or circular elements required.

Where high gain is needed for an FM station, additional sections of the antenna can be stacked on top of each other by simply bolting together the end flanges of the pipe-like unit. Since radiation is compressed in the vertical plane, there is a subsequent power increase. Stacking four sections of the "Pylon" results in a power gain of six.

Full engineering details of this unit will be furnished to broadcast engineers, FM station owners, and those charged with the installation and adjustment of FM antennas. Make your request direct to the Engineering Products Department, Radio Corporation of America, RCA Victor Division, Camden, New Jersey.

REPLACEMENT RECTIFIER

Bradley Laboratories, Inc., of New Haven, Conn., has added a replacement rectifier to its line of copper oxide rectifiers.

The unit, designated as "Coprox" Model CX2E4U, offers a multitude of circuit variations, depending on how two or more of its five leads are used.
That’s what “OK” means when the tubes you’ve installed are G-E’s

FIRST off, you’ve pleased your customer by putting General Electric tubes in his set he gave you to repair. For the G-E monogram is more than a familiar symbol to him—it stands for QUALITY.

Second, you’ve done yourself a good turn, because G-E radio tubes won’t let you down. The set you’ve just tagged “OK” will play better than ever, and will keep giving the kind of satisfaction that builds friendship for you and your shop.

When your client is asked to recommend a radio repair source (as happens regularly) he’ll give your name. That’s the sort of helpful person-to-person advertising that makes your business grow, and fattens your profit-account.

So that your radio service always may enjoy top standing in your community ... replace faulty tubes with high-quality, long-lived G-E’s—THE BEST! Electronics Department, General Electric Company, Schenectady 5, N. Y.

G.E.’s fact-filled Tube Characteristics Book ETR-15 will help you in your radio service work. Send for your copy. It’s free!

GENERAL ELECTRIC

FIR S T A ND G R E AT E S T N AME I N E L E C T R O N I C S
As a half-wave rectifier it carries a rating of 6 or 12 volts a.c. at 3 ma. d.c. or 12 volts a.c. at 5 ma. d.c. As a double half-wave unit, it is rated at 6 volts a.c. for either 3 or 5 ma. d.c. In its full-wave, back-to-back, applications the unit is rated at 6 or 12 volts a.c. at 5 ma. d.c. and as a full-wave bridge it is rated at 6 volts a.c., 5 ma. d.c.

The three-inch flexible leads are color-coded and presoldered to prevent overheating during assembly. Any unused leads are simply clipped off after the circuit has been tested.

A circuit sheet containing complete schematic data is available from Bradley Laboratories, Inc., 82 Meadow Street, New Haven, 10, Conn.

**MIDGET CAPACITOR LINE**

A complete line of flat midget capacitors. Type ZN, has recently been announced by Cornell-Dubilier Electric Corporation for applications in ultra compact electronic devices.

These units are especially designed for hearing aids and pocket radios. Because this line is flat, they are ideally suited for circuit applications where space is at a premium.

Type ZN midget capacitors are non-inductively wound with Kraft paper and thoroughly impregnated with haloxax. The leads are anchored to the capacitor body. Standard ZN type include units from $\frac{1}{4}'' \times \frac{1}{4}'' \times \frac{1}{2}''$ to $1'' \times \frac{5}{8}'' \times \frac{5}{16}''$. The values range from .0001 microfarad to .1 microfarad. d.c. rated voltages from 150 to 600 volts.

Complete details of the Type ZN line will be furnished by Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

**AMPLIDYNE BOOSTER INVERTER**

The operation of radios, movie equipment, public-address systems, fluorescent lighting and improved air conditioning for American railroads has received a new impetus with the announcement by General Electric Company of the development of a new amplidyne booster inverter which will provide an ample and economical supply of 60 cycle a.c.

This new equipment changes the current supplied by the railway car's axle-driven generator or battery from d.c. to a.c. and gives constant voltage and frequency without excessive loss. The amplidyne booster inverter con- (Continued on page 94)
Radio Parts are EASY to identify
when you use
PHOTOFACT FOLDERS

In Each PHOTOFACT Folder You Get—

What's your biggest headache when servicing radios? Identifying parts? With PHOTOFACT FOLDERS it's easy to locate and identify any item you want to find. Just look at the Complete Parts List...a list that's keyed to clear chassis photographs and a full page, easy-to-read schematic diagram. For instance, the capacitor listing alone gives complete data on capacity, voltage rating, function, replacement types...even includes installation notes.

No service problem can stump you when you use PHOTOFACT FOLDERS. They result from the actual examination of the receiver involved, and are not copied from the manufacturer's service data or from looking at his schematics. They tell you everything you need to know about any set manufactured since January 1, 1946—even to the restringing of dial cords. They do this by means of pictures, full-page schematics, original technical notes that help you work faster, more accurately...easily increase the number of jobs you can do in a week by fifty percent.

PHOTOFACT FOLDERS are sold in sets of 40, each set covering new radios, phonographs, record changers, intercommunication systems, recorders and power amplifiers within a short time after they reach the market. Their cost is only $1.50 a set, including membership in the Howard W. Sams Institute. No other radio service service compares with PHOTOFACT FOLDERS in completeness, accuracy or timeliness. Use the coupon. Mail it to your nearest radio parts supply house.

1. A cabinet view of the receiver to help you establish identity and control functions. 2. A top view of chassis and speaker to identify component parts and alignment points. 3. A bottom view of chassis and/or accessories. 4. A complete list giving keyed reference to all parts, alignment and schematic diagram. 5. A complete, full-page schematic diagram. 6. Stage gain measurements listed on the schematic diagram. 7. A complete voltage and resistance analysis chart for rapid check of operational values. 8. Complete alignment instructions on the receiver consistent with the keyed alignment points indicated on photographs. 9. Dial cord diagram and restringing instructions. 10. Complete disassembly instructions where required.

HOWARD W. SAMS & CO., INC. RADIO PHOTOFACT SERVICE

In Canada—write to A. C. SIMMONDS & SONS, 301 King Street East, Toronto, Ontario

January, 1947
Electrode potentials are varied as shown in the schedule. Actual voltages at the socket depend on currents drawn through the incandescent lamps used as economical, interchangeable current-limiting resistors.

Operations performed in seven steps are:
(1) discovery of heater-cathode shorts
(2) beginning of cathode processing to stabilize emission
(3) further seasoning and burning off of h-k leakage
(4) h-k potential increased to eliminate leakage
(5) grid, screen, and plate potentials applied to complete de-gassing
(6) cooling off period
(7) normal potentials applied to pre-heat for test.

Yes, radio tubes also must be "aged in the wood." Aging activates the cathode under accelerated life conditions, just before test. In the fundamental aging circuit shown, final seasoning and de-gassification stabilize characteristics in accordance with the carefully planned aging schedule.

Formerly tubes were plugged into long aging racks. An operator, equipped with the schedule and a timer, adjusted electrode potentials throughout the aging cycle. The human element resulted in errors of timing and switch manipulation.

Hytron's new automatic aging wheel minimizes human error. A motor drives a mechanically-indexing horizontal wheel on which 30 radial sections of 12 tubes each are slowly rotated. Brushes contacting commutator segments automatically apply electrode potentials. The wheel itself requires no operator. The final aging machine operator feeds the wheel. Tubes already pre-heated are removed by the test operator.

Other features of the aging wheel are elimination of needless handling, fast and steady pacing of the work, easy servicing, and readily interchangeable load lamps.

To you this automatic aging wheel means economical, more uniform tubes with stable electrical characteristics. Again Hytron know-how takes a forward step by making your tubes easier and better.
Most models listed below are in stock . . . ready for immediate delivery:

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hallicrafters S38 complete</td>
<td>$39.50</td>
</tr>
<tr>
<td>Hallicrafters S40 complete</td>
<td>$79.50</td>
</tr>
<tr>
<td>Hallicrafters S36A</td>
<td>$307.50</td>
</tr>
<tr>
<td>Hallicrafters SX42</td>
<td>$250.00</td>
</tr>
<tr>
<td>Hammarlund SP-494A</td>
<td>$99.75</td>
</tr>
<tr>
<td>Hammarlund HQ-129X &amp; speaker</td>
<td>$168.00</td>
</tr>
<tr>
<td>National NC-2-40D</td>
<td>$241.44</td>
</tr>
<tr>
<td>National HRO-STA1 and HRO-STA1 complete</td>
<td>$274.35</td>
</tr>
<tr>
<td>National NC-47</td>
<td>$97.50</td>
</tr>
<tr>
<td>National 1-10A with tubes and coils</td>
<td>$67.50</td>
</tr>
<tr>
<td>RME-43 complete</td>
<td>$129.70</td>
</tr>
<tr>
<td>RME-84 complete</td>
<td>$98.70</td>
</tr>
<tr>
<td>RME DB-20 complete</td>
<td>$68.20</td>
</tr>
<tr>
<td>Pierson KP-81 complete</td>
<td>$318.00</td>
</tr>
<tr>
<td>Temco 75GA transmitters</td>
<td>$495.00</td>
</tr>
<tr>
<td>Heck 607 transmitters</td>
<td>$150.00</td>
</tr>
<tr>
<td>Gordon, Amphenol, Johnson rotary beams.</td>
<td>$342.00</td>
</tr>
</tbody>
</table>

The new Hallicrafters and Collins receivers, transmitters, VFO, etc. as fast as available.

All other receivers, transmitters, parts, etc. as available.

Prices subject to change.

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Besides having all amateur receivers and transmitters, I also have a complete stock of all other amateur apparatus and parts, also test equipment, etc. I have real bargains in the really good war surplus such as BC-211, BC-212, BC-610, BC-342, BC-348, BC-312, parts, etc. Write, phone, wire or visit either of my stores.

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The parts for the receiver may be all new parts, if available, or may be salvaged from old receivers. If a power supply is available the power transformer and the 80 tube may be eliminated from the receiver. To connect the power supply to the receiver connect "E" plus to the filament of the 80, and "B" minus to the center tap of the high-voltage winding. The filament voltage is connected to the chassis of the receiver and to the other side of the filament winding of the transformer. These connections refer to the diagram but in the discussion dealing with the construction of the receiver the power transformer will be omitted.

In the construction of the receiver it is necessary to assemble the parts that are mounted on the chassis first. If a blank chassis is used it will be necessary to drill it for the various parts such as tube sockets, etc. Any salvaged parts which are used should be tested to make sure that they are in working order before installation is made. The filament circuit and the other a.c. circuits should be wired first so as to get the leads on the bottom of the chassis to prevent the other parts from picking up 60-cycle hum. It is necessary to keep all the grid leads as

* Reprinted in part from Sept., 1944, issue of Industrial Arts and Vocational Education.

Front-top view of chassis assembly showing correct placement of parts.
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This new Rider Book, soon to be announced, will be of lasting usefulness to everyone interested in any phase of radio.
short as possible to keep the set from going into oscillation and from picking up hum from the a.c. leads. When wiring the filter condensers be sure to watch the polarity of these condensers; they will be marked on the case of the condenser or in most condensers the red lead will be positive and the black lead negative. If this condenser is salvaged from an old receiver be sure to notice which terminals are connected to the positive and negative leads in the old receiver.

Upon completing the wiring of the receiver, carefully check it with the diagram as this will save many hours of work later and will preclude burning out parts because of incorrect connections. When the receiver is completely wired and checked, connect it to an a.c. line and a good outside antenna. One should be able to tune in several of the stronger stations. To get the receiver to operate properly one adjustment is necessary: tune in a station around 1400 kc. (the tuning condenser will be almost wide open); turn the volume down so the station can just be heard and adjust the two trimmer condensers on the variable condenser for maximum volume. If this receiver is connected to a good outside antenna reception of fairly distant stations may be expected occasionally.

Under chassis view of the 4-tube receiver showing simplicity of wiring.
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- Model 668 is a vacuum-tube voltmeter that is also a vacuum-tube capacity meter.
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Ranges

A-C VACUUM-TUBE VOLTOMETER: (Direct reading) Input capacity of 0.00005 mfd at terminals of instrument. Input resistance of 160 megohms on 1,500 and 6000 volts and 16 megohms on low ranges. Seven ranges: 0/3/6/30/150/600/1,500/6000 volts.

D-C VACUUM-TUBE VOLTOMETER: (Direct reading) Sensitivity of 160 megohms on 1,500 and 6000 volts and 16 megohms on low ranges. Six ranges: 0/6/30/150/600/1,500/6000 volts.

VACUUM-TUBE OHMOMETER: (Direct reading) from 0.1 ohm to 1000 megohms. Seven ranges: 0/1000/10,000/100,000 ohms; 0/1/10/100/1,000 megohms.

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paralleling two sections, it is possible to vary the range in excess of ten to one (150 to 1500 cycles).

By addition of three separate sets of \( R \) and \( R \) resistors and switching, three ranges are created: 15 to 150 cycles; 150 to 1500 cycles; 1500 to 15,000 cycles. When such ranges of frequencies are covered, phase shift becomes important. If phase shift is eliminated, calibration for a set of resistors will remain constant on the other ranges if the resistors are identical in pairs and vary in a ratio of ten to one, such as 100,000 ohms, 1 megohm, and 10 megohms, providing the resistors have close tolerances. A 1% resistance error will create the same percentage of frequency error.

If phase shift occurs, the calibration for each set of resistors will not be linear. This condition is indicated by the fact that the ranges follow the calibration for a portion of the dial and become in error toward the high frequency end of the calibration. Too low a value of capacity used in either \( C \) or \( C \) will create phase shift at low frequencies. Circuit wiring and the use of parts that have capacitance to ground will cause the high frequency calibration to vary.

The oscillator voltage can be obtained from two points, the cathode of the 6G6 or the plate of the 6G6. Approximately 1 volt is available at the cathode and 30 volts at the plate. Output taken from the plate circuit must be fed into a high impedance load which will not upset the electrical constants of the circuit, thus causing frequency variation and instability.

The RC oscillator is extremely stable, since the frequency is determined by the RC network. Variable condensers have a very slight capacity change due to temperature variations, which in most applications can be disregarded. Carbon resistors are perfectly satisfactory for normal temperature changes but cause a frequency variation of approximately 10% when the temperature is varied from +70 to -55 degrees Centigrade. Metalized resistors are readily available and vary approximately 2% over the temperature cycle mentioned above. The use of metalized resistors is desirable. The variation of the other resistor values due to temperature causes little or no effect with the exception of \( R \).

Construction Considerations

Fig. 2 is a circuit diagram of an RC oscillator with isolation stages and a built-in vacuum tube voltmeter. This unit is quite similar to an RC oscillator now manufactured commercially. Before constructing an RC oscillator, the use of the oscillator should be considered. If the oscillator application only requires fixed frequency operation, the addition of the two isolation stages may not be required.

Building in a vacuum tube voltmeter may be of no particular advantage. In that case the oscillator would only require three tubes, one being the voltmeter. Such units can be constructed in an extremely short length of time with a minimum of parts and expense. Many such oscillators were constructed and used twenty-four hours a day in production. Such units have been known to operate at 400 cycles for weeks with a frequency variation of only a few cycles. If the oscillator is to be used as a general purpose piece of equipment, it becomes desirable to add the isolation stages. The addition of a built-in vacuum tube voltmeter is desirable when the equipment is used for making fidelity measurements. The vacuum tube voltmeter circuit in Fig. 2 is extremely simple, consisting of a few parts only. A large portion of the necessity of borrowing a voltmeter from some other test position each time a fidelity run is made.

To help the reader determine how much of the equipment he needs to build to meet his particular requirements, an outline is given of the equipment necessary to make certain tests.

1. Frequency Measurements—An oscillator with an accurate calibration, an oscilloscope, and an oscilloscope or headphones. If extremely accurate measurements are required, the oscillator should be checked against a secondary standard.
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RADIO NEWS

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The Collins 70E-8 wins an Enthusiastic Booster!

Frank W. Oberlander, W9YPS
When W9YPS got his 70E-8 PTO (permeability tuned oscillator), we asked him to give it a workout and send us his comments. He did, and we'd like to quote him:

Collins Radio Co.
Cedar Rapids, la.

Gentlemen:

I wish to express my appreciation of the new 70E-8 PTO. I have used this unit since the latter part of July on 75 meter phone, 80 meter cw, 20 meter phone and cw and 10 meter phone and cw. I cannot fully describe the feeling of assurance that this unit affords in the matter of stability and ease of frequency spotting. I am sure it has enabled me to make many contacts that otherwise I would not have made. All reports are very favorable as to stability and freedom from chirps. All contacts on cw were greeted with T9X reports.

It certainly is one of the finest pieces of equipment that I possess and I would truly feel lost if I had to be without one.

Yours very truly,
Frank W. Oberlander (W9YPS)
457 Fifer Street
Galesburg, Illinois

Frank's exciter line-up, following the 70E-8, consists of a 6AK6 isolator (untuned), 6AG7 buffer-doubler, 7C5 buffer-doubler. Here are some of the reasons why he's happy with his PTO:

1. The 70E-8 is accurate to within \( \frac{3}{2} \) kc on 80 meters.
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January, 1947
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★ SIMPLE TO OPERATE—ONLY ONE CONNECTING CABLE—NO TUNING CONTROLS.
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tween the shield and the variable is kept at a minimum.

Capacity caused by the shield will reduce the high frequency range of the oscillator. Three variable resistors are located in the immediate vicinity of the range switch and are in series with the RC network resistors. The network resistors were checked on an ohmmeter, and due to production tolerances, the lowest value of resistance was placed in series with the variable resistor to ground. This made it possible to match both resistor networks. These resistors also give a small amount of frequency variation which allows the operator to make corrections in the calibration so that one calibration will hold for all three ranges.

The coupling condenser between the 6SJ7 and the 6G6 was mounted above the chassis to reduce capacity of the condenser to ground. The gain control was located at a point where lead length could be kept at a minimum. Locating the gain control on the panel would have eliminated the use of an extension shaft but would have, in turn, required the use of shielded leads to and from the control.

Shielded leads will cause a high frequency attenuation which results in reduced output at high frequencies. Note the addition of a 50 μfd variable condenser shunted across the top section of the variable condenser. This capacitor is adjusted to compensate for the capacity of the frame of the variable to ground.

The operation of the isolation stages is as follows: The first 6J5 operates as a cathode follower. The coupling to the second 6J5 is accomplished by the common cathode resistor of the two 6J5s. The plate circuit of the second 6J5 is conventional. This type of amplifier lends itself admirably to this particular application in that it is practically distortionless up to 15 volts output, and at 25 volts the distortion is less than 2%. Since distortion measurements normally require low level, the amplifier proves quite adequate.

The control of distortionless amplifiers of conventional type requires considerably more parts, adding expense to the unit. The vacuum tube voltmeter consists of one-half of a 6SL7 being used as a diode and the other half as a vacuum tube voltmeter. The power supply is quite conventional. The use of a metal plate

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1/2 milli ohms through 1.000 milli ohms. 0-50% power

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One of the finest test instruments of its type.

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The New RCP Model 802N COMBINATION TUBE & SET TESTER
DC Voltmeter 0 to 1000 at 1000 ohms per volt, AC Voltmeter 0 to 1000 DC Milliammeter 0 to 1000. Ammeter 0 to 10 D.B. Meter—8/15/15 to 29/29 to 49/32 to 55 decibels.

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January, 1947
over the bottom of the chassis is desirable but not absolutely necessary. Stray fields entering the bottom of the chassis will give an indication of distortion in excess of 1%. All parts values can be of 10% tolerance other than the RC network and the negative feedback resistor.

The selection of parts and tube types was dictated by the availability of such material at the time. This accounts for the unusual tube type selection. It is recommended that the 6S17 and the 6C6 be used in the oscillator, but the two 6J5s may be replaced by one 6SN7. The 6SL7 can be replaced by a 6H8 and a 6SQ7. The 80 type rectifier tube can be replaced by a 5Y3 or equivalent. The choice of power transformer was dictated by procurement rather than by design. Since the power supply voltage was too high, it became necessary to add a voltage divider. The current drain of the equipment is approximately 30 ma, so a low voltage transformer can be used by simply adjusting the output voltage between 180 and 200 volts.

**Tuning Procedure**

Adjust the correcting resistors in the RC network so the range switch decades. With the range switch in No. 1 position and the variable condenser closed, the frequency should be 15 cycles. Rotate the range switch to No. 2 position. Adjust for 150 cycles. With the range switch in No. 3 position, adjust for 1500 cycles. Of course, such adjustment will not be possible if the RC network resistors do not increase in steps of 10.

In this case it becomes necessary to calibrate the dial for all three ranges, or add or subtract resistance values until the calibration does decade. The negative feedback resistor may require adjustment. This adjustment is made by substituting a 10,000 ohm potentiometer and finding the correct value as outlined. Connect an a.c. vacuum tube voltmeter to the output jacks and adjust output for approximately 5 volts. Now rotate variable condenser from minimum to maximum capacity. If the output varies over 5%, adjust the 50 pF fixed condenser across the top section of the variable to correct this distortion. The adjustment of this condenser will affect the calibration slightly and may necessitate re-calibration.

**Vacuum Tube Voltmeter Adjustments**

Reduce the audio output of the oscillator to minimum. Adjust the 10,000 ohm variable resistor in the cathode of the 6S17 for full scale deflection. Adjust the oscillator gain control for 5 volts output. Next, adjust the one megohm potentiometer in the diode circuit so the meter reads half-scale. With these adjustments the oscillator is ready for use and should have a distortion content of less than 1%. The use of a wave analyzer or distortion meter will allow more precise adjust-

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| 10 mm | 1.00 |
| 6.3 mm | 0.64 |
| 3.0 mm | 0.34 |
| 2.5 mm | 0.26 |
| 1.0 mm | 0.14 |
| 0.5 mm | 0.07 |
| 0.25 mm | 0.03 |
| 0.15 mm | 0.02 |

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- **Hayesman, 15 Amp.**
- **Hayesman, 5 Amp.**
- **Hayesman, 20 Amp.**
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- **Hayesman, 500 Amp.**
- **Hayesman, 800 Amp.**
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- **Hayesman, 8000 Amp.**
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- **Hayesman, 50,000,000,000,000 Amp.**
- **Hayesman, 80,000,000,000,000 Amp.**
- **Hayesman, 100,000,000,000,000 Amp.**
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**PRACTICAL TELEVISION ENGINEERING**

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Member of National Home Study Council—National Council of Technical Schools—and Television Broadcasters Association

January, 1947
ments of the negative feedback resistor and the RC values. If this equipment is to be used for distortion measurements, a distortion check should be made to indicate that all adjustments are correct.

The design of the vacuum tube voltmeter is such that it will give linear response over the audio frequency range. Since the primary use of the meter is to simply indicate a constant level, no effort was made to calibrate it. The meter can be calibrated up to 6 volts, but above that voltage the scale no longer remains linear. By complicating the vacuum tube voltmeter circuit, a more accurate meter could be constructed. Time and expense did not justify such a procedure.

The cost of parts including chassis, panel, meter, variable condenser, tubes, etc., was $33.25.

Home Constructed V.T.V.M. (Continued from page 55)

panel will require readjustment when switching the a.c. ranges, due to the contact potential of the diode V. If the zero adjusting screw on the face of the meter is properly set, zero adjustment of the pot should not be required when changing from minus or plus polarity with the polarity selecting switch.

For use with the d.c. voltmeter, a probe with a megohm resistor included in its tip should be provided to eliminate capacity loading on a circuit when a d.c. voltage is being measured, for instance, measuring the grid voltage of the oscillator tube in a superheterodyne without detuning the oscillator. If this feature is not desired, the one megohm resistor should be connected in the instrument in series with the 6 megohm resistor and ordinary test leads used. If r.f. voltages are to be measured with a.c. input, leads should be kept as short as possible. If high r.f. is to be measured frequently, it is suggested that a 6336 be arranged on a probe to replace V, the diode rectifier, so that losses and detuning effects be reduced to a minimum. For all audio and power frequencies this is not necessary.

The power supply is conventional. A 40 mli receiver type transformer is adequate. The rectifier tube depends upon the filament windings available. If the transformer has only one filament winding of 6.3 v., then the rectifier should be a 6N5. If the transformer has a 6.3 v. winding and a 5 v. winding, then a 5Y3 or 58 may be used. The lower the high voltage winding is, the better, as 150 v. d.c. is all that is required. The 8000 ohm resistor which serves as a filter element together with the 2 μfd. condenser may have to be adjusted in value to compensate for the d.c. output voltage of the transformer used.

For indicating plates on the front panel, drawings can be made to indicate the electronic component reproducings cemented to the front panel. In the interest of durability, they may be covered with thin lucite or cellophane.

Be sure that the binding posts or tip jack you use are properly insulated from the front panel. Insulation for about 1500 volts will provide a measure of safety.

When the unit is finished it will pay for itself many times over, particularly where voltages must be measured through high resistance. Actual uses include: receiver tune up (hook d.c. meter terminals to the a.v.c. voltage and tune for maximum indication); amplifier fidelity in FM receivers (an audio oscillator is connected to the amplifier under question and the gain of each stage is measured at 12,000, 400 and 60 c.p.s. Any serious discrepancy in response will be immediately apparent); measuring the d.c. grid voltage of tubes.

Two grounded-grid lighthouse stages.
Tuned cathode and plate circuits.
RF circuits individually shielded with silver-plated brass.
Disk type vernier trimmers.
National velvet vernier dials.
right at the grid (this is a good way to find leaky coupling condensers); and a thousand and one other uses, in addition to the conventional one of measuring voltages; all of which will repay you for building this vacuum tube voltmeter.

All-Purpose Signal Tracer
(Continued from page 37)

The audio and radio frequency response may be seen from the curves given in Figs. 2 and 3. The values of the circuit constants in the grid of the 1T4 were purposely chosen to have the indicated low frequency response. If a large 60 or 120 cycle hum is superimposed on the signal, the hum frequency will not mask the higher signal frequency since it is attenuated by the high pass filter action. At the same time, the meter has full sensitivity at 400 cycles, which is the usual audio modulating frequency. The sensitivity remains flat in the audio and radio frequency range to 10 mc., above which resonance takes place in the tube and associated components; the sensitivity is increased until about 20 mc., and drops off sharply at higher frequencies.

Details of the physical construction of the unit may be seen from the photograph, Fig. 1. The entire equipment is mounted in a compact gray cradle cabinet containing all components, including the batteries. The 1T4 tube, 0002 pf. condenser and 20 megohm grid resistor are housed in a drawn brass shielded probe with which any source point audio may easily be reached for testing, and which mounts on a bracket on the side of the cabinet when not in use. On the front panel are mounted the 4" speaker, the meter, a calibrated attenuator control for the amplifier, the balancing potentiometer for zero setting of the meter, on-off switch, speaker-meter switch, and the phone jack.

The combination of rapid visual as well as aural checking of the signal in this new design makes possible a more thorough testing of the signal from the antenna to the speaker, since the signal in each circuit may be heard for characteristics and fidelity as well as measured for relative strength. Any trouble in a receiver can easily and quickly be isolated. After the initial testing with the volt-ohm-milliammeter for the proper a.c. and d.c. operating voltages, the use of the signal tracer makes it a simple matter to locate defective r.f., i.f. and a.f. components. It becomes easy to find open, shorted or noisy resistors, capacitors, coils, and transformer windings. Bad or weak tubes are checked under actual operating conditions. The sources of intermittent operation, noise, hum, distortion, and any other faults are rapidly isolated. As an example, when testing for an intermittent defect in a receiver, the signal
Satin walnut finish accented by an edge-lighted dial gives this new Air King radio-phonograph a beauty of appearance equalled only by the purity and naturalness of its tone. Styled with simple dignity, it fits naturally into any decorative scheme. Engineered by Air King, it wins the enthusiasm of the critical musician. Produced by Air King, its quality demands no penalty of price.

Features that make the Crown Princess a superlative instrument include:


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January, 1947
Radio Serviceman:

here's a valuable tool for your shop!

MAGAZINE serves the Radio Service man with original articles on servicing techniques, educational articles on how to use all kind of test equipment, and "know-how" that will speed your servicing.

For example, each month we carry a special feature entitled, "The Radio Service Bench." Prepared by Radio Maintenance staff and readers, this department completely discusses the various problems of a radio shop such as tools, work bench, hints and kinks, and so on. Here we tell you not only what is needed but how, through your own ingenuity, your service jobs will go faster with more profit for you.

Of course, we go beyond the service bench. Each month, Radio Maintenance Magazine focuses attention upon all services which come under your jurisdiction. Trouble-shooting Procedures in AM–FM–Television; Public Address Systems; Alignment Problems—all are dealt with by well known men in the radio industry.

Radio Maintenance Magazine is a trade publication. You can't buy it on the newsstands. A one year subscription—twelve full months—costs only $2.50.* If you double up on two years, the cost is only $4.00. Either way, you win in the long run.

Don't miss this valuable tool for your shop—this magazine that is published especially for you! Clip the coupon below and send it with your check to Radio Maintenance.

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January, 1947
**SEE and HEAR the signal with the new CA-12 Signal Tracer**

*Latest Superior Instrument product, featuring visible and audible signal detection—reducing the time to locate source of trouble to an absolute minimum.*

Simple to operate . . . only one connecting cable — no tuning controls.

Complete with Probe, Test Leads, self-contained Batteries and Instructions.

Immediate Shipment $34.85

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**Model 450 SUPERIOR TUBE TESTER**

"Speedy Operation" assured by newly designed rotary selector switch which replaces the usual snap, toggle or lever action switches.

Tests all tubes up to 17 volts including 4, 5, 6, 7, 7A, Octal, Loctals, Bantam Junior, Peanut, Television, Magic Eye, Hearing Aid, Thyrtronics, Single Ended, Floating Filament, Mercury Vapor Rectifiers, etc. Also Pilot Lights. Net $39.50

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**Model 650 SIGNAL GENERATOR**

Improved AC-operated — generating RF frequency from 100 kc to 10 Mc. Audio modulating frequency is 400 cycle pure sine wave. Three-step ladder — type alternator.

Net $48.75

Write for bulletins and catalog of radio parts and equipment.

Terms: 25% deposit—Balance C.O.D.

---

**Parasitic Beam Design**

(Continued from page 41)

The transmitter may be left connected with the speaker switched on, and while other work is being done, the set is at the same time constantly under test. In addition, the same simple procedure which is used in servicing broadcast receivers can be applied to the testing of all other types of communications circuits.

The unit described in this article has been designed and constructed with the purpose of making it the handiest and most conveniently operated instrument of its type. This signal tracer and a battery operated volt-ohm-milliammeter form a combination which may be used for servicing any type of communications equipment under almost any emergency conditions.

---

Allen R. Richter, foreign sales manager of Press Wireless Manufacturing Corp., explains some of the features of the new 20,000 watt radio telegraph transmitter to S. L. Chang, radio engineer for the Central News Agency of China. The transmitter pictured is one of two such transmitters built by Press Wireless for the news agency. According to Chung-Chin Kao, former director of the radio division of the agency, the units are to be utilized mainly for radio telegraph, radio teleprinters, and radiophoto operation and will be coordinated with the Press Wireless international network and other communications organizations for the distribution of news.
A MILLION Relays!

Relays to Meet Practically Any Requirement
—AT GREAT SAVINGS IN COST

Our huge inventory of relays is, we believe, the largest and most complete in the country. These relays were made to exacting standards by America's leading manufacturers and are guaranteed in every respect. This equipment will meet your critical quality requirements and save you a large portion of the cost. Our new illustrated Relay Catalog is now ready and will be mailed upon request.

Consult Wells for Quality Radio Parts
We can make immediate delivery of a wide variety of radio components either singly or in quantity. Lists are available on the following items: Volume controls, condensers, resistors, phone jacks and plugs, wafer switches, Micro switches, transmitting tubes and Jones strips.

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January, 1947
The finest in

Insure natural, brilliant sound reproduction every time with this new Thordarson line. Backed by 51 years of outstanding transformer manufacture and 30 years of audio pioneering, these new units are the last word in amplifier quality... See them at your jobbers today... For sound to satisfy the experts, specify Thordarson.

25 Watt Amplifier, Model T31 W25A

8 Watt Amplifier, Model T30 W08A

50 Watt Amplifier, Model T31 W50A

25 Watt Pre-Amplifier, Model T31W26

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RADIO NEWS

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The top requirement for the complete "Ham Shack" equipped with built-in band switching. No coils to change, six position switch. Choice of built-in or separate power supply. Ask your jobber for full information today.

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Completely dustproof, unaffected by humidity changes and unexcelled in stability, Meissner coils have been the standard of comparison for 24 years.

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Look for the Radiart Red Seal at your jobber's... Your guarantee of effective, trouble-free performance under all conditions. Radiart Vibrators are sealed against air and moisture to prevent point oxidation... a significant advance in vibrator design. Send for free catalog and vibrator guide.

AERIALS
A complete line, cowl, hood and under-hood types, designed for all cars. Permanent "All-Metal Anti-Rattler" reduces mechanical noise and Plastic-Loom Lead facilitates maximum signal transfer efficiency. See this outstanding line at your jobber's today.

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January, 1917
This is the loss due to radiation. At the higher frequencies the spacing between the standard types of feed line becomes an appreciable part of a wavelength and the fields set up by opposing currents in opposing feeder legs do not positively cancel to the point where radiation is eliminated. Many amateurs undoubtedly have noticed a similar effect in high frequency tank circuits in which the minimum plate current dip seems high. Part of the high plate current is due to the fact that at these frequencies the radiation losses from the tank circuit decrease its impedance by lowering its $Q$. Parallel rod tank circuits minimize this effect because they carry currents of equivalent magnitude and opposing direction at closely spaced distances, thus enabling cancellation and reduced radiation resistance.

In the delta match, this situation is aggravated by the fact that the legs of the delta are no longer close together and parallel. In a manner of speaking, it is now possible for the radiation fields generated by currents flowing in opposing legs of the delta to escape almost entirely, because they are at right angles to one another and cancellation is nullified. The resultant field from these two radiation components in all probability does not beneficially supplement the beam pattern or gain; therefore this energy

Technicians working quietly at their tasks at the Daven Laboratories in Newark, New Jersey were startled recently when an electrolytic condenser suddenly "blew its top." The can hit the ceiling with the speed of a bullet while paper and foil spiraled upward in a cloud of smoke. Walter Steinhard, Radio News Staff Photographer, reproduced the phenomena realistically with the original cast of parts.
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SPAGNETTI and other place settings. Price 75c to 1.75-
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SPEAKER MASTS—1500w—$115.00. Roping & rubber $5.00.Price $119.50.

CRYSTAL PICKETS—750w—$7.00. All kind known ones, one at
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PHONOGRAPH MOTOR—150w—$6.15 with turntable and high
gain crystal disc drive—$7.55.

PHONOGRAPH CART—3-WD, portable leatherette cov-
ered unit with or without speaker unit.$7.35.

PHONOGRAPH TRANSFORMERS—a wide range of Cycle Amplifier
suitable for PC systems and phono amplifier, with a band pass
range of 15 cycles. 6 transformers total.

RECORD CHANGERS—Three are beautiful—ten post, with
changeover switch and changeover ring pick-up, pans 10" and 12"
-speeds selectively boosted. Complete with blue leatherette, or
walnut frame. All prices $60-$70. 10" ones price can go as low as
the give-away price of only $24.85.

RECORD CHANGERS—Ten post. Complete, complete with 6 Watt. A.C. Amplifier previously described. Complete for fpower use $35.50.

PUBLIC ADDRESS AMPLIFIERS—55 Watts peak output, 5
fader, operate controls of all phone and public input.

$2.50 value for only $200.

CONDENSERS—Paper TUBULAR 500 WY—$1.41; 500, 1000, 2000
V—$2.50; 2500 WY—$3.50. 250, 500, 1000, 2000 V—$3.50 to
$5.00. 3000 WY—$6.50. 2500 and 5000 V—$8.00 to $9.00 and
up.

DIO TRANSFORMERS—Paper Plate to Grid. 151, 153, 156, 158
$1.25; 50, 100, 200—$2.50. 25 & 50—$1.25. Universal
40 Watt. 151, 153, 156, 158—$1.25; 40 Watt. 151, 153, 156,
158—$2.50.

MICROPHONES—100w—$35.00. 50w—$25.00. 150w tested brand.

Bake erasers $5.45. Bullet Dynamic—$7.45. Mike Jr—$60.00.

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158—$24.85.

RELAYS—Auto type...10-20,000; heavy duty. 15 Amp.
Contact—$1.25; Guardian 12 to 24 D.C. triple mole, double
break. 15 Amp. $3.75; Guardian 30 to 60 D.C. double break
$9.95. May also be operate on less than 1 Million.

SELENIUM RECTIFIERS—Dry type selenium for converting AC to
DC. See for prices. 30, 40, 50, 60, 75, 90, 100, 125, 150, 200
Watts. Price varies according to wattage and size of selenium.

Fusing Selenium—$1.95. Two Seleniums—$3.65. Three
Seleniums—$5.15. Four Seleniums—$6.65.

3.1-75mmfd. $4.95; 75mmfd. $4.50; 100mmfd. $4.35; 150
mmfd. $4.15; 200mmfd. $4.00; 250mmFD. $3.85; 400mmfd.
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000000mmFD. $1.50. For use with 150v-500v D.C. circuits.

DIODES—Any type...$0.95 each; $9.00 per dozen.

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110V Ac, 150V dc—$115.00. 220V Ac, 330V dc—$175.00.

150V 150w—$7.95. 300V 300w—$12.95. 600V 600w—$22.95.

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WIRE—No. 18 POSI 5 conductor parallel insulated, brown,
$26.00; silver—$25.50; 2600 spools—$55.00. No. 18 Ww brown
wire covered parallel insulated, brown, $26.00; silver—$25.50;
18°C rubber covered double wire for wash machines, vacuum
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WIRE—143"—$19.95. 141/2"—$17.95. 141/4"—$15.95. 11/2"—$9.95.

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January, 1947

93

Famous Collins Autotune Transmitter

This is the well known unit that has been
satisfying the amateur with the most
sensitive QST Type Autotune tuning of any of its kind.

As with any Collins Autotune, the Collins
transmitter gives you the most sensitive QSO ever
possible any time. The transmitter
operates from 1.5 to 30.0 Mc and 1000 w power input
is practically standard for all mobile units used on 80-
15-10. and 8 bands. The Collins Autotune has been
so effectively designed that units used on 80 final, and push-
pull operation on 15-10 or the 8 bands at
any time. The Collins Autotune is priced at
low. Estimated average power output is 150 Watts.
Price of transmitter $199.95.

Write for literature describing all units you wish more information on.
Figure 6. Two views of "T" section show mechanical details of construction.

may be considered to be lost or wasted. In fact, the legs of the delta matching system are, in reality, a part of the antenna rather than a part of the feeder system, and are improperly polarized and improperly located with respect to the parasitic elements to benefit proper radiation.

In the "T" match, the long sections are close together, parallel and properly located so that spuriously polarized and directed radiation is minimized.

It is not claimed that a large difference in signal level would obtain over a long distance path between the two properly adjusted feed systems. However, it is accepted engineering procedure, when measured results are so difficult to obtain, to employ those practices which are sound.

What's New in Radio
(Continued from page 66)

exists of an inverted converter (synchronous converter running from the d.c. side) with an amplydyne mounted on the same shaft. The amplidyne is connected in series with this inverter and bucks or boosts the voltage supplied by the axle-driven generator or battery to maintain constant a.c. voltage and frequency on the output side of the inverter.

The equipment is being manufactured by the Apparatus Department, General Electric Company, Schenectady, New York.

FACSIMILE RECEIVER

Persons attending the recent convention of the National Association of Broadcasters witnessed the first public demonstration of the new Finch facsimile receivers for home use.

Available in table and console models, this modern facsimile recorder is combined with an FM-AM home receiver to provide complete home entertainment. The cabinets in which these models are housed are of specially selected woods.

The facsimile recorder is capable of scanning 28 square inches per minute at 105 lines per inch. The radio provides both standard and 88-108 mc. FM sound program reception.

This unit is being manufactured by Finch Telecommunications, Inc., 10 East 40th Street, New York 16, New York.

TUNABLE DIPOLE

A new type dipole for television and FM reception has been announced by Kings Electronics of Brooklyn, New York.

A unique feature of this dipole is the fact that the arms of the dipole are adjustable and can be resonated with the wavelength of weak stations. This eliminates ghosts and weak reception on certain stations in low areas, according to the manufacturer.

The adjustable feature of this dipole consists of a u.h.f. element that is calibrated from 1 to 215 in half steps. After facing the antenna in the direction of greatest signal strength, should any weak stations develop, this element can be moved in or out, according to a carefully calculated table, and then locked into position. This setting need be made only once.

Because of the adjustable element...
A Handy Guide to SPRAGUE EL SELF-MOUNTING MIDGET CAPACITORS (Can Type)

Easier to install... Tops for Dependability

Time is money in radio servicing. Save it—make more of it—by using Sprague Type EL can type dry electrolytic capacitors for every possible replacement use. They're small enough to fit anywhere. They're absolute tops in dependability. And you can mount them in a jiffy, either by direct chassis mounting or by means of their convenient twist prongs. Both bakelite and metal washers are supplied with each unit.

Ask for Sprague Type EL Capacitors by name!

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<th>DC working Voltage</th>
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QUADRUPLICATE SECTION

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SINGLE SECTION

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A January, 1947

Joabbing Distributing Organization for Products of the Sprague Electric Company

www.americanradiohistory.com
this dipole is capable of receiving an extremely broad band of FM and television frequencies, including black and white, color and experimental television; FM; 14 meter amateur; glide paths, airport controls; and fixed and mobile stations.

Kings Electronics, 372 Classon Avenue, Brooklyn 5, New York will supply prices and additional details upon request.

PORTABLE SOUND SYSTEM
Newcomb Audio Products Company of Los Angeles has developed a new portable sound system, one of a series of portable units built around the standard and deluxe Newcomb amplifiers, and ranging from 10 to 60 watts power output.

The 3-case system includes a 30 watt amplifier with two 12", wide range loudspeakers. The cases are of plywood with airplane type fabriciod finish. Each speaker is supplied with 50 feet of detachable cable.

The combined shipping weight of the Model KX-30R12A is 147 pounds.

Complete information of this unit will be supplied by Newcomb Audio Products Company, 2815 S. Hill Street, Los Angeles 7, California, to those requesting it.

V.T.V.M.

The Type 1800-A vacuum tube voltmeter is the newest addition to the line of test instruments offered by General Radio Company of Cambridge, Massachusetts.

This unit is smaller, lighter and easier to use than the company's Type 726-A which this model supersedes. In addition, the v.t.v.m. reads d.c. as well as a.c. voltages and can be used at much higher frequencies.

The range of a.c. voltage measurement is .1 to 150 volts. Frequency correction curves for both resonance and transit-time effects for frequencies up to 500 mc. are supplied. Where absolute voltage readings are not required, the instrument can be used as a voltage indicator up to 2500 mc. A single zero setting serves for all ranges. The d.c. voltage range is between .01 and 150 volts. The rated accuracy for both a.c. and d.c. measurements is ± 2%.

The probe is supplied with a variety

Self contained magneto ringing telephones with French type handset. Complete as shown with microphone battery and box canvas carrying case. Saves thousands of steps and valuable time.

% on broadcast remotes
% on construction jobs
% between form buildings
% from store to warehouse or yard
% releasing information in public address work.

No outside power required. Easily moved from one location to another. Operate several stations on one pair of wires. These units are brand new Army surplus. Supply is limited—don’t delay—send your order in at once.

Stock No. A-744.  Price per station $14.95

CAST ALUMINUM CALL LETTER PLATES

MICROPHONE NAMEPLATES

Microphone nameplates are made of aluminum with letters and borders raised front and back) and satin finished. Background, baked black crackle enamel. Sideplates furnished with call letters or affiliation letters. Special color backgrounds 4½ extra. Special point combinations $1.00 extra. Letters may be cast inverted for boom suspension at no extra cost.

SHURE SS, S55, S56, with side plates $12.00 ea.
WESTERN ELECTRIC 633-A, less side plates 7.50 ea.
RCA-74B, less side plates 7.50 ea.
RCA-74B, with side plates 10.50 ea.
TURNER U9S, 99, 999, less side plates 7.50 ea.
TURNER, U9S, 99, 999, with side plates 10.50 ea.

The above are only a few of the types available. Write for complete information.

VERTICAL STAND PLATES

Type A-22—2 ½" x 8 ½".
Equipped with brackets for fastening to mike stand. $3.00
Each 3 for $9.00

Type A-24—Same as A-22 but with affiliation letter across top. $3.00
Each 3 for $9.00

Type A-18 Auto Plates, A-19 Panel Plates and A-26 Lapel Buttons supplied with broadcast calls at same prices as listed for hams.
ONE DEVICE NOW USED BY RADIO SERVICEMEN FOR GREAT VARIETY OF TESTS

Electrical Measurements Made Easy With New Sylvania Unit!

The Sylvania Poly (MULTI-PURPOSE) Meter

Radio servicemen now can use the new Sylvania Poly (MULTI-PURPOSE) Meter type 134 to facilitate a multitude of electronic measurements and tests to radio equipment.

This product of Sylvania Research is stabilized against errors due to voltage variations or gas current in tubes. All accessories included. See your Sylvania Distributor.

CHARACTERISTICS AND SPECIAL FEATURES

Tests audio, A.C. and R.F. voltages from 20 cps to 300 mc through use of proximity fuse-type tube built into handy probe. Full scale range of 3, 10, 30, 100, 300.

Measures D.C. from .1 to 1,000 volts in full scale ranges of 3, 10, 30, 100, 300, 1,000.

Measures D.C. current from .1 milliampere to 10 amperes in full scale ranges of 3, 10, 30, 100, 300, 1,000 milliamperes and 10 amperes.

Measures resistance from ½ ohm to 1,000 megohms in full scale ranges of 1,000, 10,000, 100,000 ohms and 1, 10, 1,000 megohms.

ACCURACY

D.C. ranges ±3% of full scale.

A.C. ranges ±5% of full scale up to 30 volts and ±7% above 30 volts.

R.F. ranges ±5% of full scale up to 10 volts; ±7% from 10-100 volts; ±10% on 300 volt range.

Ohms ±6% to the left of ½ scale; ±13% to the left of ¼ scale.

Current ±3% of full scale on all but 10 ampere scale which provides ±5% of full scale.

INPUT IMPEDANCES

R.F. ranges—2.7 megohms resistance shunted by approximately 3 mmf. capacity.

A.C. ranges—2.7 megohms resistance shunted by approximately 40 mmf. capacity.

D.C. ranges—16 megohms resistance.

Remember the Sylvania Poly (MULTI-PURPOSE) Meter type 134. It’s beautifully styled, compactly designed, has easily read meter and dials.
SET BUILDERS
TWO-TUBE SUPER HET KIT

Completely wired ready to connect into any AC-DC or 6 volt filament with 125 V or more B supply — plate current drains—2 mls. $7.95 ea. unwired

High gain and selectivity—plays with 6 ft. of wire—excellent for PA systems, radio tuners and for making combination kits for set builders—tunes police calls $9.95 ea. wired

Quantity unlimited 20% deposit with orders

Laydown model where space is essential

Model GI-RM4 Smooth Power Recording Motor

NOTE TO INDIVIDUAL USERS Smooth Power Motors are sold only through established trade channels.

3.1 µfd. The input resistance at low frequencies is 25 megohms, decreasing at higher frequencies owing to loss in the shunt capacitance. Two input resistances are available for d.c. measurements, 10 megohms and open grid. Power supply for this unit is 100 to 150 or 200 to 260 volts, 50 or 60 cycles. A voltage regulated power supply is used.

Prices and additional details will be furnished by General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Massachusetts.

FLASH TUBE

Sylvania Electric Products Inc. has recently announced the availability of a new electronic flash tube which provides increased light output and has been specially designed for black and white and color photography.

This new type R4340 tube provides a peak output of 48 million lumens or four times the amount of light produced by the type R4330 previously announced by the company.

Daylight quality of the light, which produces an almost flat curve between 4000 and 7000 angstroms, makes it suitable for color photography where both intensity and color characteristics are important.

Tube life is rated at more than 10,000 flashes with a maximum repetition rate of four times a minute. This tube is suitable for condenser discharge circuits where a 120 µfd. condenser is discharged at 2500 volts. These circuit values provide a flash of approximately 1/5000th of a second duration. Further information on the type
Brand New Standard Brand TUBES! 80% OFF

AIRCRAFT INTER-COM AMPLIFIER
Came completely wired in aluminum cabinet with the following: 2-12AU, 2-12AV Tubes, 1-Ball Grid condenser, 3-Cap Filter Condensers, 12-Precision Resistors, 6-Mica Condensers, 4-Low loss octal sockets, shielded Input and Output Transformers, 1-shielded R.F. choke, 1-S.P.S.T. toggle switch, 25 V.D.C. Battery. Radio furnishes the instructions for easy conversion to H.I.-Sensitivity phono or speech amplifier...... $8.95

SPEAKERS
New Type Waterproof speaker Stronsberg-Carson a nd RCA 15 ft. resistance trumpet with 25 Watt FM driver unit and line matching transformer. Total value for $25.00. 25 Watt FM driver unit with line matching transformer and waterproof projector mounted in a heavy duty round metal cabinet with foam rubber feet. Combination receivers and public address systems at the lowest price ever offered. ...... $14.95

LOW FREQUENCY RECEIVER BC-344
Brand new, operates on 110 volts A.C. complete with 10 tubes, 6" P.M. speaker, encased in metal cabinet. Tuned 190 to 1500 KC. A "hot" low frequency receiver at this spectacularly low price... only ....... $85.60

GARRARD RECORD CHANGER
BC/40 110 V.A.C. operation 56/60 cycles interpolates 10 and 12 inch records, automatically cuts off after last record, variable speed motors, comes with permanent needle with less than one oz. needle pressure........ $63.00
Universal model same as above but operates AC 110/120 and 220/250 volts. Walnut Wood Cabinet for above $24.00 $73.00

F.M. TRANSMITTER & RECEIVER
BC-653-FM-100 tube receiver less power supply...... $39.95
BC-664-FM-300 W a r r a n t y - T r a n s m i t t e r less crystal and power supply...... $39.95
Combination BC-653 and BC-664 Tunes 27 to 265 M.C. ........... $69.95

RADAR RECEIVER BC-106A
Guaranteed service condition. It is a Hot receiver for Home and Television experiments, takes 115 to 160 volts, contains 2 R.F. and 5 I.F. stages. Complete with 115 volt AC power supply and 14 tubes.... $99.50

GON-SET CONVERTERS AM & FM
AM 28 meters ............. $39.95
6 meters ............... $29.95
FM 85 MHz to 108 MHz ......... $59.50
59 MHz to 80 MHz .......... $14.95

WESTON No. 697 OHM METER
Scale 0-10,000 Ohms $14.97

SUN RADIO • HOME OF NATIONALLY KNOWN RADIO PARTS
WAR SURPLUS EQUIPMENT!
AT A FRACTION OF THEIR ORIGINAL GOVERNMENT COST!

SUN RADIO OF WASHINGTON, D. C.
938 F STREET, N. W. WASH., 4, D. C.
ALL ITEMS F.O.B., WASHINGTON, D. C.
All orders $3.00 or less, cash with order. Above $3.00, 25 percent with order balance C.O.D.
Foreign orders cash with all orders plus exchange rates.

January, 1947

www.americanradiohistory.com
R4340 will be furnished by the Electronics Division, Sylvania Electric Products Inc., 500 Fifth Avenue, New York 18, New York.

VARIO-TUNER
Electronic Laboratories, Inc. is currently offering their new E-L Vario-Tuner to the trade.

This permeability type radio tuner may be used in table model receivers, eliminating the need for tuning condensers and coils while providing high gain operation.

This unit provides full band coverage from 540 to 1620 kc., a simplified circuit which is ready to be connected to the radio, no backlash and new ribbon drive, simple installation, and short-wave spread-band tuning.

REDUCING NUMBER OF CAPACITORS OR RESISTORS IN DECADE BOXES

Ten-point resistance or capacitance decade boxes often are built by laboratory workers. Radio servicemen and experimenters build less accurate versions of the same units to use them as resistor or capacitor substitution boxes. In both cases, it is customary to employ ten capacitors or resistors in each such box, in combination with a single-pole, 10-contact rotary selector switch.

By using the ideas illustrated by the accompanying schematics, the number of capacitors required in a decade box to obtain ten successive positions can be cut down to five, and the number of resistors cut down to four. Where precision capacitors or resistors are employed, this will afford a substantial saving of money and space. And in the case of substitution boxes, where accuracy requirements are less stringent, but components still must be hand-picked, the saving again is worthwhile.

A 4-pole rotary switch does this unique job in the capacitor decade (Fig. 2) and a 2-pole switch is employed in the resistor decade (Fig. 1).

In the resistor decade, 1-, 3-, 5-, 2-, and 4-ohm resistors are connected in series in that order, as shown in Fig. 1A. The double-pole switch (Sf-S2) selects single units from 1 to 5 ohms (See Fig. 1B) and appropriate series combinations of resistors from 6 to 10 ohms. This is a units decade. For a tens decade, use 10, 30, 50, 20, and 49-ohm resistors; for a hundreds decade, use 100-, 300-, 500-, 200-, and 400-ohm resistors; for a thousands decade, use 1000-, 3000-, 5000-, 2000-, and 4000-ohm resistors; etc.

In the capacitor decade, 10-, 20-, 30-, and 49-µfd. capacitors are arranged as shown in Fig. 2A. The bottom pole (S1) of the 4-pole selector switch (Sf-S2) selects single units from 10 to 19 µfd. and appropriate parallel combinations of capacitors (See Fig. 2B) from 50 to 1000 µfd. This is a units decade. Home-made "units" capacitance decades are not very practicable because stray capacitances are apt to be of the same order of magnitude as the decade capacitances. For a hundreds decade, use 100-, 200-, 300-, and 49-µfd. capacitors; for a thousands decade, use 1000-, 2000-, 3000-, and 4900-µfd. capacitors; etc.

Fig. 1. Resistor decade.
Conversa Fone
INTER COMMUNICATIONS
"Your Staff at Your Fingertips!"

- Luxurious, Handsome Cabinets Fashioned of Choice Walnut Woods
- Fingertip Volume Control
- Four-Piece Amplifier (no ballast tube)
- Four-Inch Alnico Speakers No. 5
- Designed for Home, Office, Factory
- Five Push Buttons for Instantly Selecting Sub Stations

Standard Equipment: One Sub Station and One Master Station. As requirements warrant, up to four more Sub Stations may be added. Master Station is silent during normal operation and Sub Stations can initiate calls to Master but cannot call or answer one another. Installation is exceedingly simple. Master and Sub packed in one carton. Additional sub-stations packed four to a carton.

Additional Sub Stations ........ EA. $8.25

NET PRICE ............. $35.22
Immediate Delivery

- FOR VERSATILITY  
- FOR PERFORMANCE  
- FOR SIMPLE OPERATION AND INSTALLATION . . . . IT'S CONVERSA FONE

The Radio Shack Inc.
630 W RANDOLPH STREET CHICAGO 6, ILL.

COMBINATION KIT MODEL M51
- DeLuxe Walnut Cabinets
- 4" PM Alnico No. 5 Speaker
- Three-Tube, High-Gain Amplifiers (1-12SC7; 1-12AG; 1-3525)
- Excellent Tone Quality
- Volume Control
- Ideal for Two-Way Communication in Home, Office, or Factory

Standard Equipment: One Master Station and one Sub Station. Amazingly simple operation and installation. A low cost unit that can ideally fill any two way communication need. Packed one master and one sub to a carton.

Net Price ....................... $25.46
Immediate Delivery

Send coupon TODAY

January, 1947
**MILO**

Your "Q" for Quality

**FAMOUS NAMES**

HAMMARLUND

SP400-X Super Pro. This is the new model which covers a continuous range in 5 steps from 54 to 30 meg. Complete with Speaker.

$347.25

HAMMARLUND HQ129-X

Frequencies cover 54 to 31 meg. in 6 steps. Complete with Speaker...

$173.25

**NATIONAL RECEIVERS**

HR0 5TA, complete with Power Supply Speaker and Coils (1.7-4; 3.5-7.3; 7.6-14.4; 14.8-20m1C).

Additional coils available...

$306.70

NC 240D Complete with Speaker...

$241.44

NC 46 Complete with Speaker...

$107.40

**FEDERAL SELENIUM RECTIFIERS**

6 to 49...

99¢ each

1 to 5...

$109 each

Quotations on larger quantities gladly furnished

For Console Radios, AC-DC Portables, Vibrator Power Supplies, Intercom Power Supplies; replaces any 117 Volt Rect. Tube. Replace tube and socket; require less space; facilitate smaller cabinet design; prolong life of set; give immediate rectification. Schematic Application with each order.

**TALK-A-PHONE**

LP-110 Super Selective Systems

The LP-110 System is made up exclusively of Master Stations. With this system any station can call any other station in the system and in addition a number of two-way conversations can be carried on at one time. You can begin with 2 Masters and add up to a total of 10 in the LP-110 System. Each Master...

$26.50

Milo has complete stocks of Nationally known IRC, Aerovox, B&W, Newcomb, Thordarson, Motorola, Tannoy, Weston, Supreme, National, SNC transformers, etc. If not rated, 20% with order, balance C.O.D. Dept. N.

Suitable for inclusion in radio construction kits, for radio service dealers, amateurs, experimenters, engineers, radio schools and laboratories, the tuner is packaged with complete details for the construction of a complete 6-tube radio receiver, together with a parts list.

Electronic Laboratories, Inc., Indianapolis 4, Indiana, will supply further details and prices on these units.

**TELEVISION KIT**

Transvision, Inc. of New Rochelle, New York will soon begin distribution of a television kit, engineered for easy assembly by the layman as well as the technically trained.

The kit will contain, in addition to all the components, the necessary solder and wire and complete directions.

**REPLACING SHORT-WAVE SWITCH**

It is important that wires to short-wave switches or coils be replaced in original position, after making repairs or cleaning switch. Any new leads must be of the same length as the original. Such wiring should be dressed as found. See photo.

SG-3673 — Transistor receiver, assembly for telephone and telegraph indications.

No. 1...6 tube superhet; 6 tube MOPA transmitter; 607 f.s.m. P.A. Grid modulated for phone. Range 2 to 8 mc., including 40 and 80 meter amateur bands.

No. 2...235 MC transmitter. No modification necessary to operate on the new 1.1 meter amateur band.

Both units in one case as shown at A above.

BRAND NEW — Less tubes...$12.95

Power Supply Unit—(Dynamotor)—550v—50ma and 275v—110ma—RF and AF Filter built in as shown at B...

$6.95

235 mc half-wave antenna with matched coaxial lead-in...

$2.95

Amplifier — 12 ft. with variometer loaded to resonate at 2 to 8 mc. — including heavy base mount...

$3.75

2" PM Speakers — bakelite cones in 2" black bakelite case with 3" range...

$1.50

Dynamic hand mike...

$2.50

Telegraph key and plug...

$0.75

Space parts box and chassis...

$0.75

5 wire — 65 ft. cable with heavy duty weatherproof connectors...

$0.95

Control Unit Box...

$0.75

12 point cable and plug—$0.25—$0.50

**RADIO EQUIPMENT DISTRIBUTORS**

312 W. Pico Blvd., Los Angeles 13, Cal.

RADIO NEWS
The picture tube included in the kit is a seven inch electrostatic type, giving a large enough picture to be viewed by 8 to 15 people. The receiver incorporates 18 tubes, 3 i.f. picture stages, 3 megacycle bandwidth in the picture circuit, a newly designed sweep circuit, and 3000 volts second anode supply which provides sufficient brilliance to allow daylight viewing.

Further information on these kits may be secured by writing the manufacturer, Transvision, Inc., 144 Union Avenue, New Rochelle, New York.

SPECIAL TRAINING FILMS
Because of the rapid increase in turnover among sales personnel, the problem of training suitable sales help is a real one for the radio and appliance retailer.

In order to cut down training time, the Jam Handy organization has recently completed a series of five training films, the purpose of which is to help train sales personnel in proper floor conduct and customer contact in the postwar era.

Each of these films is accompanied by a disc record carrying commentary and voices. An instructor's manual accompanies the films and records, providing a pattern of procedure in holding visualized meetings. Subjects covered in this series include: friendliness, attentiveness, helpfulness, sincerity, and enthusiasm.

ECA TABLE MODEL
Electronic Corporation of America has recently announced that their Model 201 table receiver will be released from production shortly.

This new model, which employs miniature tubes, is a 5 tube receiver housed in a two-tone, wrap-around wood cabinet.

The Model 201 also features a new type of circuit which reduces hum output, and an improved i.f. amplifying...
### RHS TELEVISION-SCOPE-POWER EQUIP'T

**POWER SUPPLY FOR MARK 1-111 BC-19 OR OTHER EQUIPMENT**

12 AMPS 600V from 110 V.A.C. Unnecessary to tear apart. Leave set portable. COMPLETE READY TO PLUG IN..........................................................$32.50

**TUBES (Brand New)**

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**OSCILLOSCOPE KIT**

- 5CP4 Cathode Ray Tube. Each..............................................$6.95
- Socket for 5CP4. Each..........................................................$1.88
- Anode Stabilizer for 5CP4. Each..........................................$.35
- Shield for 5CP4. Each..........................................................$1.49
- 2X2A Hertfurd Tube. Each....................................................$1.25
- Plate Cap for 2X2A Ceramic. Each.......................................$0.28
- Socket for 2X2A Ceramic. Each.............................................$0.25
- Xformer, 160v-3.5V, 2.5V, 5.5V, 110v. 60cyc. Each..............$7.50
- Condenser, Oil 3-300v. Each.................................................$2.10
- Order separately or COMPLETE KIT. Special..........................$16.95

**XFORMERS, SCORE & TELEVISION**

- 7500v at 1 ma.................................................................$5.95
- 600v at 2 ma........................................................................$7.95
- 3kV at 4 ma, 120v at 120v-1 ma..........................................$7.50
- 375v-10 ma: at 3A, 5.5v at 3A.............................................$9.95
- 250v-10 ma: 1.10 at 3A.......................................................$6.50
- 1000v-2 ma..........................................................................$6.50
- 300v-2 ma: at 3A.................................................................$8.95
- 400v-14v at 1000 Ma..............................................................$18.95

**XFORMERS, FILAMENT**

- 115v-60 c.................................................................$39.95
- 2.5v at 1.75a: 6.3 at 1 amp. H.V. Ins..................................$3.95
- 2.5v at 0.5a: 6.3 at 1 amp. H.V. Ins..................................$3.95
- 2.5v at 50. 6.3 at 1 amp. H.V. Ins..................................$3.95
- 6.3v at 2.25a: at 2a at 2a..................................................$6.95
- 5.0v at 115a..................................................................$14.95
- 7.0v at 190s.................................................................$17.50
- 7.5v at 2a, 0.500 15a..........................................................$3.95

**FILTER CHOKE**

- Hi-Voltage Insulation.............................................................
- 1 Hy. 500 ma.................................................................$3.95
- 2 Hy. 500 ma.................................................................$3.95
- 3 Hy. 500 ma.................................................................$3.95
- 4 Hy. 500 ma.................................................................$3.95

**RELAYS**

- Sigma #103 2000 ohm SPDT. Can adjust up to 1 ma..................$1.98
- 6 V. D.C. coil DPDT norm. clos........................................$0.98
- 8 V. D.C. coil SPST norm. open.......................................$1.98

**TRANSMITTER SHELF T66CRN-10**

- Complete RF section uses 1 807 Crystal oscillator tripler, 1 807-RF doubler, 1 257R-RF tripler driving 2 257R'S RF amplifier in push pull, 1 6A6-RF output indicator. All valves and current read on 2 Wenlan meters through panel units. Now on 150uc. Slight change to 1450uc. Capable 500 watts output. Less tubes and crystal. Reduced to..........................$39.95

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**All material is new and guaranteed unless otherwise stated.**

No mail orders for less than $2.50. 20% deposit required with all orders.

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**RADIO HAM SHACK INC.**

63 DEY STREET, NEW YORK 7, N.Y.
NEW DIA-CONE SPEAKER

Altec Lansing Corporation has recently announced the addition of the Model 600 Dia-Cone speaker to their line.

Designed as a production unit for home radio, phonograph, music system and FM reception, this speaker uses the exclusive Dia-Cone principle of reproducing low frequencies and high frequencies on separate diaphragms.

The Model 600 speaker is mounted in a 12" frame and uses an Alnico V permanent magnet and a 3" wound aluminum voice coil to which is mounted a domed aluminum alloy metal diaphragm and a seamless molded cone. The seamless molded cone vibrates as a piston with the voice coil to reproduce all lower frequencies up to approximately 2000 cycles.

Although normally supplied without a cabinet, various types and sizes of cabinets are available for mounting this speaker.

Inquiries regarding this model should be addressed to Altec Lansing Corporation, 250 West 57th Street, New York 19, New York.

NEW TIMING MOTOR

Just announced by the A. W. Haydon Company of Waterbury, Connecticut, is their new Circle B, timing motor which incorporates several new features.

Exceptionally compact, the Circle B Timing Motor easily fits in a 2" circle.

Among the other features of this motor are: through holes for mounting, easy-to-solder terminals, no straggly lead wires, no ears sticking out, etc.

Production of this motor is limited, at the present, to 1 and 5 r.p.m. speeds, with other speeds available. Voltage ratings are 110, 220 and 24 volts at 60 cycles.

Complete information and prices will be furnished by writing direct to A. W. Haydon Company, Department P, Waterbury, Connecticut.

MINIATURE SELENIUM RECTIFIER

The Selenotron Division of Radio Receptor Company, Inc. is currently in production on a new miniature five...
**Two basic parts—a coil assembly and a contact assembly—comprise this simple, yet versatile relay.** The coil assembly consists of the coil and field piece. The contact assembly consists of switch blades, armature, return spring, and mounting bracket. The coil and contact assembly are easily aligned by two locator pins on the back end of the contact assembly which fit into two holes on the coil assembly. They are then rigidly held together with the two screws and lock washers. Assembly takes only a few seconds and requires no adjustment on factory built units.

**On Sale at Your Nearest Jobber NOW!**

See it today! ... this amazing new relay with interchangeable coils. See how you can operate it on any of nine different a-c or d-c voltages—simply by changing the coil. Ideal for experimenters, inventors, engineers.

**TWO CONTACT ASSEMBLIES**

The Series 200 is available with a single pole double throw, or a double pole double throw contact assembly. In addition, a set of Series 200 Contact Switch Parts, which you can buy separately, enables you to build dozens of other combinations. Instructions in each box.

**NINE COIL ASSEMBLIES**

Four a-c coils and five d-c coils are available. Interchangeability of coils enables you to operate the Series 200 relay on one voltage or current and change it over to operate on another type simply by changing coils.

Your jobber has this sensational new relay on sale now. Ask him about it, or write for descriptive bulletin.

GUARDIAN ELECTRIC

1630-A W. WALNUT STREET

CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY
NEW YEAR
SMASH HITS!

Don't forget that we regularly carry all popular and nationally known lines in parts, tubes and equipment...as well as the SMASH SPECIALS advertised here!

KENYON 115 VOLT AC
60 cycle transformer cased job with insulator.
2500 V Sec @ 2 mils.
6.3 V Sec. @ .6 Amp.
2.5 V Sec. @ 1.75 Amp.

$375 ea.

SIGNAL CORPS V9
4 Prong Standard Vibration. Lots of 5 $150 ea.
4 mfd-600 V G.E. Oil Cond. ... 95 ea.
8 mfd-600 V G.E. Oil Cond. ... $1.25 ea.

POPULAR 5" PM SPEAKER
Alnicco 5.25 oz. slug—Big Value!
Lots of 5 $166 ea.

TUBULAR ELECTROLYTIC
With leads and bracket 10-30-20 mfd.
All at 150 volts. Lots of 10 65c ea.

OPEN-TYPE FILAMENT TRANSFORMER
Pri—115V—60 cycle
Sec. #1—6.3 V—16.0 Amp.
Sec. #2—6.3 V—9.0 Amp.
Sec. #3—2.5 V—3.0 Amp.
Sec. #1—2.5 V—3.0 Amp.

$75 ea.

U.T.C. No. VM3—125 Watt Mod.
Transformer ... $18.00
U.T.C. No. VM4—200 Watt Mod.
Transformer ... 30.00
U.T.C. No. VM5—400 Watt Mod.
Transformer ... 69.00

TEST EQUIPMENT
RCA VOLTOHMYST ... 69.50
RCA CHANALYST ... 162.50
RCA TEST OSCILLATOR ... 69.75
WESTON #697 VOLTMETER ... 26.52
WESTON #729 ANALYZER ... 76.46
WESTON #785 CIR. TESTER ... 87.02
WESTON #798 MUTUAL CAPACITANCE TUBE CHECKER ... 187.00
HICKOK #125 VT V.O.M. ... 94.95
HICKOK #191X MICROVOLT GENERATOR ... 145.92
HICKOK #293 ELECTRONIC V.T.M ... 79.80
HICKOK #393X SIGNAL GENERATOR ... 144.60
HICKOK #353 TUBE & SET TESTER ... 138.30

25% deposit, balance C.O.D. Please include sufficient payment for transportation. Overpayment will be refunded.

New Year's Resolution: Replace old equipment with newer models.

Employing a newly developed diode probe and capable of measuring peak-to-peak voltages at very high frequencies, the new meter, designated as the RCA WV-75A, features circuit innovations which make the meter suitable for high frequency work.

The instrument comprises a v.h.f. voltmeter, audio voltmeter, a.c. voltmeter, d.c. voltmeter, ohmmeter and F.M. indicator. Special features of this unit include the ability to read both a.c. and d.c. voltages up to 1000 volts and an electronic monitoring circuit which makes the meter virtually burn-out proof. A polarity reversing switch which eliminates the necessity of changing leads is another new feature.

A full wave rectifier, built into the a.c. probe, makes possible the reading of both negative and positive voltage peaks even at the higher frequencies. The diode probe contains a standard plate selenium rectifier, the 5M1, which has been designed to replace such rectifier tubes as 26Z5, 35Z5, 117Z6, QY4, and others in a.c.-d.c. battery portables, consoles and vibrator power supplies.

This unit, 1" x 1" in size, features high current capacity and low loss. The 5M1 is designed to be used with 25 ohm series resistor and maximum capacitance of 40 mfd. Maximum continuous current is 100 ma. at an ambient temperature of 35 degrees C. The d.c. output voltage and maximum a.c. input voltage is 130 volts.

Radio Receptor Company, Inc., 251 West 19th Street, New York 11, New York, will furnish additional data on request.

FM CONVERTER
Waterproof Electric Company of Burbank, California is currently in production on a small unit for converting FM receivers operating on the 42-50 mc. band to the new FM broadcast band.

This unit requires no adjustment or tuning operations. The receiver operates in the usual manner.

The converter unit measures approximately 1 1/2" x 2" x 4" and weighs less than a pound.

Complete details and prices on this unit will be supplied by Waterproof Electric Company, 72 East Verdugo Avenue, Burbank, California.

NEXT MONTH
TRANSMISSION LINE SYSTEMS FOR FM AND TELEVISION HOME RECEIVERS
Servicemen must know the facts presented in this article to understand higher frequency antenna system installations.

RETAILING BASICS THAT PAY OFF
A New York University Professor analyzes important facts for new and old dealers.

A 5-TUBE HAM SUPER
Construction details of a low cost short-wave receiver.

SIMPLE 10-METER CONVERTER
An easy method for adapting war surplus receivers to the 10-meter band.

CAPACITY OPERATED RELAYS
Experimenters and builders of gadgets will find many applications for these circuits which are actuated by body capacity.
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AND FINE METALCRAFT

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ETCHING
LITHOGRAPHING
EMBOSSING
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STAMPING
ALUMINUM WELDING
& HEAT TREATING
ASSEMBLIES
SOLDERING
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ANODIZING
PARKERIZING
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FLUORESCENT
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DECORATED GLASS
GLASS DIALS
DECORATED PLASTICS
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RADIO TUNING UNITS
REMOTE CONTROLS

OVER 40 YEARS EXPERIENCE IN FINE METALCRAFT

CRONAME
3701 RAVENSWOOD AVENUE
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January, 1947

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part of the card shown below is that of Auburn Esslinger, W8OZP in Owosso, Michigan. Mr. Esslinger operates mostly on the 75 meter phone band and his card is of particular interest because, by means of pictures, he has told a complete story of his country, state, city, home, operating table and himself, XYL and other points of interest which are used to make up the call letters.

Since others of our readers might wish to adopt Mr. Esslinger’s technique in preparing their own distinctive QSL cards, the methods used are outlined briefly. The original card measured approximately 20 x 30 inches and was as white a cardboard as it was possible to obtain. This size was chosen because it was easier to take standard size negatives and enlarge them to a size that would make them proportional to the layout. Incidentally, the layout was drawn in very lightly in pencil on the cardboard first.

While the pictures used for this particular card were 3½ x 4½ inches and were taken with a Speed Graphic, other sized prints taken with any good camera are equally suitable. The choice of pictures and the actual design of the card are left up to the individual as there are many different ways that this material can be presented.

In printing the pictures for the card it is important that the correct grade or contrast of paper be used to keep all pictures on the same scale as far as the blacks, whites and grays are concerned. The pictures were fastened to the card with rubber cement as ordinary paste or matting causes the pictures to wrinkle or buckle.

All of the lettering was done with India ink. The pictures were all printed on glossy paper (single weight) as it was found in a previous attempt that this type of print made the best copy, as a dull finished paper usually shows up the grain of the paper. Single weight paper was chosen as it adhered to the surface of the card better than double weight paper.

The entire card was then photographed to give a postcard size negative which can be printed on double stock with a postcard back. Of course for those amateurs whose equipment or talents do not run along photographic lines, the entire job of printing pictures and photographing the completed card can be entrusted to a professional photographer.

Mr. Esslinger expressed a willingness to discuss further details of his card on the air or by mail. Inquiries should be addressed to him at 721 E. Oliver Street, Owosso, Michigan.

“Personalized” QSL card which tells a story about Mr. Esslinger's home and hobbies.
Three big stores, each carrying tremendous stocks, are ready to serve you with tools, replacement parts, test equipment, sets or anything else you need. Wire, write or telephone if you can't visit one of our stores. If you can visit with us you'll find our trained staff of tremendous help to you.

SERVICE
Mail orders are shipped the same day they are received. You don't have to wait when you buy from Newark. On special inquiries, we give you full information, prices and delivery dates promptly. Newark will give you service that will help you serve your customers better.

FOR GOOD BUYS AND A GOOD TIME VISIT OUR BIG BARGAIN COUNTERS
These big bargain counters in all our stores, are loaded down with special items available in quantities too small to advertise. Marvelous war-time sets, new small gadgets you can have fun with . . . all sorts of new parts and special things you'll want to see. Come in, look around and ask all the questions you wish. Come in often you'll have a wonderful time.

WRITE FOR OUR BIG BARGAIN BULLETIN LISTING THE LATEST AVAILABLE EQUIPMENT
Magazines are printed months before you read them, stocks change, new things are developed and made, so we give you the very latest news about the very newest things in radio and electronics in our Big Bargain Bulletin. Send for your copy today and know all about the latest equipment first. When writing address Dept. C7.

N.Y.C. Stores: 115 W. 45th St. & 212 Fulton St.,—Offices & Warehouse. 242 W. 55th St., N.Y. v9

January, 1947
The FEILER TS-3 Signal Tracing "Stethoscope"

**Save Time...Earn More on Every Radio Repair Job!**

GETS TO THE HEART OF RADIO TROUBLE IN A FLASH! There's nothing like the FEILER STETHOSCOPE for saving service time—solves the toughest repair problem in minutes. To isolate and locate trouble, you just "listen in" or on "look at" the signal as it progresses through the circuit. Traces trouble at First Grid, R.F., L.F., Audio, test parts; locates causes of mistracking, intermittent, distortion, etc. Features: 1" dia. aluminum probe with 3 ft. cable; Full 5" PM Speaker; R.F. vacuum tube voltmeter circuit provision for visual indication of R.F. voltages; Output meter provision; Headphone connection. In handsome brown-finished steel case with carrying handle; 8" x 11½" x 6"; wt., 10½ lbs. Operates on 100-125 volts, 50-60 cycles A.C. A professional instrument for the Service Engineer who wants the best at a moderate price. Complete with valuable Radio Service Guide.

**MODEL TS-3 Signal Tracing STETHOSCOPE for A.C. operation.** Complete with 2-1/4" (or IL4: 1-6K6 or 6F6), and 1-6X5 tubes.

**IMMEDIATE DELIVERY!** Place your order with your regular parts jobber. If he can't supply you, write for name of nearest local jobber stocking the FEILER STETHOSCOPE—or send your order to us direct.

**ONLy $34.95**

FEILER ENGINEERING CO., Dept. 1-A7, 803 Milwaukee Ave., Chicago 22, Illinois
- Ship me one TS-3 STETHOSCOPE.
- Enlarged.
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**Depreciation and your Income Tax**

By HAROLD J. ASHE
Tax Counselor

_Income Tax is a costly item. Save by following the tips presented by this noted income tax counselor._

Considerable confusion still exists in the minds of many businessmen as to how to treat depreciation in their income tax returns. Not a few are still ignoring depreciation entirely on certain depreciable assets, with the result that their taxes are greatly increased. Many others have set up or are continuing to set up depreciation schedules which do not conform to the rules laid down by the Internal Revenue Bureau. In the latter instances, such tables of depreciation are frequently challenged at later dates by bureau auditors.

One commonly held misconception is that if depreciation is not taken from the outset of acquisition of a depreciable asset, the taxpayer may not start taking such depreciation at a later time. He may take such depreciation in a current return, even though he has overlooked it in previous returns. However, the depreciation, contrary to another misconception, does not start as of the date he first takes depreciation, but starts as of the date the asset is acquired. That is, past "allowable" depreciation is gone, even though not previously taken. Third error is that taxpayers who have not previously taken depreciation, even though it was "allowable" in past income tax returns, ignore the "date of acquisition" and "cost or other basis," misconstruing "other basis" as an invitation to value such assets at what their present new replacement value would be, a figure usually higher than the actual asset cost at time of acquisition.

As relates to Federal income taxes, depreciation is an allowance for exhaustion, wear and tear of property used in a trade or business, or of property held for the production of income. The purpose underlying allowances for depreciation is to permit the taxpayer to recover over the useful life of the property the capital sum invested therein. The terms "used in trade or business" or "held for the production of income" would include property held for such purposes, though actually not in use during the taxable year.

Taxpayers should not confuse fluctuation in value of an asset with depreciation. For example, a piece of equipment becomes second-hand at the moment it is first used and at least its resale value may drop appreciably at that point. However, such a circumstance has no direct bearing on depreciation. Only that part of the loss in value which is due to actual exhaustion, wear and tear in business use, during the year, may be deducted as depreciation.

Neither are "obsolescence" and "depreciation" synonymous. Obsolescence is the reduction in value resulting from obsolescences in circumstances that make it desirable or imperative that the property be replaced before it has been worn out, such as newer machinery that is faster, better or more economical than the old machinery. Annual depreciation is the loss which takes place in the course of a year.

If it is clearly shown that, because of economic or other conditions, property must be abandoned at a date prior to the end of its normal useful life, so that depreciation deductions alone are insufficient to return the cost or other basis, a reasonable deduction for obsolescence may be allowed in addition to depreciation.

"Complete exhaustion" does not necessarily mean the same thing as "useful life." If a piece of equipment, for instance, has a salvage or scrap value at the end of its useful life, this value must be taken into consideration in determining the depreciation rate.

A further refinement in determining depreciation is that the property must have a limited and determinable useful life in the trade or business. Land, for instance, upon which a building is erected, is not depreciable since it has no determinable life, and in setting up depreciation on real estate, the cost or other basis for the land must be segregated from the cost or other basis for the building. Thus, a building and land might represent an original cost at time of acquisition of $20,000. If, however, a fair value for the land at time of acquisition was $5,000, then the building's value at time of acquisition would be $15,000, and the depreciation schedule would be based on the $15,000 figure.

The length of useful life of a property is often difficult to determine. It depends upon particular circumstances, including the character of the property and its use. A well-built brick building may have a useful life of 50 years, and a frame building 25 years, a piece of machinery 5 or 10 years, a

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RADIO NEWS

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UNIVIBE... The Universal Vibrator!

1. Welded pole pieces for lifetime adjustment accuracy.
2. Snug fitting synthetic sponge insulation for quiet operation.
3. Spot-welding of fingers, in contact against each other and the center reed, reduces voltage drop in center reed assembly.
5. Face of center reed weight is surface-ground to improve magnetic coupling.
6. Center reed uniformly stressed to prevent breakage.
7. Specially tempered reed and side contact arms.
8. Pressure plate on top of stack keeps stack tight under tension over wide ranges of temperature.
9. Extra flexible roped wire leads eliminate strain and weakening.
10. Metal can, spun at bottom, seals vibrator against dust and dirt.
11. Metal can, spun at bottom, seals vibrator against dust and dirt.
12. Precision ground bakelite spacers for structural and dimensional stability.
13. Neoprene wafer in hermetically sealed vibrators effectively seals vibrators against atmospheric pressure changes and moisture.

8 TYPES SERVICE OVER 2500 AUTO RADIOS

NEW LINE COVERS 97% OF ALL VIBRATOR REPLACEMENTS

UNIVIBE—the complete 8-model vibrator line—covers the replacement needs of over 2500 auto radio models! Provides quick, easy replacement of worn out vibrators in 182 makes of auto radios, as old as 1936!

Think of it—97% service coverage with only 8 fast-moving numbers—every one a repeat profit producer!

Yes, Univibe is right at the top in quality. Well known "balanced resonance" design, of extra heavy-duty construction, means 33% longer vibrator life by actual test.

Here is another money-making radio parts line for National Union dealers.

For immediate delivery order Univibes today from your N. U. Distributor.

NATIONAL UNION RADIO CORPORATION, NEWARK 2, N.J.

NATIONAL UNION RADIOS, TUBES AND PARTS

Receiving Tubes • Transmitting Tubes • Special Purpose Tubes • Cathode Ray Tubes • Radio Sets • Phototubes
Panel Lamps • Flashlight Bulbs • Ballasts • Volume Controls • Condensers • Batteries • Auto Vibrators

January, 1947
Instructor demonstrating rare Schmidt Optical System, used in big picture, projection type, television receivers. This famous television school’s location in the heart of the television industry helps it to get such scarce scientific equipment. At N.Y.T.I. of N.J. all types of television receivers are available for student study.

You can build a direct viewing television chassis similar to the one pictured above, either in your own home or in the magnificently equipped shops and laboratories of this famous television school, located square in the HEART of America’s television manufacturing and broadcasting industry. Mail the coupon at the right to get full details.

To stimulate its radio and television training programs, this famous resident radio and television school is offering men interested in television this unusual opportunity.

If you are unable to leave home to go to a resident school, N.Y.T.I. of N.J. can supply you with parts to build a television chassis in your own home. You will be supplied with the same instructions and directions with which the school’s resident students are equipped, when they reach the stage in their training that calls for television set construction. If you already have a sound radio background, with experience in building radio receivers, you will be surprised to find how much you can learn about television by building this set.

N.Y.T.I. of N.J. is one of America’s leading resident schools for men seeking dependable, thorough, up-to-the-minute training in the various fields of radio and television.

The schooling offered by N.Y.T.I. of N.J. is particularly useful to those who recognize the high-earning possibilities of technical training in radio and television and are willing to tackle the class and laboratory work offered, regardless of their previous education.

No high-school diplomas are needed for entrance. But N.Y.T.I. of N.J. requires that a student be earnest, sincere, and radio-minded. Students without proper mathematical backgrounds are taught the radio and
1946 OUT OF 5 DIAGRAMS YOU WILL EVER NEED
Find radio faults quickly. Make the needed repairs in any radio in minutes instead of hours. Save time on every job. This large, inexpensive diagram manual has the circuit for every popular 1946 radio set made since V-J day. Large manual, 8½ x 11 inches, 192 pages. Just out. Price postpaid, only... $2.00

1942 CLEARLY PRINTED CIRCUIT DIAGRAMS
Follow the factory instructions given in these manuals. 1942 Manual has 351 models of 40 largest manufacturers. 182 fact packed pages, large, size, 8½x11 in. Manual style binding. Order manuals you need today... $2.00

Simplified Radio Servicing By Comparison
Learn new speed-tricks of radio fault finding, case histories of common troubles, servicing short-cuts, expert technique and much more. Many articles on the use of popular test equipment, explanation of signal tracing, television circuits, color code, meter scales, Ohm’s Law, alternating current, etc. Many pictures, tables, charts. Reproduced in 1941 with new information on signal tracing, television, visual alignment. P.A., phono, and every other fact you must know. Complete, 22 lessons, size 8½x11 in. With self-testing questions. Great bargain in home study radio training. Postpaid only... $2.50

Low-Priced Diagram Manuals
These easy-to-apply, inexpensive manuals will help you repair radios faster. This volume covers 1941 models, with alignment data, I.F. peaks, and replacement parts lists. Compiled by M. N. Beitman, radio serviceman for many years, author and teacher. Be an expert in radio servicing; simplify your work. 1941 Manual priced at only... $2.00

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1926-1938 The most popular volume of the series. Write for pay with itself for the time saved during the first day of use. Includes all the popular old timers. Save hours on every job. 427 diagrams of the non-serviced radios of this period, with parts lists and alignment information. 240 pages, 8½x11 inches. Sold with a money back guarantee. Price... $2.50

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January, 1947

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Ring Oscillators (Continued from page 50)

would be possible with only one or two triodes of the same type.

Lastly, this circular arrangement also permits, when desired, the use of u.h.f. triodes which are physically large.

For the foregoing reasons of stability, greater output power, higher operating frequency, and use of larger vacuum tubes—it is evident that these important advantages can be increased in magnitude by the addition of more and more pairs of triodes to the basic 4-tube ring oscillator.

Large Ring Oscillators

Any even number of u.h.f. triodes of the same type may be connected in this series-circular arrangement, known as a ring oscillator.

All of the previous circuit conditions for sustaining oscillations will apply to such multi-tube oscillators.

Leads between plates and grids of adjacent tubes connect to quarter-wave resonant lines, each of which is tuned to resonance by a shorting bar.

Oscillations take place because of unbalance due to standing waves on the Lecher lines, inherent inductive effects of the circuit system, and feedback through the interelectrode capacitance of all tubes.

Use of a large number of pairs of triodes does not alter the fundamental circuit operation.

Output power of a ring oscillator increases almost linearly with the addition of each pair of tubes; a transmitter with 16 tubes having an output power of approximately 8 times that of a pair of the same type of triodes in a push-pull resonant-line circuit.

Maximum high-frequency limit of operation in the u.h.f. band is extended by the addition of each pair of triodes in a ring oscillator. This extension is somewhat logarithmic, but varies in degree according to the type and frequency characteristics of the u.h.f. triodes used in the circular circuit.

A typical ring oscillator, consisting of 24 triodes of the same type, is shown in Fig. 4.

Quarter-wave sections of resonant lines are used to tune the plate and grid circuits of every tube. Grid tank circuits are connected together by a grid ring—which is biased to r.f. ground. All plate tank circuits are also connected together by a plate ring. Plate voltage is applied through this output ring to all of the u.h.f. triodes.

Cathodes or filaments of the oscillating tubes should be operated at r.f. ground potential. At ultra-high frequencies of operation, bypass condensers would not effectively ground the filaments because of high reactance in the filament leads. For this reason, a half-wave section of transmission line—either resonant line, or
January, 1947

McGEE'S BARGAIN PAGE

SATIONAL PEE WEE AC- DC KITS. Modell K-5, K-7A. $1.41 to $4.21 each. Only 10 cents in smalls. Several different models to choose from. All kits are complete. Ask dealer for the one you want. A must for all hobbyists.

LATEST IN PHONO-KITS

High Power Push-Pull Amps

You can save money by assembling your own record player. All kits you see here are economy models; nothing else to buy. In 15 or 20 minutes any of these kits will be ready for you to plug and play.

*The model J-7 push power-pull tube AC-DC amplifier for $1.95. This is the most popular record player kits complete; wired and tested and furnished with tubes and speaker. It is a high quality amplifier having a musical sound with good hum response even at low volume. For serviceability convenience and control, we make a schematic diagram is furnished.

**A single record player kit. A compact cabinet with 15, 78 HM phonograph record player, which crystal pickup and "J-7-5" transformer, and "1" and "2" inch 5 PM speakers. This player will surprise you in appearance and performance.

Model J-T-5 Dealers. $1.95 complete

Model J-16 AUTOMATIC RECORD PLAYER. Attractive 9 inch tone arm and "J-7-5" transistor tube power push-pull AC-DC amplifier (twice) and (twice) heavy duty 5" inch 5 PM speakers. Offered as a deluxe frame record player.

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January, 1947

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Fig. 5. Method of coupling employed in ring oscillator.

coaxial cable—is connected to each filament. The far end is shorted to ground, and transformer action of the half-wave line makes this r.f. ground appear at the filament of the triode.

Since the plate ring is circular in nature, output power is coupled from it by means of a single-loop induction coil placed in the same plane as the plate ring.

The method of coupling and physical arrangement of components can be better understood by reference to Fig. 5, showing a portion of the construction of a typical ring oscillator.

Physical arrangement of the oscillator places all of the triodes in a circle, equidistant from one another. Plate tank circuits of each pair of triodes are constructed on the inside of the tube circle. If possible, the grid tank circuits should also be on the inside of the circle. The half-wave Lecher or coaxial lines used to tune the cathodes or filaments are generally enclosed in metal cylinders, and each triode is mounted directly atop its respective resonant line.

In the interest of space economy, grid and plate tank circuits are also mounted vertically. This arrangement places all of the shorting bars on approximately the same horizontal plane in somewhat of a circle, with the shorting bars of the plate circuits on a different plane and separated from the grid-circuit shorting bars. This separation should be more than one-half wavelength to prevent coupling between the two circuits.

In all the plate tank circuits current is maximum in the shorting bars, and flows in the same relative direction. Thus, the bars can be physically and electrically connected together. One arrangement (Fig. 5) connects all of the shorting bars together to form a continuous, circular metal ring. This plate ring shorts every plate circuit of the oscillator, and provides a single loop of current.
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January, 1947
Individual tank circuits can be tuned, as before, by adjusting the position of this plate ring or circular shorting bar. A single-turn loop or coil placed in the same plane and within the circular plate ring will receive u.h.f. energy oscillations by inductive coupling. Coupling to the pickup loop is due to magnetic fields produced by currents in the plate ring.

In a somewhat similar manner, individual shorting bars on each of the grid tank circuits may be replaced by a single, continuous, circular metal ring (Fig. 5). The physical arrangement of a multi-tube ring oscillator is considerably simpler than the schematic circuit (Fig. 4) would indicate. Despite its simplicity of construction, however, spacing and arrangement of all components of the oscillator are extremely critical of design.

The u.h.f. oscillator has only one disadvantage; it requires a large number of tuning adjustments. Grid rings, plate rings, and shorting bars in the filament circuits all require deft tuning at the resonant frequency of the transmitter. If adjustments are not made properly, considerable inefficiency will result.

However, this single disadvantage is offset by the symmetry of physical construction. Equippaced circuit elements and circular arrangement permit ganging of many tuning controls. For most types of the newer u.h.f. triodes, critical circuit adjustments are not necessary to sustain oscillations.

Antenna of Baythorne's Mariner's Pathfinder radar test installation which was recently installed aboard the Atlantic Refining Company's "SS Atlantic Mariner." This installation marks the first time ocean-going American commercial tankers have been equipped with radar. The first run covered the Atlantic water route from Corpus Christi to Fort MIlihn. According to Captain Preston I. Williamson, ship's master, "The return to Patent Office token over" when a flashing buoy off Cape Hatteras failed to operate in marking position of a wreck.

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How to Avoid Saving Money

by DANNY KAYE

To avoid saving money, the first thing is to cut off all your pockets. (Or throw away your purse and keep your lipstick in your snood.) Thus you will have to carry your money in your hand. Which will insure that you—1. spend it, 2. lose it, 3. get it taken from you—quicker!

Also to be avoided like crazy are piggy banks and sugar bowls. Keep these out of your home! The kiddies in particular are victimized by such devices, often saving quite a bale of moolah. Be stern even if the little ones cry—remember what money could do for them! And be sure to avoid budgets. It is best to draw your pay and walk down Main Street buying anything you don't particularly hate.

Above all, don't buy any U. S. Savings Bonds—or it's impossible not to save money! These gilt-edged documents pay fat interest—4 dollars for 3 after only 10 years! There is even an insidiously easy scheme called the Payroll Savings Plan by which you buy bonds automatically. Before you catch on, you have closets full of bonds. You may even find yourself embarrassed by a regular income! Get-gat-gittle!

SAVE THE EASY WAY...
BUY YOUR BONDS THROUGH PAYROLL SAVINGS

Contributed by this magazine in co-operation with the Magazine Publishers of America as a public service.
"Thecomplainantsappear to have overlooked the revised allocations of frequencies made at Cairo in 1939. Under the Madrid regulations of 1932, the whole band from 7000 kcs. to 7300 kcs. was reserved exclusively for amateur use, but under the Cairo Conference regulations, which became effective on October 1, 1939, the whole band from 7200-7300 kcs. was shared between amateurs and broadcasting.

"While, therefore, the BBC is justified in using these frequencies for its broadcasting services, it naturally does not wish to interfere with the activities of amateurs, and will always seek to avoid such interference by choosing frequencies in other broadcasting bands when these are suitable and available.

"As solar activity is now increasing, the BBC expects to be able to maintain its services to the Americas during the next few years without recourse to the 41-meter band, thus reducing to a minimum interference with amateur activity."

**International Short-Wave**

(Continued from page 60)

**News of the Clubs**

AUSTRALIA—I have just received a copy of "Skyrider," a publication devoted to the progress in DX, published by the Australian DX Radio Club with headquarters in Melbourne, Victoria. Gives present club officers as: J. Hutchinson, president; R. McGrath, vice-president; A. Canty, secretary; editors are E. Tinnings, broadcast, C. R. Skoglund, short-wave and E. J. Miller, amateur. All correspondence regarding short-wave activities should be addressed to Mr. Skoglund at 32 McCulloch Avenue, Kew, Melbourne, Victoria, Australia.

DENMARK—From Lund Johansen, Editor, Populaer Radio, Pilestraede 35, Copenhagen, comes word that the Danish Short-Wave Club has recently been organized in that country. "I would be pleased to hear from DXers in any part of the world," Mr. Johansen writes. He sends out a monitor's card and offers Danish and other Scandinavian stamps to those sending in reports for use in Populaer Radio and the Danish short-wave bulletin, "Shortwave-Listener." Members of the new Danish club are seeking "pen pals" throughout the world. Further details can be had by writing to Mr. Johansen at the address given above.

ENGLAND—Sponsored by Short Wave News, the International Short Wave League has been formed in Britain. According to information just over from England, "The ISWL will cater for every class of short-wave enthusiast, be he constructor, listener, or transmitter. Entry into the ISWL is not hampered by any unnecessary restrictions, and there will be no varying classes of membership. For the present, membership fees are purely..."
nominal and are intended simply to cover cost of certificates, postage, address plates, and so forth. Membership identification numbers will consist of the letters 'ISWL,' followed by the prefix for locality coupled to an individual number. E.g., ISWL/VK234 would indicate a member in Australia. Until such a time as the membership justifies the publication of a separate League Journal, news of the League will be carried in the pages of Short Wave News. "The First Annual has been prepared and should be out by this time; it is described as containing a wealth of information for the DX listener" and as "the only book of the type and accuracy available" in Britain at this time. Arthur C. Gee (G2UK) is editor of Short Wave News, and Ken Norman Stevens (G3AKA) is assistant editor.

Objectives of this new ISWL are listed as: "To bring together the short-wave enthusiasts of the world, regardless of race, creed, or politics, to their mutual benefit. To foster and promote international goodwill through the medium of short-wave radio interests. To provide facilities which will enable enthusiasts to carry out their hobby to the greatest advantage to themselves and their fellow enthusiasts."

All communications regarding the ISWL should be addressed to ISWL, 57, Maida Vale, Paddington, London, W. 9, England.

The present Council of the International Short Wave Club, 100, Adams Gardens Estate, London, S.E. 16, includes A. E. Bear, secretary, and joint trustee with T. E. Port; members, T. A. Lidstone, Bob Cowell (G3WX), and Wing Commander Kenneth Jowers (ISWC).

New Zealand—The New Zealand DX Club, Inc., has chosen as officers for the coming year: President, Stuart G. Bennett, 7 Rautara St., Opara, Auckland; vice-president, Chas. McMillan; secretary-treasurer, Hamil Barr (G3CB); members, Auckland, S.E. 2: members of the Executive Committee are Mrs. M. Bennett, Mac Allison, Ted Bacon, James Dawson, Arthur Gunn, and Bill Mason. Merv Branks, 5 Dublin St., Invercargill, Southland, is editor of DX-TAA, monthly bulletin of the club.
Arthur T. Cushing is the short-wave editor, and Keith Robinson, the BCB editor.

SWEDEN—From Halsingborg, Carl-Eric Petersson writes that DXers in that town have organized a new radio club, Foreningen Nordvartaa Skane Radioanvconare. The club has two sections, DX and "ham." President of the organization is Torge Paus, (SMT 656). Petersson also writes of a monthly house organ called "DX-News," of which Mr. Peterssson is editor. The club will use both Swedish and English in its publication. Address is Luulagatan 14, Halsingborg, Sweden (Sverige).

**Verifications**

Stations operating from Switzerland are now verifying with an attractive card. It features a map of Europe, with Switzerland stressed in red. The country is aptly referred to as "the heart of Europe." The reverse side gives details of frequencies of the Schwarzenburg transmitters. Address for reports is: Broadcasting Corporation, Neuenassae 30, Bern, Switzerland.

"Radio Maroc" verified by letter (in French) for an Australian DX'er and gave address as "Radio Maroc," Resident Directorial de Republique de France en Morocco, Rabat.

Per Friis, Denmark, lists recent verifications as WBCB, WCBX, KUID, KCBR, WBOB, FZI, VLA3 SEAC (Ceylon), CKLX, ZLT7, XOY, XORA, OTC. Incidentally, Per, who is 17 years old, uses a 1941 Philips 3-tube with only one short-wave band.

Recent verifications received by Glenn Moss, Ontario, are from Radio Paris, XEQQ, XEBT, OTC, and HJDE.

Verifications reported by Bill Milne, New Zealand, include BFN, SGD-2, WKRO, WRUS, WRUL, Singapore Radio (6.77 and 11.735), VLR, CKKO, and XGOY.

Jean-Marie Gauvreaux, Quebec, reports a verie from CKOC, 8.955, Santiago de Cuba, which sent a postcard in color and a mimeographed letter (in English). Address, La Cadena Oriental de Radio, Palacio del Estado, Estrada Palma No. 658, Apartado 82, Santiago de Cuba, Cuba. Mr. Gauvreaux also reports HZT2, 6.480, Monsenor Noel, Dominican Republic. Verifies with a nice postcard in blue, white, and orange; address, La Voz del Yuna, Monsenor Noel, Dominican Republic.

Received by Mervyn Laubscher, Johannesburg, South Africa, are veries from CKNASA, VLG4, XGOY, FZI, HEF4, Radio SEAC (Ceylon), PCC, ZFY, Cable and Wireless Ltd. (Radio Athens). Mr. Laubscher reports that Radio SEAC, G.P.O., Colombo, Ceylon, recently at 8:25 a.m. on a Sunday (heard by him on 15.120 but now on 11.77 at that time), presented a talk by the Chief Engineer (probably Mervyn Laubscher himself) in which it was stated that QSL cards are now being sent. Incidentally, the verie letter received by Mr. Laubscher from Radio SEAC was a reply to his report on a test transmission on 9.520, heard June 7-8, 1946.

A verification card from TGWA, Guatemala City, Guatemala, lists frequencies as TGW, 640 kcs.; TGWB, 9,760 and 15,170; TGBW, 6,535; and TGWU, 1,520 kcs.; it was stated these frequencies TGWA is actually operating on.

Late veries received by Ronald W. Gray, New Zealand, are from VY1RX, LRS, COBQ, CKKO, CXA19, CXA10.

**This Month's Schedules**

ALBANIA—ZAA, 7.582, Tirana, has English news at 4:45 p.m. (BSWL). This station is seldom heard in the United States; has bad QRM.

ANDORRA—Radio Andorra, on about 5.980 (varying), is sending a good signal most afternoons and early evenings; has English at 3:30 p.m. (Gauvreaux).

AUSTRALIA—Recent changes effecting Radio Australia, as listed by August Balbi, Los Angeles, Calif., are: ARD1, 11.77, 11-12 noon to West Coast and South Africa, replacing VLG, 9.58; VLBD, 9.68, heard 11:45 p.m.-12:45 a.m. to West Coast, replacing VLBH, 21.60; VLC4, 15.32, heard to 10 a.m. to Asia, replacing VLC6, 9.615, also heard to Britain, 10-11 a.m.

The evening beam to the Eastern U.S. and Canada is now heard beginning at 7:15 and closing at 8:30 p.m. over VLA9, 21.600, and VLC7, 18.400. English news is still read at 8 p.m. I note that both these stations now return at 9 p.m. with a "program for Australian Forces during the next two hours"; stations in the 25- and 30-meter bands, respectively, are announced as in parallel also; news is at 10 p.m.

East Coast DXers desiring of log VLR2, 6.150, Melbourne, will find it a fair to good signal at 6 a.m. when news is given; others that can be logged, until 10 a.m., when VLR3 (Brisbane), at that time include VLGQ, 7.215, Brisbane, weak, and VLW7, 9.520, Perth, excellent.

VLA4, 11.77, in the Forces' program, is usually a good signal in the East around 4:15-5:30 p.m.; announces VLC10, 21.680, VL6, 15.200, as in parallel. (Ferguson, Beck)

VLR2, 6.150, appears to have lengthened its schedule recently; new signoff in 9 a.m. (Dilg)

AUSTRIA: Radioverkehr Aktion Gesellschaft stated in a letter to a Swedish reporter that they operate over KWS-1, 9.833, KWS-2, 12.212, KWS-3, 6.171, and KWS-4, 7.161, with power of 35, 2, 4, and 4 kw., respectively.

The KWS prefix probably stands for "Kurswellen Sender." (Gillett)

AZORES—"Emissora Regional Azores," 11.090, Ponta Delgada, is being heard well on East Coast, 3-4 p.m. (Dilg)

BARBADOS—According to Charles Mohri, reporting from Rio Grande, Brazil, VPL6, 5.305, Radio Distribucion, Ltd., on facilities of Cable and
Wireless, Ltd., Trinidad, broadcasts sports events and other items of public interest at certain times; no fixed schedule.

BELGIAN CONGO—A letter received from Institut National Belge de Radiodiffusion, Brussels, lists Loophville transmitters at OTC-1, 17.770; OTC-5, 9.745; and OTC-3, 9.380, being kept as a reserve. OTC series is 30 kw.; and OTM-3, 9.280, OTM-2, 11.720, with 7.5 kw., and OTM-5, 6.282, with 3 kw. (Ferguson)

BELGIUM—New Zealanders report picking up Brussels on 11.850 between 3:45-4 p.m. poor signal. (Milne)

Directly or through us, it is learned that Ruyssselede, 17.945, is used for telecommunication between Brussels and Leopoldville, Belgian Congo, 12:45-1:15 a.m., 5:30-6 a.m., 10-11 a.m., and 1:30 p.m. irregularly. (Ferguson)

BRITISH SOMALILAND—Radio Somalia, 7.126, operates on Tuesdays and Thursdays between 9-10:30 a.m. (BSWL) Has fair signal on Thursdays at 9:30 a.m. when it has English program. (Dilg)

BULGARIA—Radio Sofia, 9.350 (varying), is heard in Massachusetts at 3:30 p.m. with English news, through heavy CWQR; weak signal. (Stenfert)

BURMA—English transmission from Rangoon, 8:45-10:15 a.m., previously on 11.845, is now radiated on 9.540; usually has news just prior to closing down. (BSWL) Appears to be on 9.540 rather than 9.540, is badly jammed by VESAI, Edmonton, Alberta, and Radio Australia, on 9.540. (Dilg)

CANADA—CHOL, 11.72, and CKLO, 9.63, Montreal (transmitter at Sackville, New Brunswick), sign off the European networks 16 p.m.; but English newscast is at 5:45 p.m. (Balbi) VESAI, 9.54, Edmonton, Alberta, is reaching out these days, being heard in Sweden between 8-9 a.m. (Night-Out) CBN, 6:160, Vancouver, British Columbia, appears to sign on now at 10 a.m. (Dilg)

CEYLON—Radio SEAC on November 4 moved its 100 kw. transmitter from 15.120 to 11.770 m. (Balbi) Official schedules just in from Colombo, confirming change at 7:30 a.m. from 15.120 to 11.770, are as follows:

Main Programs—7:30-10:30 p.m., 15.12 and 6.075; 10:30-11:30 p.m., 15.12; 11:30 p.m.-3:30 a.m., 15.12 and 6.075, 30-7 a.m., 15.12 and 6.075, 7:30-7 a.m., 6.075; 7:30 a.m.-12 noon, 11.77 and 6.075.

Special Services (Educational transmissions and Indian Forces Program)—10:30-11:30 p.m., 11.77 and 6.075, and 3:30-4:30 a.m., 17.77, 6.075, and 11.77 (alternative). These schedules "are subject to change, of which
the only warning will be preliminary microphone announcements. The following additional frequencies are likely to be brought into use for the benefit of listeners in Malaya, Netherlands Indies, India, China, and Japan—17.77 and 9.520 MHz.

The 6075 transmitter is heard in Sweden around 10:30 a.m.-12 noon sign-off. (Gilbert Andersson) Australians report the 6075 frequency is paralleled by 6,180 (?) after 7:30 a.m.

CHINA—Australian sources say it has been almost conclusively proved that XGAP is the call sign of the Chinese station operating (probably from Kalgan) on 9,625; these letters are spelled out on opening at 5:45 a.m. and on closing at 9:30 a.m.; other callsigns are given during the broadcast period, apparently from stations in relay.

In the United States, reception from the various Chinese transmitters appears to continue poor, XGQY, Chungking, on 11,920 (varying), is heard from around 10:45 to 11:45 p.m. sign-off; English news is scheduled for 11 a.m. On 9,640, XGQY is heard earlier in the morning to around 10:30 a.m. sign-off, English news is scheduled for 9 and 10 a.m.; is usually inaudible now (Continued on page 140)

Quality Before You Sell
(Continued from page 51)

for his family—not one too small that will give inadequate hot water nor one too large that will cost too much to operate. Thus your "Good Service" continues. During the sale you arrange satisfactory credit or terms; after the sale you take care of good

EASILY CONSTRUCTED DUMMY ANTENNA FOR RECEIVER MEASUREMENTS

By GUY DEXTER

Radio servicemen and experimenters who desire to make receiver tests and measurements in the approved manner often deplore the lack of a regulation dummy antenna for connection between signal generator and receiver. Such dummy antennas are sold by precision instrument manufacturers, but usually are designed mechanically to fit the attachments of a specific signal generator (usually costly) or are priced out of the reach of most non-scientific users.

Fig. 1 shows the arrangement of a dummy antenna that can be built easily by any radio man. The electrical circuit employed is the one specified in I.R.E. Standards.

The entire unit should be built into a small metal can. One of the popular 3" x 4" x 2" steel shield boxes used for ham instruments will make an ideal housing. Coaxial jacks are mounted directly on the box for efficient connection of the two shielded lines.

$C$ and $G$ should be the smallest-sized mica capacitors (such as Aerovox type 1469 or Cornell-Dubilier type 5W), in order to minimize capacitor inductive effects. Each capacitor must be selected carefully for exact capacitance. $R$ is a 400-ohm, 1-watt carbon resistor (or precision non-inductive wire wound resistor) likewise selected carefully for exact value.

The 20-microhenry coil, $L$, is made by winding 31 turns of No. 24 enamelled wire on a 1-inch-diameter form. The turns are spaced to occupy a winding length of 1 inch. The coil form should be polished, varnished, or low-loss (mica-filled) bakelite. The dimensions of the coil give it a good form factor. If a Q-meter or inductance bridge is available, the coil should be adjusted carefully for the exact 20 microhenry value. But if such a checker is not handy, the builder may strike the inductance value quite closely by adhering strictly to the winding directions.

All leads inside the dummy antenna case must be short. But the component must not be placed so close together that the capacitors come nearer to the coil than three-quarters of an inch. The capacitors must be mounted "on edge" so that their flat faces do not rest on the sides of the metal box. This will reduce stray capacitance to ground. The coil must be mounted well away from the sides of the box, preferably in the center of the enclosure.

The coaxial line from the signal generator must be kept as short as possible. In fact, whenever possible, the dummy antenna case should be mounted on the front or side of the signal generator right at the latter's output terminals, in order to keep this connection short. The coaxial line to the receiver should not be any longer than absolutely necessary. A 2-foot length usually will be more than adequate to allow for moving the receiver about, tipping up on edge, etc.

A dummy antenna requires no adjustment nor manipulation. It merely is inserted between the signal generator and the receiver under test. It should be used when making all standard receiver measurements, such as sensitivity, image ratio, selectivity, etc.

Fig. 1

- Diagram of the dummy antenna.
installation; then you maintain the product. All are “Good Services.”

Your first duty therefore is to supply your customer with a good product. You, in the selection of your lines, must make sure that the radios and appliances you offer to your customers are well built, well designed, reasonable in price and will do well, the job for which they are intended.

There will be quite a few new manufacturers looking for outlets for their goods. Don’t make the mistake of letting an extra five or ten per-cent discount be the deciding factor. The best ad for any radio or appliance dealer is a satisfied customer. You can’t have satisfied customers with inferior products.

In my opinion, which was formulated primarily by testing all sorts of radios and household appliances, most nationally advertised appliances are good appliances. This does not mean that appliances made by smaller companies are no good nor does it mean that all products made by the larger companies are super products. It does mean, however, that the larger companies, as a general run, make good, easy-to-sell products and for the following reason.

1. Practically all, in fact all that I know of, the larger companies have extensive engineering departments and research laboratories for product development, refinement and improvement. These companies are continually working on their products to make them better.

2. The larger companies have excellent manufacturing facilities. For example, in refrigerator and range manufacturing such things as roll-welded frames and bodies make for far more sturdy construction than nut and bolt assemblies. Then, too, the bigger companies make larger quantities of any particular product and these production quantities tend toward economy of manufacture. This usually means a better product at the same price.

3. All of the large manufacturing companies have excellent testing, inspection, and quality control set ups. The quality of production in many cases is superior to engineering standards. Component parts are tested and inspected, sub-assemblies are tested and inspected, and finally the finished product is rigidly tested and inspected. I know of several companies that have a system of engineering check that is designed to insure uniform quality production. In the case of a refrigerator manufacturer, a certain percentage of the finished refrigerators are uncrated after production and completely checked by engineering. These boys know that they have a good refrigerator. They keep it that way by spending a lot of money on quality.

4. All of the larger companies have a very close coordination between service department, engineering department and production department. If at any time a number of field failures on a particular point are noted,

QUALITY ELECTRICAL CONNECTORS

IMPROVE OPERATION AND SELLING
FEATURES OF ANY EQUIPMENT...

An axiom of the electrical equipment industry receiving greater and greater acceptance is “No equipment is better than its electrical connections.” Cannon Electric has long taken pride in furnishing connectors for quality equipment. These vital parts are recognized by manufacturers as “musts”—such as the Collins and Bendix new equipment shown here. Many other prominent firms specify Cannon Plugs because “Equipped with Cannon Plugs” means quality connections.

CANNON ELECTRIC
DEVELOPMENT COMPANY
LOS ANGELES 31, CALIF.
In Canada — Toronto, Ont.

SINCE 1915

* All the connectors shown in the transmitters are type “K.” If you wish a bulletin covering these fittings, write Cannon Electric Development Co., Dept. 1-228, 3209 Humboldt Street, Los Angeles 31, Calif. for Type “K” Bulletin, or contact our representatives located in principal cities of the U.S.A.
A NEW PRECISION BUILT PORTABLE RADIO

Custom Built, S-tube, battery operated receiver with extremely good selectivity and sensitivity. Covers 2 bands—broadcast and medium short wave.

Mechanical construction is excellent. Hardware including handle, feet and panel are solid brass.

 Receivers have been treated to withstand rigors or effects of all climatic conditions and will perform excellently on either land or sea.

Replacement batteries are standard type and can be replaced by any local serviceman.

PRICE—complete with batteries and tubes:

$68.00 Tax included


AARON LIPPMAN AND CO.

246 Central Avenue
Newark, 4, New Jersey

the engineering department corrects the situation, and changes in the product are made to alleviate the condition. This too, makes for a better product.

5. All of the larger companies advertise their products. This makes it much easier for you to sell them. This advertising, in many cases, sells your customer before he comes into the store. Most of you know that the blame falls on you if the customer is dissatisfied with an unknown brand. If a nationally advertised product, in isolated cases, turns out to be a lemon, the purchaser is much more likely to forgive you and blame the right person—the person who made it.

The large manufacturer also offers advantages when it comes to service on appliances. Some of the reasons why this is so follow:

1. Most large manufacturers have many, centrally located service and parts depots. This enables you to obtain quickly needed parts, and in many cases the company service center will repair the defective appliance for you.

2. Practically all of the larger companies have complete service manuals and parts lists so that service on their products is greatly simplified.

3. Training classes for servicemen are held with the advent of new products. Color films and factory experts get the story across to your service people and make the job easier for you.

4. The service problem is continually being worked on by all of the larger manufacturers. They keep rigid records of all service calls and then design the products to simplify servicing. Remember the first automatic washers—it took several years to replace a mechanism. Today, the same mechanism can be changed in about half an hour. These advances in design—pointed towards ease of service—save you much time and money in the long run.

The above seems to point out that the only safe course for a dealer to follow is to handle the products of a large, national advertiser. Strictly speaking, I do not mean that. The only way for a small manufacturer to get to be a large manufacturer is for him to get more dealers and sell more of his products. I repeat, “Many small manufacturers make excellent products.” For the sake of your reputation, however, you should use care in picking the ones whose products you are going to handle. Get the answer to some or all of the following questions. If the answer is favorable there is no reason why you cannot promote these products and at the same time do a service to your customer and the manufacturer.

1. Will the product fulfill the manufacturer's or distributor's claims? This should be determined by test or through reliable sources.

2. Is the product well designed and constructed? This can be determined by comparison with proven products. Examine the construction, look for flaws or weak points.

3. Can it be easily serviced? Try
removing and replacing some parts. You'll soon know if servicing is difficult.
4. Are parts readily available? Find out the location of the nearest source of parts. See if the stock is complete.
5. What selling aids does the manufacturer offer? Check the ease of selling against other products. Folders, leaflets, window displays, cut away models and many other sales promotion features help you to sell.
6. Is the company reliable? Find out if they can back up their guarantees. Make sure you don't put a lot of effort behind something that will be out of the picture in a short time.

If you are sure that the contemplated line will give you good answers to these questions, then go ahead. You can then, with confidence, tell your customer that he is buying a good product; you can tell him that you have checked and you know. Remember again, the easiest sale you can make is by having Mrs. Jones tell Mrs. Smith that she bought a good piece of merchandise at your store.

After you are sure that you have "Good Products" and "Good Service" most of your "danger signals" have been taken care of. There is, however, one more important one that you must watch with care. It is really possible to sell a person a good product, that can be easily serviced, and still wind up with a very dissatisfied customer. Always make sure that you check the mechanical and electrical requirements of the appliance you sell against conditions in the customer's home. For example, when you sell a refrigerator, make sure that the size is adequate for his needs and make sure the door swings in the right direction. When you sell an automatic washing machine, make sure that there is an adequate supply of hot water so the machine will operate efficiently. When you sell a water heater, make sure it is properly sized. When you sell an electric range, make sure that the range can be installed with correct wiring for proper operation. When you sell a radio, make sure you don't oversell. I have seen many oversized console radio sets in small living rooms. When you sell a man in a small house a radio with twenty or thirty watts of audio output, you are overselling him. Thirty watts of audio output will knock the plaster off the walls in most small houses. Normal reception, in most homes, requires just normal audio output. When you sell small appliances, such as toasters, irons, room heaters, waffle irons, sandwich toasters, etc., make sure that the purchaser's home is adequately wired for the use of these appliances. The main thing to remember is, you cannot have a satisfied customer if he does not get full use of the product he buys.

Make a list of questions on each product you sell. Phrase these questions so that when you get the answers you know that the customer can make full use of that which you sell to him. This, in the long run, leads to more business. If you refuse to sell a man

---

Mr. H.B.K. of Long Branch, N.J.* says, "I am employed as a radio mechanic at the Signal Corps Laboratories at Fort Monmouth. In my work I have many times used Kwikheat Soldering Irons. I had never seen, nor heard of your irons until I came here, but I am certainly convinced that they are the best irons that can be obtained.

They (Kwikheats) are a real pleasure to work with.

* Letter on file at our office
an automatic washing machine because he does not have an adequate supply of hot water, you are doing him a service. Sell him a good, adequate hot water heater first, then the automatic washer. Perhaps in these cases your competitor will sell the product to the same customer, let him do it. In the long run you will be better off. Most people will listen to reason—just give your customer good reasons.

All dealers are in an excellent position to improve the standard of living of all America. Do the job well—it’s not easy—it’s hard work—but the rewards are many. Just remember—"Be sure of quality before you sell."—

Your Shop Location
(Continued from page 31)

you are specializing in ship radio repair, you must have your shop near where the ships are. If you specialize in auto radio repair, there is no better place to have your shop than in or near the biggest garage in town, for here will come the largest number of automobiles needing repairs of one type or another. Always remember that the servicing of auto radios requires sufficient parking space for the cars themselves. Try to locate a shop with a yard or courtyard in the back, and with an entrance for autos from the street.

There are two other thoughts which should be considered in determining the proper shop location. The first is to try to anticipate either a "business trend" or a "population trend" in the vicinity of the proposed location. Remember that the business you establish will have a certain amount of "good will." This "good will" is built up slowly, yet it may become your biggest asset. "Location" is usually an integral part of "good will." If you must move because of the location becoming unsuitable, some of the value of your "good will" may have to be sacrificed.

The other thought is that many shops have been built up on AM receiver servicing. However, the times change, and when you pick your new location, study the potential need for radio service on FM, television, home and industrial electronic devices, inter-com units, home recorders, etc. Study these needs in the light of the shop space and location best suited to their requirements.

To sum up, the location of a proper shop site for your radio service business should be picked with the following thoughts in mind:
1. You must know your particular need and pick your site accordingly.
2. Work up a clientele at home before you risk too much money in the rental of a store.
3. Be sure that you are ready to take on the responsibility of a store.
4. Know the territory you intend to serve. Learn its real estate values,

Records

LATEST & HARD-TO-GET BACK NUMBERS

Some slightly used and some brand new—Victor, Bluebird, Columbia, Oriole, Decca, Capitol, Columbia, Decca, Bluebird, etc.: Bob Wills, Benny Goodman, Harry James, Bing Crosby, Frank Sinatra, Gene Autry, Duke Ellington, Fats Waller, Guy Lombardo, Andrews Sisters, Kate Smith, Ink Spots, Mills Bros., etc.

BIG PROFITS on your opportunity to cash in on this new field that is sweeping the country. Specify the type of music that sells best in your territory such as Swing, Sweet Music, Cow-boy, Hill-billy, Polka, Blues, etc. Your price $15.00 per 100 records, f.o.b. Chicago, 2% off for cash orders. All shipments made within 48 hours.

CHAS. HOODWIN CO.
4419 Broadway, T-15, Chicago 40, Illinois
World's Largest Dealers in Used Records

Electronic Volt-Ohmmeter

$11.85

110 Volts AC to 20 Ranges
D.C. and A.C. 0-1,000,000,000 ohms
POSTPAID
in a VOLT-OHM-METERoffers her Volt on 5 volt ranges.

Complete kit in includes all precision tubes, precision and drill points and beautifully finished panel. Easily assembled, circuit consisting of numerous electronic elements developed during war by scientists in the electronic field.

The Gauge, built to new standards of accuracy, sensitivity, and performance, is the most essential instrument in the service laboratory. This instrument is for the serious trouble shooting work, the service laboratory routine, teaching and training purposes, and the hobbyist.

STERLING ELECTRONIC COMPANY
Dept. 9
168 N. Siles Buena Ave., Pasadena 4, California

Electrical Training

Intensive 32 weeks' residence course in fundamentals of industrial, electrical engineering, including radio, electronics. Preparation for technicians, engineering aides. Approved for veterans training, 50%.

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Electricians! Radio Men!

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Electrical and Radio TROUBLE SHOOTING MANUAL

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Send for Free Trial Manual now.

Satisfaction guaranteed by famous Coyne Engineers.

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This manual brings you the best of all the time tested methods of electrical and radio trouble shooting and repair. With all shipping charges paid, your new Coyne Price $10.00. Send coupon for trial and return privilege. If not satisfied return it and your money will be refunded.

SUCCESSFUL COYNE ALUMNI

Address

City

State
its available stores, their relative advantages and their relative rentals.
5. If you intend to serve only a portion of the town or city in which you have your business—locate your shop near the center of this area.
6. Check the type of businesses surrounding the shop site. Pick a street as near as possible to the heaviest flow of street traffic.
7. If you are interested in specialty repair service, pick your site near other firms who cater to the same type of trade.
8. Check the different hours of day.
9. Look for advantages including proximity to transportation stops.
10. Avoid entries that have "sales-killing" step.
11. Watch to see that the place you pick will "wear off." That is, see that the neighbors will not change over the period of years and in such a manner as to make your location unsuitable.
12. If you want to get into one or more of the newer electronic servicing fields, study your location to see that there is a need for these services in your area.

TUBE REMOVAL
MOST every radiomani has available or can make a wire "skinning" tool of the type illustrated, or of spring steel with "V"-shaped notches in the bent over ends.
This tool is also useful in removing radio tubes as may be noted in the photo.
Metal tubes may be removed while warm with a tool of this kind without danger of burning fingers.

THE CLARION MAGNETIC WIRE RECORDER Model A

The CLARION WIRE RECORDER is scientifically designed, carefully engineered, and will give full range fidelity in recording and reproduction. One reel of wire records, both voice and music for a full hour. The wire can be used indefinitely as recorded, or erased and reused countless times. Records from standard phonograph records and radio. Home or office recordings made with microphone. ALL YOU NEED IS A RADIO OR AMPLIFIER!!

SPECIFICATIONS
Record One Hour, Rewind 12 minutes. Frequency 85-3000 cps. Leader for simple threading of wire speed. Automatic erase, rewind, and stop. Fits standard phonograph records. Record or playback thru radio or amplifier. Operates from 110 volts 66 cycles AC line. High frequency oscillator for bias and erased, operates at 40 K.C. Size: 4" x 4" x 6" Weight: 15 lbs.

Limit: One to a purchase. No Radio Mfrs.—COD orders honored with $50.00 deposit.

SEND FOR OUR BARGAIN FLYER
30% Deposit with COD Orders. Minimum order $3.00. Many other items and specialties. Quality sound and recording equipment. Write us your needs.

ClARION SOUND ENGINEERING CO.
363 VICTORY BLVD. STATEN ISLAND 1, N. Y.
GIBRALTER 7-8033

January, 1947
AMATEUR RECEIVER

The new Collins 75A receiver, which has been specifically designed for operation on the amateur bands, is described in a new 4-page bulletin just released by the company.

The bulletin lists several features of this receiver and includes circuit data, control information, frequency coverage, bandspread, image and i.f. rejection data, selectivity, etc., in addition to a block diagram of the receiver.

A copy of the booklet which covers the 75A amateur receiver will be forwarded upon request to Collins Radio Company, Cedar Rapids, Iowa.

ELECTRIC CONTROL DEVICES

In a compact, 8-page bulletin just released by Ward Leonard Electric Co. of Mount Vernon, New York, carries listings of a.c. and d.c. motor starters, speed and voltage regulators, resistors, ring and plate rheostats, switches, magnetic contactors, relays and dimmers.


SOUND SYSTEMS CHART

Of particular interest to the serviceman who installs and services sound systems is the new chart issued by Mark Simpson Manufacturing Company, Inc.

The chart offers general suggestions for handling different types of installations, and makes recommendations regarding the size of amplifiers that should be used to service particular applications.

A copy of this chart is available from Mark Simpson Manufacturing Company, Inc., Long Island City, New York.

C-R OSCILLOGRAPH MANUAL

Although pertaining specifically to the DuMont Type 274 Oscillograph and designed to be used as an instruction manual, the new book "Observing and Maintenance Manual" issued by Allen B. DuMont Laboratories, Inc., contains much general information of interest to users of cathode-ray oscillographs.

The manual contains 30 pages of information plus a folded chart of the circuit schematic and constants of the Type 274. Several pages are devoted to the theory of operation of the cathode-ray tube and oscillograph circuits, complete with illustrations and diagrams.

Operating instructions deal with the alignment of AM and FM receivers and the use of the oscillograph in conjunction with radio transmitters.

These manuals are available at a charge of $.50 each from the Allen B. DuMont Laboratories, Inc., 2 Main Avenue, Passaic, New Jersey. Payment must accompany your order.

ANTENNA EQUIPMENT

The Workshop Associates, Inc. have just issued a series of data sheets covering their line of antennas and antenna masts.

Included in the data sheets is information regarding the electrical and mechanical design of beam antennas, and dipole antennas for amateur applications. Antenna mast and mount, accessories for rotating masts and stand-off insulators are also listed.

Copies of these data sheets will be forwarded to interested persons upon request to The Workshop Associates, Inc., 66 Needham Street, Newton Highlands 61, Massachusetts.

REGULATED POWER SUPPLY

Pan American Electric Company of New York has announced the availability of a data sheet covering their regulated power supply, Model PAS-2000.

Included is application data, circuit design information, electrical characteristics, mechanical characteristics and a summary of specifications.

The regulated power supply described is suitable for use as a component for production testing equipment requiring stability of performance.

A copy of this data sheet will be sent upon request to Pan American Electric Company, 132 Front Street, New York 5, New York.

SHURE CATALOGUES

The recently issued 1946-47 Shure catalogues, covering the company's microphone and pickup lines, feature several innovations in catalogue design which, according to the company, will facilitate the proper selection of equipment with a minimum of trouble.

Catalogue 155 illustrates the Shure line of microphones and features an article "How to Select the Proper Microphone" covering requirements, types, polar response, characteristics, and frequency response.

Catalogue 156 shows the line of "Glider" crystal phonograph pickups and lever-type cartridges. It also features an article entitled "Facts You Should Know About Pickups" which includes a discussion of needle-point compliance, tracking angle, tone arm mass, voltage sensitivity, type of
needle, amplifier input circuits, and surface noise.

In both of these catalogues emphasis has been placed on readability and imparting detailed information on applications, technical data, construction, design, etc.

Copies of these catalogues may be secured from Shure Brothers, Inc., 225 West Huron Street, Chicago, Ill. -

PARTS CATALOGUE

Scenic Radio & Electronics Co., has just issued a new 16-page catalogue covering test equipment, sound apparatus, phonograph players, automatic record changers, speakers, tubes, microphones, antenna kits, radio test books, etc.

Listed in the test equipment section are volt-ohm-milliammeters, signal generators, tube testers, oscilloscopes, v.i.m., v.m.s., and signal tracers.

The company will forward copies of this catalogue free of charge to those requesting them from Scenic Radio & Electronics Co., 53 Park Place, New York 7, New York.

BALLAST BULLETIN

The JFD Manufacturing Company of Brooklyn has recently announced the publication of a new a.c.-d.c. ballast bulletin.

This new 4-page booklet contains complete listings of a.c.-d.c. ballasts for individual sets and a complete listing of the new, improved JFD air-cooled adjustable ballasts.

This booklet will be sent free of charge to those who request a copy from JFD Manufacturing Company, 4117 Fort Hamilton Parkway, Brooklyn 19, New York.

OLSON CATALOGUE

Olson Radio Warehouse has recently issued a new catalogue which will be of interest to radio servicemen.

Thousands of items are listed in this 32-page booklet including microphones, amplifiers, intercoms, head-phones, sound systems, speakers, record changers, pickups, and all types of radio components.

Copies of this catalogue are free for the asking. Address your requests to Olson Radio Warehouse, 73 East Main Street, Akron 8, Ohio.

PRICE AND DATA SHEET

Electronic tubes for amateur radio applications have been listed in a new price and data sheet currently being distributed by the Tube Division of General Electric's Electronics Department.

The new sheet, ETX-19, has been introduced to facilitate the selection of tubes and provide a handy reference chart for all amateur applications.

Technical information and operating conditions data on over thirty tube types are contained in the new sheet. The information is presented in precis form and describes each tube available to amateurs from price to plate dissipation and power output ratings.

Distribution of the sheet will be handled by G.E. distributors or a copy may be secured from the G.E. tube Division, Schenectady, New York.

ANTENNA SUPPORTS

Wind Turbine Company is distributing two data sheets which should be of interest to amateurs and servicemen of this magazine.

Information is furnished on several types of FM and television antenna supports as well as specification on a rotary beam antenna support for a four element 20-meter array.

Copies of these data sheets will be supplied upon request to the Trylon Tower and Antenna Division, Wind Turbine Company, West Chester, Pennsylvania.

ELECTRO-VOICE BOOKLET

One of the most valuable features of the new Electro-Voice catalogue, which has recently been released, is a page devoted to an easy-to-read guide to the selection of the proper microphone for specific applications. Listed
catalogue which should be of interest to the broadcasting industry.

The new catalogue is subdivided to cover speech equipment, remote amplifiers, speech input consoles, mixing panels, program equalizers, console desks, relay panels, turntables and accompanying reproducing group, and various types of monitoring and measuring equipment.

Designed to facilitate the easy selection of equipment, this catalogue includes 40 pages of valuable data. Copies of this catalogue are available from Collins Radio Company, Cedar Rapids, Iowa.

HEAVY DUTY RELAYS
Signal Engineering & Mfg. Co. of New York has just released a four-page data sheet covering their new line of heavy duty multiple arm relays.

Data has been presented covering basic design features, contact ratings, circuit arrangements and other pertinent information.

A copy of Bulletin 30 will be sent to those requesting it from Signal Engineering & Mfg. Co., 150-4 W. 14th Street, New York 11, New York.

SUPERIOR BULLETIN
A new catalogue, which replaces all of the previous publications by the company, has just been issued by The Superior Electric Company of Bristol, Conn.

Bulletin 150, as the new catalogue is designated, includes charts, circuit diagrams, and other data pertaining to Powerstat variable transformers, SECO automatic voltage regulators and Voltbox a.c. power supplies.

The material is presented in easy-to-read form to facilitate ordering the proper equipment for the job.

In addition to listing the equipment the company has in production, the bulletin offers engineering service on specialized problems faced by the manufacturer.

A copy of Bulletin 150 will be forwarded promptly to those requesting it from The Superior Electric Company, 713 Laurel St., Bristol, Conn.

Radio Controlled Flight
(Continued from page 27)

with a high-powered v.h.f. radio receiver which can filter out a single channel, or any of the ten audio-frequencies. The v.h.f. transmitter may be located either in a ground installation or a mother aircraft, or, in some installations, both.

Each of the ten audio-frequencies or tones, when filtered, actuates a relay which, in turn, accomplishes a distinct flight function. The drone's mission determines the variety and choice of functions which can be accomplished by radio in any particular set-up.

A control box installed in a jeep, or other ground station, supervises the takeoff of the drone until an airborne mother plane takes over. Either the ground station or the mother plane can control the drone up to a distance of 75 miles. However, effective control varies with the quality of radio reception.

In addition to its radio receiving set, the drone carries two television transmitters. One is trained on the instrument panel and the other on the outside atmosphere. The control pilot can, by flicking a switch, place himself in the position of a pilot in the drone. He can view the area in front of the drone from the "pilot's" seat, or examine the control panel when blind flying is necessary.

The television units in the drone contain an infinity-focus optical system and television camera pickup tube, plus the necessary sweep and electrical circuits for transforming the light waves from the viewed scene into equivalent video signals which modulate the transmitter. A conversion unit generates signals which synchronize the scanning of the mosaic screen with the sweeps of the reproducer tube at the receiver.

The drone's radio receiver actuates the relay mechanism which operates the camera lens stop and optical filter, to prevent "burning" the mosaic, and the optical heating system which prevents fogging.

The transmitter in the drone may

---

Olson's 2 Great Money-Savers!

OHM CHEST packed with 100 Insulated Resistors
This handsome Chest has twenty compartments — 10 in the base and 10 in a removable tray. Walnut finish; brass hinges and fastener. Contains 100 resistors stamped with resistance values, 5 ohms to 20 megs, 1/2 watt to 2 watts, color coded. Every size is popular. No war surplus resistors in this Ohm Chest!

$4.95

Free!

With each Ohm Chest ordered, we send our "Resist-O-Guide" free. Revolving wheels in color show all resistance values.

Panel Lamp Tool
With each Condenser Kit ordered, Rubber tool grips bulb for easy installation or removal in hard-to-get-at positions.

Condenser KITS
Sweet savings on seventy 600-V. By-Pass Condensers, made to rigid Olson specifications. Will withstand voltages higher than ratings. Worth much more than our low price!
Small size (approx. 1 1/2" long. 1 1/2" dia.) makes these units right for compact circuits. Long tinned copper leads. You get 70 Tubulars, as follows:

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Send for our free BARGAIN CATALOGS

Send me Ohm Chest with 100 Insulated Resistors in each, @ $4.95. (Resist-O-Guide free with each Chest.)
Send me __ Kit of 70 Condensers each, @ $4.95. (I will receive a Panel Lamp Tool FREE with each Kit.)

I enclose $_________. Order will be postpaid. Send my order C.O.D.
I will pay postage.

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ADDRESS ____________________________________________
CITY __________ STATE __________

January, 1947

137
be adjusted to operate on any one of the ten separate frequency channels between 264 and 372 mc. This permits the simultaneous operation of ten separate sets within the general area without interference. However, a different antenna unit is required for each of the ten operating frequencies.

The FM radio control receiving equipment on the drone permits ground-to-air or air-to-air control up to a normal range of 18 miles. However, by the use of an r.f. amplifier unit the effective range may be stepped up to 75 miles. The receiver-selector incorporates an eight channel audio filter selector circuit for discrimination between the various tones received. A relay unit passes control voltages to the automatic pilot from the receiver output.

Normally, the altitude of the drone is automatically controlled by alitmeter equipment installed for that purpose. However, the altimeter setting may be overridden, when necessary, by a special relay box.

The television receiving and reproducing system employed in the mother aircraft is a superheterodyne type receiver which amplifies the received signal and removes the video component from the carrier. It impresses this video signal on the grid of the picture reproducing tube, which in turn reproduces the scene viewed by the drone camera equipment.

This unit also generates the necessary horizontal and vertical deflection voltages for the cathode-ray picture reproducing tube. The scanning of the picture pickup mosaic screen on the drone, and the generating of sweep circuits for the picture reproducing tube on the mother plane, are synchronized by special pulses generated by the drone transmitter.

Closeup of jeep control station showing the control box in the foreground.
Ten different antenna units are supplied with each receiving set. They operate at spot frequencies within the frequency bank of 264 to 572 mc., and are located approximately 12 mc. apart. The antenna is gyro stabilized within the aircraft.

Operational and tactical use of the drone and other guided missiles is being subjected to a thorough evaluation by a group of highly-qualified specialists under the direction of Colonel Harvey T. Alness, commanding officer of the Army Air Forces 1st Experimental Guided Missiles Group at Eglin Field, Florida. It is his duty to subject to punishing tests new projects in the remote control field development of AAF engineers.

The following radio control and television equipment was used in the flight from Hawaii to the United States in Operation Remote:

a. Installed in drone aircraft:
   (1) AN/ARW-1 Radio Control Receiver
   (2) AN/AXT-3 Television Transmitter

b. Installed in mother aircraft:
   (1) AN/ARW-18 Radio Control Transmitter
   (2) AN/AXR-1 Television Receiver

The AN/AXT-3 differs from AN/AXT-2 in that it contains an additional optical system and conversion unit for televising flight panel data. All AN/AXT-3 sets were created through modification of AN/AXT-2 sets.

The U.S. Army metascope, used to detect the presence of infrared light. Small enough to be held in one hand, this instrument was used by paratroopers to detect the infrared radiation which signaled landing spots. A small lead-sheathed compartment in the base of the metascope, containing radioactive material, furnishes the power source for the device. When a control switch on the outer hull of the unit is set on "charge," energy from the radioactive material is used to charge a viewing screen which is thus made sensitive to infrared radiation. A periscope-like mirror with an infrared filter, located in the cover of the unit, is raised to pick up the infrared light.
in Eastern U.S. A Chinese station heard mornings on the West Coast on approximately 6,050 may be one of the new U.V.C. transmitters. (Dilg)

XTPA, 11,695, Canton, is coming through again early mornings to the East; appears to use only Chinese in programs, but does announce call in English at times.

Since China has gone back to standard time, XNCR, 7,520, Yanan, is scheduled 7-8:30 a.m.

XORA, 11,695 (varying), Shanghai, has poor signal on West Coast this winter. (Dilg) Was fair to good early mornings here in West Virginia during later summer and early autumn, but has been inaudible lately.

CZECHOSLOVAKIA — Prague’s OLR4A, 11,84, is being heard opening at 3 p.m. daily; starts English program at 3:30 p.m., with the news being read at 3:45 p.m.; appears to use French at 4 p.m., Spanish at 4:30 p.m.; uses Dutch later on and usually identifies in German around 5:30 p.m.; the National Anthem (“Kde Domov Můj”) follows and the carrier leaves the air at approximately 5:35 p.m. (Havlenna) Sends fair to good signal here in West Virginia.

In the nightly North American beam, 7-11:30 p.m., OLR5A, 15,230, has a fair to strong signal; English news is heard most evenings, around 7:07 p.m. (Casey) I note that more fluent English is being broadcast.

DENMARK—OFZ, 9,520, Copenhagen, is scheduled 12:30-5:30 p.m.; OJH, 15,520, is heard on same schedule, but Sundays only in English. (Fris) The new 50-kw. short-wave station is to commence operations early in 1947. (Cushen)

DOMINICAN REPUBLIC—Glynn Moss, Ontario, sends along this information secured direct from a Spanish employed at HIST. This station is located in Puerto Plata and is called “Broadcasting Tropical”; operates daily, 10 a.m.-2 p.m. and 4-7 p.m., except on Thursdays when the evening transmission runs to 9 p.m. Frequency is 6,175.

ENGLAND—Latest official listings of the BBC’s North American service are: GWH, 11,80, 5-6 a.m.; GSP, 15,31, 6-8 a.m.; GRP, 18,13, 8-11:15 a.m.; GRP, 18,13, 11:30 a.m.-4:15 p.m.; GSP, 15,31, 4:15-7:45 p.m.; GWH, 11,80, 4:15-9:45 p.m.; GSC, 9,58, 4:15-11 p.m.; GHR, 9,825, 5-11 p.m. and GEL, 6,11, 7-11 p.m.

GSS, 26,100, is reported to be carrying the African Service, afternoons.

European Service of the BBC is still being heard in the United States afternoons and after midnight on such frequencies as 7,120, 7,230, 7,260, 7,320.

FINLAND—From this country, English news is being heard nightly at 7:25 p.m.; has Finnish between 7:35-7:45 p.m. sign-off; is heard in East on OIX4, 15,190, but woman announcer says OIX2, 9,505, is also being used at
the time of this beam to America.

France—Recently, Radio Paris was heard on 9.94 in the evening North American beam, beginning at 9 p.m. with English news, but at last report was back on 9.550; 11.845 is in parallel and is the better signal. (Balbi) Appears to have dropped the 10:30 p.m. English news relay. (Cooper)

French Indo-China—Radio Saigon’s evening transmission on 11,778 is now heard 6:7:15 p.m. (Balbi) I believe this is entirely in French. A good signal is heard from this station at 5:30 a.m. when English news is given. According to Swedish observers, the 4,810 transmitter is heard there well at 5:30-6 a.m.

Rex Gillett, Australia, reports that after a short period on about 9,580, Hanoi is again being heard back on 9,600; at the conclusion of English news about 6:15 a.m., the station announces, “You have just been listening to the day’s news broadcast from Hanoi, Indo-China.” Later in the day, Hanoi is heard in Australia on 11,900; modulation of both outlets is always poor.

French West Africa—Radio Dakar, FHE3, heard signing on at 1:45 p.m., usually is blocked by WLLS, 11,710, when latter takes to the air at 2:15 p.m. (Harris)

Germany—Leipzig, 9,680 (listed as 9,688), “Mitteldeutscher Rundfunk,” is heard in Denmark with a powerful signal, 8 a.m.-2 p.m. and between 4-6 p.m. (Friis) “Berlin Rundfunk,” 6,072, has German news between 11:45 p.m.-12:10 a.m.

DTCY, the 100-kw. American short-wave station in Munich, 5,3025, is still testing each Monday, Wednesday, Friday at 9:30 a.m.; address, The Military Government Station DTCY, A.P.O. No. 170. (Skog)

BFN, 7,290, Hamburg, carries same program as AFN, 6,078, Saturdays, 6-7:20 p.m.; should not be confused; BFN often relays BBC’s GPF. (Harrison) In British Columbia, is heard opening at 1 a.m., relays BBC’s “7 o’clock news” at 2 a.m.; good signal. (Cooper)

Gold Coast—ZOY, announcing as on 61.04 meters (probably is 4.915), Accra, is heard in South Africa daily from 12 noon to 1:30 p.m.; relays BBC news from London at 1 p.m., followed by local news and schedules. (BSWL)

Guadeloupe—“Radio Guadeloupe,” 5,985 (varying), was recently picked up at 7:35 p.m., still going at 8:45 p.m. (Bromley)

Guam—According to Australian and New Zealand sources, it is probable that WXLI, “Radio Barragada,” 1380 kcs., using 325 watts at present, will add short-wave facilities, in addition to becoming the main U.S. outlet in the Western Pacific area.

Guatemala—TGWA, 15,170, has fine signal now, evenings. (Harris)

Holland—PCJ, 15,220, Hilversum, appears to have daily morning broadcast beginning at 8 a.m. (Grivakis) This is probably beamed to Netherlands East Indies. PCJ will celebrate its 20th anniversary this year.

Hong Kong—According to a recent DX broadcast from Radio Australia, ZBW is now operating on 9,540; West Coast monitors report the frequency rather as about 9,538; poor signals are heard some mornings here in the East, around 6:30-6:45 a.m.

India—VUDY, 6.19, Delhi, now signs off at 10 a.m., is audible on West Coast to around 11 a.m. (Balbi) The 15.16 frequency is heard well both East and West Coasts mornings; some days has surprisingly good signal here in West Virginia at late as the 9:30 a.m. English news period. The 8:30 a.m. English news is heard well some mornings on 11,850.

Calcutta’s 7.21 is used in parallel with Delhi’s 15.16, 11.87, and 9.95, mornings; English news is at 7:30 a.m. Madras, on 7,255 (listed), also carries this 7:30 a.m. news. (Balbi) Calcutta goes down to the 3-megacycle band at 8 a.m. (Dilg)

Bombay is using 7.24 mornings instead of 9.63; carries English news at 7:30 a.m.; moves to 4,880 at 9:15 a.m. (Dilg)

Iran—Radio Teheran, EPB, 15,100, can be heard some mornings in the eastern U.S. around 6:15 a.m. when it has English news; identifies in French at 7 p.m. as “Ici Teheran,” then continues with French news; I recently heard the station leave the air abruptly at 7:30 a.m.

Swedish observers report EQP. 6,155

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(varying), is heard there around 11 a.m.

IRELAND—Bertram Podall, Vermont, writes that in April of last year, following directions given on a broadcast of Radio Eireann, he wrote to the Consulate General of Ireland, Chrysler Building, New York City 17, and received a letter from that office stating that his report was being forwarded to Dublin and that he would hear from there. In two months he did receive a letter thanking him for his report "and to confirm your reception of the 4th of April." The verie came from Office of the Engineer-in-Chief, Department of Posts and Telegraphs, The Castle, Dublin.

ITALY—Radio Italia, 9.630, Milan, is being heard in Denmark, 1-6 p.m. (Friis) Comes in to West Coast well by 5 p.m.; has bird identification; Italian news is at 6 p.m., just prior to close; has occasional identification in English. (Cooper) Is heard on 11.810 afternoons in East, has English period between 1:20-2:10 p.m.; announces 9.630 as in parallel. (Grivakis)

JAPAN—JLP, 9.605, Armed Forces Network, Tokyo, off since November 1 (Bilibi) 1 recently heard JVU 11.845, Tokyo, in contact with San Francisco between 7-8 a.m., excellent signal.
The Home Service from Tokyo is heard early mornings "back at the old stand" on 7.288, 7.285, 9.560, 9.505, 4.930, 4.910, and others. (Digg)

JAVA—Rex Gillett, Australia, reports that a recent letter received from Lieut. W. Werner, formerly of Radio Balikpapan, Dutch Borneo, stated that a new 100-kw. transmitter has arrived in Java from the United States and that a suitable site in either Batavia or Bandoeng was being sought. Whether this is for shortwave or BCB use was not indicated.
The Indonesian operating on approximately 12,002 was heard by Australians to announce location as Djokjakarta; was heard at 5 a.m.; signals in Australia are only fair; is heard in certain parts of the U.S. also, particularly in the Deep South.

From South Africa, Mervyn Laubscher reports the Indonesians on 8,000 is heard as early as 8:30 a.m. with weak signal; at 9:30 a.m. announces program for Dutch Forces and has requests until 11:30 a.m.; announcements are mostly in Dutch, but at 11:30 a.m. sign-off a man announces in English, "This is the Official Dutch Station in Bandoeng"; further English announcements are quite irregular, sometimes they announce frequencies but usually just say that they're signing off and wish everybody "Goodnight." Time in Bandoeng at 11.30 a.m. EST is given as "midnight." Announced wavelengths of 99.5 and 37.5 meters (3.015 and 8,000, respectively).

LUXEMBOURG—Radio Luxembourg, 6.092, is heard with an English session between 3-3.30 p.m. (Milne)

MADAGASCAR—Radio Tananarive, 6.128 and 6.063, is heard on West Coast most mornings; at times, however, only the 6.063 transmitter is audible. (Digg)

MALAYA—Singapore's 15.275 is heard well early mornings in Colorado. (Woolley) The 15.300, 15.275, 11.735, and 6.77 frequencies open now at 3:45 a.m.; English periods are at 3:45, 6:30, 7:30, and 9 a.m.; oriental type sessions are broadcast during the intervening times; the station closes down at 9:30 a.m. (Gillett, RADIO CALL) "The Voice of Britain" period.

Kenneth C. Prince, manager of the 1947 Radio Parts & Electronic Equipment Show (left) and Jack Berman, of Shure Brothers, show president, inspect a floor plan of the exhibit hall of the Stevens Hotel in Chicago where record crowds are expected to assemble to view new radio components. Peggy Skeffington of the Show staff explains display arrangements. Drawing for exhibition space took place in N. Y.
appears to be scheduled for 8:30 a.m.
MANCHURIAN—August Balbi, California, reports a station on 11.77, heard from 9 a.m., that may be HTYC, CHB tuned on Harbin (Hsinking), listened on 11.775 with 20,000 watts. Manchuko has been heard mentioned many times.

Australians report a station tuned on 7.273 at 8:30 a.m. with a news service. A Chinese dialect may be heard in this country; such cities as Harbin and Hsinking are mentioned frequently; music is broadcast prior to 8:30 a.m. (Gillett)

MAURITIUS—Reports from several quarters appear that a s.w. station is operating from this island on the 41-meter band have not been confirmed. A careful check by Mervyn Laubscher, Johannesburg, South Africa, at my request, did not reveal a station operating from Mauritius. Mr. Laubscher reports, however, that his failure to pick up the station may have been because of bad static interference on that band; he will check further. It is probable the station reported was an amateur.

MONACO—Radio Monte-Carlo, 6.130, heard signing on at 1:30 a.m. with musical selection; then woman announces, 'Ici Radio Monte-Carlo'; musical program follows (Sutton) Is heard in England at 3:30-4:30 p.m.; badly QRM'd; uses single gong; woman announcer; French only; frequency appears to be higher than listed, probably about 6.135-40. (Harrison)

In a verification letter to a Scandinavian correspondent, Karl-Ake Bergstrom, Radio Monte-Carlo officials wrote: 'We do not own our complete equipment yet, but we hope that the final installation will take place in 1947. Our transmissions are probably not heard very well at present because we have only one long-wave transmitter of 10 kw. on 410 meters and one experimental short-wave station of 30 kw. on 490 meters. Our transmissions take place daily at 1:30-3:30 a.m., 6-8 a.m., and 1-5 p.m. We hope to be in a position to give better service starting in 1947 when our complete installation will be finished. We will have a short-wave outlet of 25 kw. at the beginning of 1947 and our long-wave station will run with 120 kw., probably around July, 1947.' A descriptive booklet on the Principality of Monaco was enclosed. The address is Administration-Direzione, 16, Bd. Principesse Charlotte, Monte Carlo, Monaco.

MOZAMBIQUE—A station heard signing on at 10 a.m. on approximately 4.910 is believed to be Mozambique; weak signal, but should improve during winter months. (Dilig)

NEW CALEDONIA—Radio Noumea, 6.210 (listed as 6.208), now gives power as day time signal. (Gray) Operates around 2-4 or 5 a.m.

NEWFOUNDLAND—VONH, 5.970, St. John's, is heard well at 8 p.m. in English news cast.

NEW ZEALAND—ZL77, 6.715, Wellington, appears to have left the air possibly in preparation for advent of the long-promised new s.w. transmit

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Building, Manila, Philippines. Mr. Laubser says he finds this station audible only for few hours prior to the 11 a.m. sign-off, strength is weak to fair; reception in July, when he sent in his report, was much better than it has been this winter. In New Zealand, KZRH is a good signal from 4 a.m. (Milne)

KZRM, 9.590 (listed as 9.570), is being heard in Denmark starting at 10 p.m. (Friis)

P07-1, Radio Polskie, 6.100 (varying), has English news now: it 3:15 p.m., according to British sources. Some reporters still list the time as 3 p.m., however.

PORTUGAL—CSX, 6.374, Lisbon, has a short session between 3:50-4:15 p.m. (Milne) I believe English is scheduled for that time.

SIAM—HSPP, 5.990, Bangkok, signs off at 9:45 a.m.: program is mostly in Asian languages. (Dil) Reporters in Australasia say some English is heard.

SOUTH AFRICA—Johannesburg IV, 6.095, is heard in Sweden at 12 noon. (Night-Owl) Capetown, 5.877, heard 11:45-12 a.m. (Sutton) at BBC news relay from London at 12 midnight. (Sutton)

SWEDEN—Signals are improving greatly from SBT, 10.55, Stockholm, in the Northern America network (English and Swedish), 10:10-11:30 a.m.; after usual chime interval signal, continues in Home Service, has English again around 12:35 p.m., leaves the air usually at 1:15 p.m.; the 10.780 frequency (SDB-2) is good in Home Service all afternoon to around 5:45 p.m. sign-off.

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S W I T Z E R L A N D—HER3, 6.165 (listed as 6.166), Berne, is heard leaving the air at 5:32 p.m. (Bromley) HER4, 9.535, not HE14, 9.539, is being used by Berne between 12:21-1:30 a.m., with HER3, 6.165, in parallel; opens with setting-up exercises; has German news at 12:45.

TAHITI—FOF6A, 6.980 (appears higher, about 6.99), Papeete, Radio Club de Tahiti, appears to be scheduled 10:11-14:50 p.m. or to 12 midnight, irregularly, Tuesdays and Fridays; uses French marching song (not "La Marseillaise") prior to closedown which is usually without announcement. (Dilg) Heard 10 p.m.-12 midnight a recent Saturday. (Crosston)

TANGIER—The station on approximately 6.190, heard in England between 3-5 p.m. (not complete schedule), uses English, Spanish, French, and Arab languages; identifies about every half hour in English as "Radio International, broadcasting from Tangiers." Usually has English at 4:45 p.m. but no news has been noted; poor signals. (Harrision)

TURKEY—TAP, 9.465, Ankara, is still reported on Sundays with the "Postbag" program, and to England, also in English, on Thursdays and Mondays, for fifteen minutes, all these periods beginning around 4:30 p.m. (Sternfelt) Has bad CWQRM here in West Virginia. On the same frequency is heard weakly some days at 12:45 p.m. in regularly-scheduled English news period; now coming through to West Coast again. (Cooper)

U.S.S.R.—Komsomolsk, 9.565, signs on at 9 p.m., off at 12:30 a.m., and back on at 3 a.m.; has English news now at 4 a.m. (Balbi) Some days Moscow can be heard in English beam to Britain at 12 noon on several frequencies in the 19-m. band (15.385, 15.412, 15.440). (Harrision)

Although not announced, a Russian transmitter is being heard mornings on 11.720, from around 7 to 8:15 a.m., relaying Moscow's beam to North America; frequencies announced at 7:15 a.m. recently were 11.63, 15.18, 15.36, and 17.82. The 7 o'clock newscast is followed by Review of the Soviet Press and then a commentary; further news is heard at 8 a.m.; at 7:45 a.m. they announce addition of 9.565, 11.89, and 15.44.

New frequencies in Moscow's Home Service, heard after 10 p.m. on West coast, include 9.715, 15.23, 15.32, 11.745, and irregularly, 11.87. (Balbi)

Excellent signals are heard in England from Moscow on 6.160 at 5 p.m. when English news is presented. The transmitter on 6.020 (probably Kiev) is heard in European languages around 4-5 p.m.; Kremlin clock is heard striking at 5 p.m.; excellent signal. (Harrision)

Tiflis, 11.960, is heard 1-2 a.m. or later and also at 1-15 p.m. all Russian; Petropavlovsk (Kamchatka), 6.070, is heard on Sundays, 1-3:35 a.m., in British Columbia blots out Toronto; mostly music. (Cooper)

Kiev, 11.72, is being used, yet in evening transmission to North America, 6:20-9 p.m., in spite of announcement of operating on 6.020; between 9:9-15 p.m. sign-off, uses Yiddish. Frequencies announced as used between 6:20-7:30 p.m. to North America include 7.26, 11.89, and 15.73; only the 7.26 one is audible in New York; transmitters announced for 6:20-9 p.m. are 7.24, 7.30, 9.48. (Beck) Some evenings they announce and are heard between 6:20-7:30 p.m. on 15.71.

U.S.A.—This interesting comment regarding reception of American short-wave broadcasters along the eastern coast of South America comes from Charles Mohr, written from Sao Salvador, Brazil: "I have been observing a phenomena the past few weeks..."

"No, you always interrupt me."
which I have never heard about before. It may have been previously recorded, but if so, it has been unknown to me. From my observations, the beam of American short-wave stations is increasing in the number of degrees from 0 to 360. Stations on the East Coast of the United States (WRUA, WRUL, for example), beam ed to Europe, have been heard fairly well near the end of October, whereas in September they were absolutely silent. Stations on the East Coast (such as WLWO, 11.790, for instance), beamed to Latin America, are heard with much poorer signals on the east coast of South America than they were during September. Stations on the West Coast of the United States (such as KNBX, 15.250, KWIX, 17.760), with main beams to China and Japan and with reciprocal (plus 180°) beams, which were heard with fair signals on the southern coast of Brazil, are now unheard. San Francisco stations beamed on Central and Southwest Pacific (KGEI, 15.130, and others), with reciprocal ordinarily over the eastern United States or the Caribbean, are being heard very well now. On the return trip to the United States, Mr. Mohr promises to let us know of any further developments in his observations regarding signals of U.S.

VATICAN—Listeners in England report HVJ, 15.100 (listed as 15.095) and 9.660, has English news at 9 a.m., and on 5.970 (listed as 5.971) at 1:15 p.m. BSWL) The 6.190 transmitter is heard in foreign languages during the afternoon to about 4 p.m.; some days the 9.571 transmitter has a talk in English at 2:30 p.m. (Harrison)

WESTERN SAMOA—2M16, 7.700, Apia Radio, which tested in early autumn to 12 midnight-1:05 a.m., has not been heard lately. (Balbi)

YUGOSLAVIA—Radio Belgrade, 6.150, is heard 1-6 a.m.; the 9.420 (listed as 9:418) frequency is heard between 12 midnight-2 a.m.; both have fair to good signals. (Croston)

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The Electroplex
(Continued from page 39)
feedback between the plate and grid of V1a through C7 and R15. The feedback is most effective for the higher frequency components of the transient negative voltage which is applied to the grid when the control switch is opened at a time when V8a is conducting. The circuit is thus rendered relatively insensitive to the transient and tends to wait until V8a begins conduction, then terminates the dash and returns in the normal manner for correct timing.

Condenser C6 connected between the fixed contacts of the control switch remedies a slight lag in response when the control switch is moved to the dot position.

A different type of relay may be used, provided that the series resistance of the relay coil and R8 totals 7500 ohms. The plate current of V1b is about 7 milliampere but the relay should be able to close on 3 milliampere.

The monitoring oscillator uses the amplifier section, V1c, of a combination rectifier-amplifier tube. It is a blocking oscillator such as is used in sweep generators for radar and television equipment. It produces short pulses separated by time intervals much longer than the pulses. The output signal therefore has a very high harmonic content, resulting in a distinctly musical tone.

The fundamental frequency of the oscillator is dependent primarily on the discharge time of the grid condenser, C8, and is practically independent of the resonant frequency of the tank circuit. A potentiometer, R7, controls the positive bias to which the grid leak, R8, is returned, thereby controlling the frequency of the audio tone. The fundamental frequency is variable from about 400 to 6000 cycles per second. A frequency control potentiometer, R9, is mounted at the upper right-hand corner of the front panel.

Condenser C9, not ordinarily found in blocking oscillator circuits, was found necessary in order to lengthen the pulses which otherwise were so short that their energy content was very low. The result was greater audio output power and a more pleasing tone quality.

The oscillator transformer, T0, is a universal midget output type which has six taps on the secondary winding. It is connected to provide an impedance transformation from 8000 ohms plate-to-plate to voice coil. The oscillator tube, V8a, is rather lightly loaded and draws only about ten milliampere plate current. The oscillator is a surprisingly efficient noise-maker, the volume control being normally set at about one-third of maximum. The volume control, R9, is mounted at the upper left of the front panel.

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ing circuit and the oscillator are somewhat dependent on the plate voltage, it is desirable to maintain a constant load on the power supply. For this reason, the oscillator runs continuously with the output being keyed by short-circuiting the voltage through the back contact of the keying relay, RLk. This arrangement affects stable and clickless operation of both the oscillator and the timing circuit.

**Power Supply**

The power supply circuit is rather conventional and requires little comment except to point out the advantage of connecting the pilot light in series with the power line. It serves as a line fuse as well as an on-off indicator. Also, it indicates whether the audio oscillator is functioning properly. If the brilliance of the light changes when the oscillator is keyed, it is an indication that the oscillator is too heavily loaded and/or is not blocking. To reduce the loading, the output connection should be made to a lower impedance tap on the secondary winding of the oscillator transformer. The key has been found to operate satisfactorily from both a.c. and d.c. 115 volt power lines.

**Construction**

The arrangement of parts, as illustrated, is governed primarily by the desirability of minimizing waste space in order that the instrument may be as compact as possible. Fortunately, since the keying frequencies are less than 20 cycles, the layout problem is not complicated by consideration of stray capacitances and the leads may be as long as is expedient. However, leakage conduction through insulation or condensers must be minimized in order to prevent faulty operation. The condensers should be of the best quality and have a low leakage conductance.

The control switch was made from parts of an old "bug" and is mounted upside down on the bottom of the chassis. Both of the fixed contacts are mounted on a strip of lucite which is visible in the photograph. The lucite strip is secured in place of the arm which had previously supported the adjustment stop for the dot side of the old "bug."

The potentiometer R5 and R6 are mounted on brackets secured to the chassis and their shafts are sawed off and slotted flush with the right-hand side of the cabinet where holes are provided for their adjustment. From the outside, these adjustments are inconspicuous. A looking like ordinary screw heads.

The keying terminals are mounted on the back of the cabinet. The back and bottom of the cabinet are perforated with ¥" inch holes to provide ventilation. Ventilation holes are also drilled in the chassis wherever space can be found for them. The heat within the cabinet induces an adequate flow of air in through the bottom of the cabinet, which rests on rubber cushions; this helps to prevent overheating of the cabinet. The condensers should be mounted as high as possible in order to reduce their capacity effects. A minimum of condenser leads and hence a minimum of leakage is desirable.

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bumper feet, and out through the holes in the back.

The smallest available parts were used throughout. As a result, the cabinet occupies about the same table space as the "bug" which it replaced. The dimensions of the cabinet are 6 inches long by 3 inches wide by 5 inches high.

The few adjustments of the control switch mechanism may be reached conveniently by unscrewing the four bumper feet which secure the bottom of the cabinet.

Adjustment

The adjustment of the key comprises setting potentiometers \( R_1 \) and \( R_3 \) for the correct, or desired, dot and dash lengths. To insure the correct mark-to-space ratios of 1 for dots and 3 for dashes, the best method is to connect a volt-ohmmeter across the keying terminals. Switch the meter to the "ohms" scale. Set the speed control at about 1250 per minute. Then hold the control switch in the dot position and adjust \( R_1 \) until the meter reads exactly half-scale on any "volts" range. Now hold the control switch in the dash position and adjust \( R_3 \) until a deflection of full scale is obtained. No further adjustment of \( R_1 \) and \( R_3 \) will be required as the mark-to-space ratios will remain substantially constant for all settings of the speed control. The relays should be set to minimum space between the contacts and for very light spring tension. Also, there should be at least 1/4 inch space between the relay pole piece and the armature when the relay coil is energized.

The nominal speed of transmission may be determined by counting the number of dots per second and multiplying by 2.5 or by multiplying the number of dashes per second by 3. The speed control may thus be calibrated directly in words per minute as shown in the photograph. This nominal speed is attained when the operator properly executes the spaces between letters and dots and dashes.

Modifications

It seems desirable to indicate a few modifications which appear feasible, though not confirmed experimentally. For example, the plate of \( V_1 \) might be coupled to the grid of a transmitter keyer tube which is normally biased on cut-off. Beyond cut-off the voltage on the plate of \( V_1 \) is of approximately rectangular waveform in accordance with the code signals being transmitted, with about 45 volts difference between maximum and minimum amplitude. The coupling circuit should include a blocking condenser of about 0.2 mfd and the grid leak of the keyer tube should be at least one megohm. The 45 volt signal from \( V_1 \) must be sufficient to drive the grid of the keyer tube above cut-off voltage and should also turn the keyer tube on and off in response to the code signals.

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**Operation**

The experienced operator will become proficient in the use of the Electrolux after one or two hours of casual practice. Numerals, such as 5 and 0 are easiest to send at the start and illustrate well the advantage of the key. A single test word should be selected and transmitted repeatedly at varying speeds until familiarity with the action of the key has been acquired. The basic rhythm established by the timing circuit is quickly picked up by the operator and he is soon transmitting almost perfectly timed code signals with maximum readability and minimum effort.

The beginner should set the speed control for at least ten words per minute even though he may leave much more than normal spacing between letters. As his skill improves, he will increase his speed by closing up the gaps between letters. Both he and his tutor will be pleasantly surprised at the accuracy of his sending and his rapid progress toward higher speeds.

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**Practical Radio Course**

(Continued from page 45)

non-linear element in single-electrode input type mixers in superhetodynes receivers designed to operate in the u.h.f. and s.h.f. ranges that are beyond the capabilities of even diode tube mixers. These miniature crystal rectifiers, which measure only $\frac{1}{4}$ inch in diameter by $\frac{1}{2}$ inch in length, are really wartime improvements over the Galena crystal detectors of the 1920 era, and are now made in compact, fixed form. Without them, present-day microwave and radar receivers would be impossible to construct.

Two types of these crystal rectifiers, both illustrated in Fig. 2, are in use. The germanium type constructed as shown at A contains a very small piece ($\frac{1}{16}$" square and about .025" thick) of crystal material consisting of a carefully controlled mixture of germanium and a small amount of tin. This is soldered to one lead wire. The exposed surface is highly polished so that the point of the springy tungsten wire cathode may be readily moved about until a sensitive spot is found, and then the unit is sealed. The theory which has been proposed to explain the operation of a crystal rectifier is too complicated to justify going into detail here. Briefly, the soldering of the crystal to the copper lead wire forms a large contact area, the tungsten contact point a small contact area and since, in certain crystals, electrons have been found to move more readily in one direction across such a junction than the other, rectification occurs. The outside case
is marked "plus" and "minus" to indicate that when the side marked "plus" is connected to the positive terminal maximum current will flow. The tungsten wire is at the end marked "plus.

The germanium crystal rectifier is rated for operation up to 100 mc. but it can be used to a somewhat higher frequency. Its cathode-to-anode capacitance is only 3 μfd, so it is suited for use in FM and television receivers which have high intermediate frequencies. For operation into low-resistance loads, this rectifier is said to be superior to vacuum tube diodes.

The silicon type, constructed as shown at B, employs a silicon crystal and a longer tungsten wire cathode. The silicon type crystal rectifier will operate satisfactorily at higher frequencies than will the germanium type, but it must be operated at lower-current and voltage levels. One unit (Sylvania No. 1N21B) is recommended for 3000 mc. operation. Another (Sylvania No. 1N23B) is recommended for 10,000 mc. operation. Still another (Sylvania No. 1N26) is designed for 25,000 mc. operation.

Both the germanium and the silicon type crystal rectifiers shown in Fig. 2 are very rugged mechanically.

**Operation of Crystal Rectifiers as Mixers**

The treatment that has been presented here for the diode tube as a mixer applies in part to crystal mixers also. The circuit arrangement used for them, see Fig. 3, is also similar to that employed for the diode mixer, the crystal unit being substituted for the diode.

Like the diode mixer, the crystal mixer will convert in both directions, even though the ratio of forward current to back current may be as high as 1000 to 1 in some types. This action is minimized by suitably platting the crystal element before it is embedded in its fusible alloy mounting.

Because no frequency-conversion gain is obtained with them (actually a conversion loss of approximately 10 db. is sustained when they are employed), crystal mixers are widely used only in those receivers designed for operation on the u.h.f. and s.h.f. ranges where conventional forms of vacuum tube mixers and frequency converters would fail to operate satisfactorily. For this type of service they have no competition at the present time.

Due mainly to the fact that the capacitance existing across the actual crystal element acts as a bypass to the high-frequency voltage which would normally appear across the contact junction, the conversion efficiency decreases with increase in frequency. In the compact, well-designed, completely-enclosed cartridge type units now available (see Fig. 2), the internal structure has been designed to produce an exceedingly low amount of shunt capacitance. For example, the cathode-to-anode capacitance of the Sylvania 1N34 germanium crystal shown in Fig. 2A is only 3 μfd. Because its capacitance is very low, the crystal rectifier's electrical time constant is very small.

Also, the resonance frequency of the crystal rectifier unit must be kept well above the highest operating frequency that will exist in the mixer circuit. When the series resonance frequency of the crystal unit is approached, the series resonance frequency is made high by proper design that reduces the inductance of the contact lead and the capacitance across the crystal element.

Crystal rectifiers are not as uniform in operating characteristics as are diodes. Also, when used as mixers they must be protected from strong signals or r.f. fields that will set up sufficiently strong currents to damage the junction between the contact and the crystal. Consequently, they are unable to handle extremely high signal voltages and electrical fields that will protect from them, otherwise burning of the sharp cathode contact point will result.

An important advantage of well-designed crystal mixers besides their ability to operate at very high frequencies, is that they have a high signal-to-noise-ratio. Also, the fact that either or both sides may be operated above ground by any reasonable potential is a distinct advantage over the tube diode for many uses. Then
too, they require no heater or plate supply, so the possibility of hum is reduced.

The tabulation (Table 1) has been prepared to classify the various types of mixers and converters discussed in the last seven articles of this series, and to summarize pertinent information concerning the operation of each type. Also, the particular article of this series in which each type was discussed, and the illustrations in that article which refer particularly to it, are listed for convenient back-reference in the right-hand column.

This concludes our discussion of frequency conversion. The intermediate-frequency amplifier will be studied next.

(To be continued)

Crystal Diode Applications
(Continued from page 43)

screws to hold the disc in place. Drill a ¾” hole in the other end of the tube shell and insert a grommet.

In the disc, which can be made of phenolic, polystyrene, or lucite, a banana plug is mounted for a probe. A 4-40 bolt is mounted off center on the disc to serve as a ground for the crystal diode, the condensers, and resistor. The probe in Fig. 1 was to be used at frequencies above 100 kc so two 100 micromicrofarad Ceramicon condensers were used.

If audio frequencies are to be measured, a larger condenser would be necessary, as the effective impedance of the diode is lower than a tube diode. If this is kept in mind, the probe can prove quite useful. It can be plugged into the d.c. voltage jacks of your volt-ohm-milliammeter and will read peak a.c. volts. Provided it does not seriously load a circuit, it will measure a.c. voltages up to 100 megacycles.

With the 100 micromicrofarad condensers eliminated and a 1 microfarad condenser substituted, the meter will read audio frequencies accurately. The average volt-ohm-milliammeter uses a copper oxide rectifier for its a.c. ranges, which does not accurately indicate voltages above several thousand cycles. The crystal probe converts a volt-ohm-milliammeter into an audio output meter which is independent of frequencies. Remembering that the input impedance is in the order of several hundred thousand ohms, the readings would be reasonably accurate.

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General Electric's recently completed 130-foot steel tower located in the Helderberg mountains 12 miles from Schenectady. The structure of the top of the tower contains antennas, transmitting and receiving apparatus for the company's experimental microwave two-way radio relay network to operate between New York City and Schenectady as a carrier for television and FM radio programs, facsimile and business machine circuits. Other such relay towers are now under construction.

And a dipole antenna, constitutes a simple field strength meter for measuring field strength and antenna patterns. Substitute a pickup coil for the antenna and it becomes a handy resonator for uhf oscillators or transmitters. Being inexpensive and requiring no power, it would be very useful in portable mobile equipment—for instance, in a portable transmitter-receiver, the diode could be used as follows: Mixer or first detector in the receiver; second detector in the receiver; a.c. rectifier in the receiver; rectifier or a.f. modulation meter in transmitter; rectifier in r.f. tuning meter on transmitter.

These five functions would normally have to be done with five diode tubes and, so, in the case where power is at a premium, the crystal would prove quite a battery saver.

In pulsed circuits, the crystal diode is also useful. It is here that we may make use of the fact that it provides a diode, together with its own load resistor. Useful, also, is its low forward resistance. For instance, if we have a piece of gear which is keyed off with a positive pulse but whose operation is erratic if the pulsing source contains even a very small amount of overshoots, then a crystal diode connected across this pulsed input will short out any negative going overshoots but will easily pass all positive pulses. Its back resistance, in the order of several hundred thousand ohms, constitutes the grid resistor of the input tube and, thereby, saves a part. It may, likewise, be used in d.c. restoration circuits whose resistance is not over several hundred thousand ohms.

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General Electric’s recently completed 130-foot steel tower located in the Helderberg mountains 12 miles from Schenectady. The structure of the top of the tower contains antennas, transmitting and receiving apparatus for the company’s experimental microwave two-way radio relay network to operate between New York City and Schenectady as a carrier for television and FM radio programs, facsimile and business machine circuits. Other such relay towers are now under construction.
Within the Industry

**Leslie G. Thomas** has recently been elected vice-president in charge of manufacturing at Solar Manufacturing Corporation, of New York.

Mr. Thomas will have complete supervision of production at Solar's plants in Chicago, Bayonne and North Bergen, New Jersey. He has had extensive experience in the various manufacturing phases of the radio parts industry and until recently served as vice-president and works manager of International Resistance Company of Philadelphia.

**Norman A. Koetke** has been added to the executive staff of the National Electronic Distributors Association's national office.

Mr. Koetke, who brings to the association a wide range of experience, will assist the executive secretary, Louis B. Calamaras.

The addition of the new staff member will permit an increase in the services rendered by the Association to its members. A monthly publication will be prepared for members to supplement the regular bulletin service now offered. Mr. Koetke's presence in the national office will release Mr. Calamaras and permit him to attend chapter meetings, visit manufacturers and appear before representative groups.

**Joseph L. Collins** has been appointed chief engineer of the Aerovox Corporation of New Bedford, Massachusetts.

Mr. Collins previously headed the Electolytic Engineering Division and prior to that time was in charge of Electolytic Engineering, *Sprague Electric Company*.

**Samuel Lubin**, formerly a member of the new development section of the Technical Standards and Testing Laboratories of REA, has recently joined the field engineering staff of Sprague Electric Company of North Adams, Massachusetts.

Mr. Lubin will be stationed in Washington, D.C. in charge of contacts with all government agencies and laboratories, including the Navy Department, Signal and Air Corps and the Departments of the Interior, Commerce and Agriculture.

During the war Mr. Lubin served as transition engineer of the Radio Research Laboratory at Harvard University. From 1932 to 1939 he was managing director of International Radio Ltd. of Tel Aviv, Palestine, representing American firms in North Africa and the Near East.

Mr. Lubin received his engineering training at Northwestern School of Engineering, George Washington University, Washington, D. C.

**Don E. Corson**, well-known in the radio parts field, has recently been appointed to the post of manager of the Special Products Division of Solar Manufacturing Corporation.

Before joining Solar, Mr. Corson was associated with Aerovox Corporation, in the capacity of sales manager of the Power Division and Cornell-Dubilier Electric Corp. where he served as sales manager of the Power Factor Department.

Mr. Corson is a graduate of M.I.T. and is a member of the American Institute of Electrical Engineers.

**Ralph S. Merkle** is the new manager of parts sales for Sylvania Electric Products Inc. in which position he will direct the sales of small metal and mica parts, wire and welded wire products manufactured in the company's plants at Emporium and Warren, Pa. and Jamestown, New York.

Mr. Merkle joined the staff of Sylvania in August of 1929 and has served as sales engineer, sales representative, commercial engineer and in the customer technical service department.

He was granted a leave of absence from June, 1942 until July 1, 1946 during which time he served in the Signal Corps and assisted in the development of the Joint Army-Navy electron tube program which resulted in the JAN specifications. He was discharged with the rank of major.

**Victer E. Olson** has been appointed sales manager of the Receiver Sales Department of Allen B. DuMont Laboratories, Inc.

Before assuming his new post with DuMont, Mr. Olson was Eastern Sales Manager of the Midwest Manufacturing Division of Maguire Industries, in charge of dealer organization and sales promotion of their radio-phono-graph combinations.

In his new position Mr. Olson will be...
Connecting a diode from grid to ground on one or both of the multivibrator tubes. During the flip-over period, one of the multivibrator tube's grids acts as a diode when it is driven positive. This grid, however, does not have a very low resistance in such a case, so it may be driven quite a bit positive, giving rise to an unwanted overshoot on the edge of the square-wave. Also, it takes an appreciable time for the coupling condenser to discharge, after this function has taken place. A diode connected from this grid to ground will keep the grid from being driven so far positive and will quickly discharge the coupling condenser which will steepen the square-wave output of the multivibrator and increase its frequency range.

There are a host of other uses for these crystal diodes, the low cost of which makes them practical where a tube and associated power requirements would be impractical. Its frequency response compares favorably with a miniature diode, which will make it as commonplace as the neon bulb in the ham shack. It has many ham applications, such as in noise silencer circuits, crystal detector in a monitor or frequency meter, tuning indicator and in antenna pruning. There will be other uses and it is hoped that this discussion will stimulate your thinking on the subject.

For the Record
(Continued from page 8)

Know what great brains are cooking up these new servicing plans, but we do know these facts: AM has created a force of nearly 60,000 dependable servicemen-dealers who have been reasonably gainfully employed in keeping the 60,000,000 AM receivers in working order. But servicing AM sets is supposed to be child's play compared to techniques that will be required to service FM and television. If any radio manufacturer or group of manufacturers plans to develop a large organization to service FM and TV (and they confidently expect these media to be publicly accepted on a large scale) then they had better prepare to employ 100,000 to 150,000 technicians to handle the service which will be required in every city, town and hamlet.

Years ago, when the automobile industry faced a similar problem—they did something about it by supplying vital information to local blacksmiths and bicycle repairmen—the forerunners of our modern automotive mechanics.

Mr. and Mrs. Customer, especially farmers and others living in remote areas—many without telephones—are not going to sit around for a couple of weeks waiting for the serviceman to arrive. They would far rather rely on their local serviceman, just as they would their doctor, to be able to call on them promptly—when needed. O. R.

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<thead>
<tr>
<th>No.</th>
<th>Tip Type</th>
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<tr>
<td>536</td>
<td>Pyramid Tip</td>
<td>Tellurium</td>
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<tr>
<td>539</td>
<td>Chisel Tip</td>
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<td>Pencil Tip</td>
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<tr>
<td>538</td>
<td>Chisel Tip</td>
<td>Elkaloy</td>
</tr>
</tbody>
</table>

Perfect Balance

Skillfully designed for versatility in soldering, this rugged pencil iron tackles those big jobs with ease, yet has that light magic touch so necessary in delicate precision soldering.

More Points to Remember

- Heats in 90 seconds
- Requires only 20 watts
- Weighs 3.6 ounces
- Length 7 inches

Perfect Balance

See your nearest radio, hardware or hobby dealer

Presenting The New Improved JFD REMOTE-O-CABLE REPLACER

Servicemen's Net Cost $64.30

The Most Efficient Auto Radio Tuning Cable-Servicing Machine in Use Today!

Completely redesigned to meet MODERN Servicing requirements, the NEW JFD REMOTE-O-CABLE REPLACER is a vital necessity in the workshop of every auto-radio serviceman.

1. SWEDGES SHAFTING TO PREVENT UNRAVELLING.
2. CUTS SHAFTING TO EXACT LENGTH.
3. REPLACES OLD FITTINGS ON NEW SHAFTING.
4. CASING GROOVE MAKES CUTTING EASY.

J. F. D. MANUFACTURING CO., 1141 FT. HAMILTON PKWY., ESPLAN., N. Y.
January, 1947

MILTON E. LAUER has been named to the newly created post of Product Manager of the Radio Tube Division, Sylvania Electric Products Inc.

Mr. Lauer will be responsible for close coordination between manufacturing, engineering, sales and administrative departments with respect to all products of the Radio Tube Division.

He has been associated with Sylvania since 1933 and has served in various capacities in the production department of the company. From September, 1944 until June, 1945 he served as Chief, Production Scheduling and Distribution Unit, Electron Tube Section, Radio and Radar Branch of WPB.

WILLIAM C. LEWIS, former chief of the Stromberg-Carlson government contract terminations department, has been promoted to the position of assistant sales manager.

A veteran of 17 years' service with the company, Mr. Lewis will assume many of the duties of the Rochester radio, telephone and sound equipment sales executives in order to free them for field activities.

MARTIN A. ALEY has been elected to the post of president and general manager of Aviola Radio Corporation of Phoenix, Arizona, according to a recent announcement made by the Board of Directors.

Mr. Aley is well known in radio, manufacturing, and merchandising circles having held executive positions with Detroit Radio Corporation, Lee Anderson Advertising Company, Willys-Overland Company and Warren City Manufacturing Company before joining Aviola.

Aviola manufactures a line of radios, record players and phono-combination in addition to aluminum window frames and sashes.

GEORGE C. CONNOR has recently been named general sales manager of the Electronics Division of Sylvania Electric Products Inc.

Mr. Connor, who has been associated with the company since 1934, will be responsible for the merchandising and sale of electronic products, including special tubes, measurement controls, stroboscopes, thyatrons, photo tubes and custom-built precision equipment.

Name __________________________________________
Address _________________________________________
City _______ State _______

Mailing this coupon to MONTGOMERY WARD, Chicago, Ill., Please send your free catalog of Airline Electronic Equipment.

Name ___________________________
Address ___________________________
City _______ State _______

Contains nationally-known volt-ohm milliammeters, tube testers, signal generators, set analyzers, oscilloscopes, etc., all available on Wards Convenient Monthly Payment Plan. This first post-war issue of the Airline Electronic Equipment Catalog also features Amateur communications receivers and Wards Airline Sound Systems. Send for your free copy today.

Solar

Model CF-1-60

EXAM-ETER

With Exclusive Patented Solar "Quick Check" Circuit. A sturdy, reliable instrument designed to simplify and speed up electronic servicing.

QUALITY CHECKING OF CAPACITORS UN- DER ACTUAL OPERATING CONDITIONS.
CAPACITANCE-10 mfd. to 10,000 mfd.
PERCENTAGE-5 to 50 percent.
LEAKAGE CURRENT-at voltages up to 500 Volts.
Isolation Resistance-10,000 meg.
Test leads up to 7.5 volts.
D.C. Vacuum Tube Test 0-550 volts.
AC Vacuum Tube V.M.-10 to 500 volts.
Comes with tubes and test leads ready to operate.

RCP Model 802N COMBINATION TUBE-SET TESTER

Immediate Delivery

A complete tube tester and a complete set of test tubes, with 5 simple adjustments to operate for both tube and set meter combined.

DC Volt. 6/15/50/500/1000 at 1000 ohms per v.
DC V.M. 6/15/50/500/1000
DC M.A. 0/1/10/100/1000 D.C. Ammeter 0/15.
D.C. Milliammeter 0/20/30/100/100. Low ohm center.
D.H. Meter 0/15/15 to 20/20 to 49/24 to 55 dc.
Four range output meter-same as ac volts. Ranges: 1% to 5V incandes. Wurats 11% incandes. Complete in hardcase hardcase base, with test leads, self-contained batteries, ready to oper.

WAR SURPLUS SALES

RADIO - ELECTRICAL - ELECTRONIC EQUIPMENT - PARTS - SUPPLIES

SUPERIOR 2 KVA Power State, input 115 volt AC, 50-60 cycle single phase, output voltage 115 volt AC single phase. Same as the above but twice the input and output voltage. Each.

WESTERN ELECTRIC or Sylvania 1-N-11, 1-N-23 Crystals, .25 each.

Zenith-Bendix or Rawlins Frequency Meters BC-224 with original crystals, complete with spare tubes and calibration book, each one tested, guaranteed.

4-Tube 2-Meter, Model 2415, ;1-1/2 mil. D.C. .25

G.E. 2-Meter, Model 5614, 1-1/2 mil. D.C. .25

Tatton-2-Meter, Model 7647, smal- .50

Phantom antennas, each 1.95

Crystal 5000 KC complete in holders .50

Standard rack cabinet, heavy gauge steel, tray crackle finish, panel opening 16" wide, 27" high with 500 watt, 115 volt, 5000 KC. $12.95

5000 KC ANTENNA-all aluminum, uplead screw, dark grey finish, 12 Dent holes in 3 sections, weight 10 oz.; base 5/16", dia. 1/4". Very special.

Many other interesting items.

Prompt Delivery

20% deposit required on each order

Shipped F.O.B. New York

Minimum Order $7.00

MICHAEI STAHIL, INC.

39 RNJ VESEY ST.

Tel. Corland 7-5800

NEW-JUST RELEASED!

$970

$59.50

$29.95

$25.45

$29.50

$54.50

$0.98

$1.00

$9.45

$12.95

$59.70

$59.50

www.americanradiohistory.com
During the early part of the war, Mr. Connor was liaison agent between Sylvania Electric and the government on the engineering development of radio and radar products, and in 1943 he established the company's West Coast sales office.

**CARL W. MULLER** has assumed his new duties as vice-president and general manager of Soven-

**MR. MULLER**

RCA OUTDOOR SPEAKER

Designed and Engineered by RCA for the U. S. Navy for use on warships

Specifications

Magnet weight—7 lbs. Rated watts—30 watts, Voice Coil—8 ohm impedance, Complete with output transformer for multiple use.

6 for $84 Each $15 Each

MODEL PA-1 READY TO INSTALL

Completely assembled system, ready to hook up. Includes high fidelity 14-watt amplifier; 12" PA speaker; crystal microphone; wall baffle; 25 foot speaker cable and connectors.

Other Sound Systems Also Available... Write for Full Details.

Radio Electric

SERVICE CO. OF PENNA., INC.

7TH AND ARCH STREETS, PHILA. 6, PENNA.
Branches: 5133 Market St. and 3145 N. Broad St. in Phila.
Also in Wilmington Del., Easton, Pa., Kittanning, Pa., Camden, N. J.

Clippard

ELECTRONIC VOL- OHMMETER, MODEL 406

Immediate Delivery!

$49.50 NET

From Jaeger or F. O. B. M. C.

CLIPPARD INSTRUMENT LAB., INC.

1125 Bank St., Dept. 3, Cincinnati 14, Ohio

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**January, 1947**

**AMERICAN SALES COMPANY**

1811 West 47th Street, Chicago

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**2 & 3 Conductor Twisted Communication Type Wire**

Made by Columbia for all inter-communication, transmission and various other purposes. Color coded twisted wires with Geon plastic insulation, insuring high resistance to dirt, oil, water, flame and many other normally destructive factors.

Per 1,000 feet

<table>
<thead>
<tr>
<th>2 conductor</th>
<th>3 conductor</th>
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<tr>
<td>$1.07</td>
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<td>16.71</td>
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**SPECIAL OFFER:**

22 Gauge twisted pair consisting of 2 stranded wires, tinned copper shield and waxed cotton braid overall.

250 ft. coil $9.00 per coil

1,000 ft. spool $37.50 per spool

**Single Conductor Shielded Wire**

Stranded tinned copper conductor, high dielectric insulation, with closely woven polypropylene shield overall. Ideal for shielded lead-in or wherever electrostatic shielding is necessary. Put up in 500 foot metal spools.

$9.25 per spool

Same as above, but has additional cotton braid overall.

250 ft. spool $8.00

1,000 ft. spool $28.10

See Your Local Jobber or Write Direct

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Our Latest Catalog Will Be Available Shortly. Be Sure to Write for Your Copy.

Columbia Wire and Supply Company

5736 North Kimball Avenue, Chicago 30, Illinois

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**SPECIAL OFFER!**

A $30.00 Lectrovision seven-inch Picture Tube ... plus ALL other tubes.

A $110.00 Lectrovision four-inch Picture Tube ... plus ALL other tubes.

A $159.50 Rapid Vision four-inch Picture Tube ... plus ALL other tubes.

Easy-to-Assemble: No knowledge of television required. COMPLETE easy-to-follow INSTRUCTION SHEET gives you all the knowledge you need.

This Kit INCLUDES SOUND, all component parts, and the following:

1. Specially designed Television Antenna.
2. A $30.00 Lectrovision seven-inch Picture Tube... plus ALL other tubes.
3. A $110.00 Lectrovision four-inch Picture Tube... plus ALL other tubes.
4. Pre-tuned R-F unit.
5. Finished front panel.
6. All solder and wire ... and sixty feet of low loss lead-in cable.

Operates on 110V.; 50-60 cycles A.C.

Price: complete with ALL tubes, $159.30. Shipment will be made approximately 4 weeks after receipt of order. $25.00 deposit required on all orders, balance C.O.D.

Trade Inquiries Invited

We believe that the comparative quality of this set is superior to other available sets. For full information write to:

**TRANVISION, INC.**

108-4th Street

New Rochelle, N. Y.
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### RADIO PARTS COMPANY

612 W. Randolph St., Dept. C, Chicago, Illinois

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**Service— Our Guiding Policy**

- For nearly 20 years, Radio Parts Company has used as a watchword—SERVICE. We have felt and still feel that a company will grow and prosper according to the measure of service it provides for its customers.

- During the past war years, we did our level best to serve all equally in furnishing hard-to-get radio parts. We are proud of our record of seeing that radio service men, amateurs and others received the parts essential to their work.

- In the coming years, we pledge ourselves to continue serving the radio industry to the best of our ability. You can count on Radio Parts Company in the future, as in the past, for dependable parts at all times.

WRITE TODAY FOR OUR LATEST POST WAR CATALOG.

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**RADIO PARTS COMPANY**

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**The Symbol of Experience**

Years of experience and research have enabled HALLDORSON designers and engineers to produce transformers of the highest quality. Look for the well-known HALLDORSON trademark when ordering transformers. It is your guarantee of high quality backed by long experience. . . . We are developing additional and improved transformers to make our line more complete.

Join the list of alert jobbers who are planning to carry this better line of transformers. WRITE TODAY.
TELEVISION COMPONENTS
MAGNETIC DEFLECTION YOKES —
No. DY-15, 1.5 mh type for 55 deflection angle as required by B31P, 7CP1, 10KP4, etc. 23° long, 27° deep. $14.75
No. DY-4L, 6 mh type. For 49° deflection angle as required by B9K4, 12A4P, 57F4, etc. 34° long, 17° deep. $15.75
No. DY-4L, 1.5 mh type as required for TRN-120 and similar receivers. Construction identical to No. DY-2L. $15.75
FOCUS COILS —
2060 ohms, 1900 volt inst. test, 15½ I.D., 4½ O.D. These are brand new, war surplus, a real buy!! $4.50

BLOCKING OSCILLATOR TRANSFORMERS
No. OT-103H. For 15,750 cycle oscillators. Housed in very attractive metal case, lug terminals. $4.75
No. OT-101H. Same as No. OT-1031, uncased. $3.25
No. OT-104V. For 60 cycle oscillators. Housed in very attractive metal case, lug terminals. $3.55
No. OT-102V. Same as No. OT-104V, uncased. $2.50
Probably available through your local jobber. If not, order direct. Additional literature available on request.

THE TELECRON COMPANY
1900 East 59th Street, Cleveland 3, Ohio

FIGHT INFANTILE PARALYSIS
MARCH OF DIMES
JANUARY 15-30
“No victim of poliomyelitis—regardless of age, race, creed or color—shall be deprived of care and treatment because of want of money.” — National Foundation for Infantile Paralysis.
Your help is needed! Join the March of Dimes.
AMATEURS
EXPERIMENTERS
SERVICE MEN
Supplies & Equipment
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★ ★
BUFFALO’S LEADING
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RADIO PARTS DISTRIBUTING CO.
128 W. Olney Road
Norfolk, Va.

REPORT ON EUROPEAN RADIO INDUSTRY
(Laden) ........................................... 25 May

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POWER SUPPLIES
Constant 6 volt D.C. Supply (Springer) .......... 44 June
Recent Developments in Heavy Duty Vibrator Type Power Supplies (Williams) .......... 46 June

RADIO COMPONENTS (TESTING)
Radar Reaches the Moon (Gootce) .......... 25 Apr.
Spotting Hurricanes and Thunderstorms by Radar (Wright) .......... 45 Mar.

LAKE
Amplifying Systems

LAKE SENIOR

As listed below:

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<th>No.</th>
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<td>A19</td>
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<td>Receiver</td>
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C-R—2 mmd, typ. 850.

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Kensington, P.O. Box 91, Brooklyn 18, N. Y.
"THE SERVICING OF TELEVISION RECEIVERS" by the Philco Service Division. Published by Philco Corporation, Philadelphia. 135 pages. Price $2.25.

Every radio serviceman should own a copy of this book against the day when he will be called upon to service television receivers in his shop.

In the brief span of 135 pages the men of the Service Division at Philco have managed to crowd an amazing amount of practical information. They have wisely left the discussion of television theory to the engineering texts and have gotten down to brass tacks to deal with some of the problems that will confront the serviceman who has to service the new television receivers now coming from the production lines.

The book is divided into five sections, the basic television system, the composite video signal, the television receiver, television antennas, and servicing the television receiver. Within this structure the authors have presented pictorial material, circuit diagrams and tables, all of which can be used at once by the serviceman.

For those servicemen who are located in areas already boasting of television service, this book is an immediate must. To those for whom television is a thing of the future, a word of warning—it is not too early to study up on the subject.


It was with the pleasure at meeting an old friend that this reviewer welcomed the third book from the pen of Mr. Still for, here again, the author has presented another interesting facet of the vast field of electricity, in the thoroughly readable style which characterizes all his books.

The reader cannot help but feel that the author truly enjoys writing these little books—for so easy and natural is his style that the reader can easily visualize himself having a chat with Mr. Still on the subject rather than reading the story from the printed page.

This time the story deals with all forms of communication from sign language to modern television. The need to communicate with one's fellow man is a basic human need and an exposition of how men have gone about satisfying this desire through the years makes good reading.

This book should find a place in the bookshelves of many homes, both for its interest and the essential information it contains.


January, 1947
That most people take radio for granted is a foregone conclusion, but it is well to look back and review the monumental work that has been accomplished in a relatively short space of time.

Evidently the author felt that just such a survey should be made. Mr. McNicol, himself an engineer and past president of the I.R.E., has drawn on his vast experience and the memories of those still living who saw the beginnings of radio, to present this most readable story of the conquest of space.

While the presentation is non-technical, the author has not “written down to an audience but assumes that, like himself, his readers are interested in some of the early experimental work done in the radio field.

This book should engender in the hearts of all who work in the radio industry a feeling of pride over the accomplishment of a vast group of scientists, both named and unknown, who in the short span of a lifetime have conceived and brought to fulfillment the industry as it stands today.

**Spot Radio News**
*(Continued from page 18)*

for experimental facsimile and picture transmission. Facsimile also includes, of course, transmitting newspapers over the air, hot off the press.

**NOT ON THE** immediate television horizon, but far enough along to have won favorable comments from FCC experts who saw it demonstrated recently, is the Radio Corporation of America's aviation device, Televar. This is a televised blind flying system whereby a televised navigation map of the area over which the plane is flying appears continually on a screen on the plane's instrument panel. Superimposed over the televised map are radar blips which indicate every plane in the area at the altitude where the aircraft is flying. Changes in any flight condition are noted on the screen as quickly as they occur. RCA believes that Televar promises to revolutionize post-war aerial navigation and remove a majority of weather hazards now inherent in flying.

**EQUALLY INTERESTING and doubtless a dramatic source for news stories of the future was a recent FCC announcement put out in routine fashion on the granting of authority to an,' School District No. 9, Glacier County, Montana, to construct seven provi- sional stations. They will operate in the intermittent service on a temporary basis. Purpose: to be used as a safety and health-protection measure. School district headquarters plan to go on the air, especially during the winter months, when roads are bad and

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BARGAINS. Tubes, Parts, Supplies. Write: J. C. Thinijian, Lake City, Minn.

E. C. §, RADI0 Servicing Course, $10.00; Modern Radio Servicing, $2.50; Radio Physics Course, $2.50. Wendell Cahill, Lambert Minn.

WATERS Conley inky tape recorder, $89.50; Gray Electric Automatic device is designed to record to 100 W.P.M., both $125.00; R-100 A.C.D.C. Barnt. receivers, transmitters, meters, keyers, etc., parts. Real bargains. Send for complete list. Nivalco Radio Co., 41 Astor St., Brooklyn 12, N. Y.

SELENIUM Rectifiers, full wave, 1/4 ampere, $.85; half wave, $1.50. Wausau Radio, Route 5, Grand Rapids, Mich.

TELEVISION Parts: 15 and 12 inch cathode ray tubes, very reasonably priced and the following parts in kit form—defeating coils—focusing coils—picture and sound i.f. channels using the latest circuits with the newest miniature tubes, R.F. high voltage power supplies and R.F. tuners. These units are built with parts on main chassis. Send for our price list now. Television Specialties Co., 315 Madison Street, Oak Park, Ill.


RADIO Tubes—dealers, order your needs—be surprised at our prices. Address Radio Tubes, Box 195, Elizabeth City, N. C.

BC-221 FREQUENCY Meter Power Supplies with meter tube built in for modulating R. F. output. $22.50. Television Specialties Co., 315 Madison Street, Oak Park, Ill.

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WIRE recorders, radio equipment, 1/2 to 1 1/2 normal price. Surfus, Box 18, Station G, Brooklyn 22, N. Y.

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Taylor Equipment Co.
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Transistor, Inc.
F. L. Gold, Advertising
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500A Output...$1.59
400A Output...$1.49
8 Watt Universal Output...$1.29
2 Post V.M. Record Changer...$17.95
3 for $22.00

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DUALS

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20-20 150v .70 20-20 150v .70
20-20 150v .70 20-20 150v .70
20-20 150v .70 20-20 150v .70
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25 watt wire-wound...$2.00
100 watt insulated...$1.00
100 watt insulated...$1.00
1/2 watt, all sizes...2c
1/2 watt, all sizes...3c
1 watt, all sizes...4c
5 watt wire-wound..$0.80
10 watt wire-wound...$1.00
25 watt wire-wound...$2.00

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ELECTRONIC PARTS, Inc., Dept. A1
622 W. Randolph St.
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SILENT CRON HALLOWED VOLTMETER

The Sylvania type IN34 crystal diode with a 0-1 d.e. milliammeter makes a sensitive voltmeter for a.c. and r.f. values below 1 volt. The simple circuit of the instrument is shown in Fig. 1. A meter of this type is invaluable for fractional voltage measurements in the communications laboratory, for use as an indicator across tuned circuits, in wave meters, in weak-signal a.f. or r.f. bridges, in conjunction with exploring probes, in signal-strength meters, modulation meters, etc., where no d.e. component is present and where the relatively low impedance of the diode and meter combination can be tolerated.

The calibration curve appears in Fig. 2. An almost imperceptible vibration of the milliammeter pointer was noticed at 60 cycles and apparently was due to the small back conduction of the crystal diode, but it did not appear to affect the accuracy of the calibration. Experimentation proved that it could not be eliminated by using a larger meter bypass capacitor than the one shown in Fig. 1.

The voltmeter may be calibrated against some other reliable a.c. voltmeter (v. 1 voltmeter or 1000 to 20,000 ohms-per-volt-meter) by means of a source of variable a.c. voltage (0-1 or 0-2 volts r.m.s., such as the output of a 2½ volt filament transformer taken through a 10,000-ohm potentiometer. For approximate results, the curve given in Fig. 2 may be used in lieu of an individual calibration.

U.H.F. Oscillator (Continued from page 35)

SENSITIVE CRYSTAL VOLTMETER

are no difficult adjustments to be made.

With the condenser soldered across the end of the line, the frequency of oscillation will be about 400 megacycles. When the condenser is soldered directly at the plate and grid terminals at the tube socket, oscillation frequency will be 800 megacycles.

This little gadget is a suitable foundation unit which can be used as the r.f. section of a superregenerative receiver or simple low powered transmitter. A small modulator of 2 watts output will provide satisfactory phone operation.

Fig. 3 shows how an antenna may be coupled to this oscillator. Coupling may be adjusted by varying the position of the loop and adjusting the screw for capacity variation.

With an oscillator operating at this frequency there is not a great deal of difference in the loaded and unloaded condition.

RADIO NEWS

www.americanradiohistory.com
television mathematics they need. Several students with only grammar school educations have successfully completed advanced technical television courses.

A considerable number of out-of-state students attend the school because of its excellent, practical type of radio and television courses, so difficult to get anywhere else in the world today. Living quarters are obtainable by single students.

You Put Into Practice Everything You Learn

Students at N.Y.T.I. of N.J. particularly like the way the school puts into practice what it teaches. You may actually build a 17-tube television chassis. You also help build as many as 7 radio receivers of different types, a total of 75 electronic educational devices. Class study, and laboratory study, in the proper combination, increase interest—and your hands get as smart as your head.

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The New York Technical Institute of New Jersey is in Newark, N. J., just across the river from New York City (only 20 minutes from Broadway by subway or train). The school is located in the heart of America's great radio and electronics industry. Such leading television, radio and electronics manufacturers as R.C.A., Western Electric, Du Mont, Federal and Edison are nearby. This means that the school offers numerous advantages, as it is in touch with the most recent developments in radio and television.

Highly qualified television and radio instructors are here in abundance. Equipment is easier to get. Television students are offered exceptional advantages in this great electronic center.

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The school issues a special Bulletin which illustrates and describes its truly exceptional facilities and equipment. This Bulletin also describes classes that may be attended, housing conditions, costs, hours, etc. If you are interested in Television—you will want to read this Bulletin. You can have it free, merely by mailing the coupon at right.

The school will also be happy to send you complete information about the television kits and directions which are now available to you if you desire to build your own television chassis at home.

Just fill out the coupon at right and mail it NOW to:
New York Technical Institute of New Jersey, Dept. 11, 158 Market Street, Newark, N. J.

Instructor demonstrating theory of light in connection with study of optical systems used in projection type television receivers. This is just another one of the pieces of equipment which the New York Technical Institute of N.J. has available for resident student instruction.

Big picture television (16" x 21½") in the flesh at N.Y.T.I. of N.J. When it comes to television receivers, N.Y.T.I. of N.J. has it! All types of television receivers are available for student use and instruction at the school.

Standard laboratory type test pattern used for determining picture perfection in all types of television transmitters and receivers. (You can see it at N.Y.T.I. of N.J.)
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